

**CONSUMER FOOD SAFETY NEEDS ASSESSMENTS: EXPLORING  
ELEMENTS OF BEHAVIOR CHANGE**

by

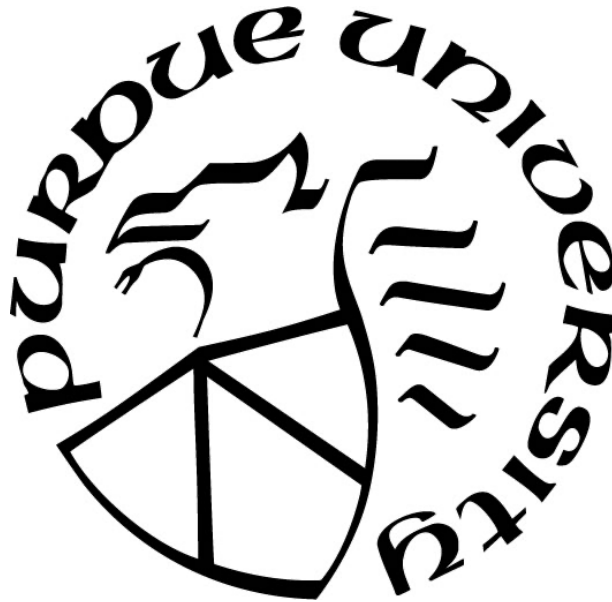
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*This dissertation is dedicated to God for being a loving father through this entire journey and during the next chapters of my life. I also want to dedicate this dissertation to my parents, Thomas George and Mini George, and my sisters, Preethi Thomas and Jemeya Thomas, for their support and encouragement as I pursue my dreams.*

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## **ABSTRACT**

Behavior change is not a product of knowledge alone but by the other constructs within the Theory of Planned Behavior (TPB). This includes attitude, subjective norms, and perceived behavioral control. In order to ensure positive change in food safety behavior, researchers should explore the current situation before providing the necessary resources for consumers. This can be done through consumer needs assessments which explore practices, perceptions, demographics, and more. Along with that, major health events like the COVID-19 pandemic can increase risk perceptions of consumers which may lead them to follow safe (washing hands with soap and water) and unsafe food handling behaviors (washing fruits and vegetables with soap). Information spreads quicker during this digital age and this can cause consumers to follow certain behaviors. To assess information being spread, chapter 2 includes a study assessing COVID-19-related food safety information on YouTube early on in the pandemic. Chapter 3 and 4 contain longitudinal studies that used surveys and focus groups to assess consumer food handling practices and risk perceptions throughout the pandemic. Another factor is the type of food being handled. Consumers are not aware that certain foods like pet food (Ch. 5) and raw wheat flour (Ch. 6) can cause foodborne illness. Thus, they may not be handling these types of products as carefully. It is important to communicate that these foods can also cause foodborne illness. In the case of raw wheat flour, while commercial brands provide food safety messages on the packaging, consumers have a hard time finding and understanding the messages. All the studies within this dissertation explored multiple elements that can fall under the different constructs of the TPB in the context of the different factors that affect food safety behaviors. For example, previous studies have found that risk perception may fall under the construct of attitude because human perceptions can influence how a person feels about the situation. The objective of this dissertation is to explore different

consumer food safety needs and explore how the elements within the needs assessments feeds into the TPB. With this information, researchers can advance the use of the TPB and researchers and food safety educators can ensure positive behavior change through the TPB.

## **CHAPTER 1. LITERATURE REVIEW**

### **1.1 Background and overview**

Although food security and safety are a top priority, foodborne illness, or disease caused by the consumption of contaminated food products, has made an impact in the United States (U.S.). The Centers for Disease Control and Prevention (CDC) estimate 48 million people becoming ill, 128,000 being hospitalized, and 3,000 dying annually throughout all environments including domestic and restaurant (Centers for Disease Control and Prevention, 2020i). The CDC also notes that these numbers are based on an estimate and there may be more foodborne illnesses that go unreported (Centers for Disease Control and Prevention, 2018b). Most foodborne illnesses are caused by bacteria, viruses, and parasites and can range from being very mild to severe depending on the health of the infected individual (Centers for Disease Control and Prevention, 2020i). Older adults (age 65 and older), young children (younger than 5 years old), those who have weakened immune systems/ chronic diseases (diabetes, diseases, cancer, etc.), and pregnant women are considered high-risk individuals and may have a more severe reaction to foodborne pathogens than healthy individuals (Centers for Disease Control and Prevention, 2019f).

This literature review will provide evidence for the need to explore food safety knowledge, experiences, and challenges of consumers. Needs assessments provide information that will be helpful in building interventions that will bring positive and lasting behavior change. Foodborne illness is preventable however, consumers may not be aware of proper food handling practices. There are many factors that can cause individuals to adopt safe and unsafe food handling practices and the first section of this literature review will discuss these factors in context with the studies within this dissertation. Moreover, awareness and knowledge alone may not bring behavior change which brings us to the next section: The complexities of behavior change. This section discusses

the Theory of Planned Behavior (TPB), the theoretical framework for this dissertation. The TPB was chosen for this dissertation because of it has been proven to be robust when predicting food safety behavior change (Mucinhato et al., 2022; Mullan & Wong, 2010; Mullan et al., 2013). It is important to explore components of the TPB to ensure positive behavior changes. The next section will discuss consumer needs assessments and how to collect them using both quantitative and qualitative methods. The first step to implementing any behavior change intervention is to collect the needs of the consumers. Moreover, the last portion of this review briefly explores food safety communication efforts to bring positive change over negative change. Communicating correct, science-based information is just as important as collecting data for needs assessments and implementing interventions.

## **1.2 Factors that influence perceptions of food safety**

Food safety risk perception indicates how people perceive the risks associated with food and these perceptions may affect how they handle the food (Nardi et al., 2020). Several factors may affect how an individual will handle food. Some of these include demographics (age, gender, health status, etc.), major health events (epidemics, pandemics, outbreaks, etc.), and the type of food being handles (high moisture vs low moisture). These factors can affect a person's food safety risk perception and cause them to adopt not only safe but also unsafe behaviors.

Demographic information includes the following but not limited to gender, age, and health status. There may be differences in food safety perceptions within these demographic groups. Previous research has found that individuals who identify as male tend to have lower risk perceptions when compared to females due to higher confidence (Davidson & Freudenburg, 1996; Hitchcock, 2001). However, this may be different when it comes to food-related situations since, traditionally, women tend to be the primary meal preparers in the household (Schaeffer, 2019;



Taillie, 2018). A study within this dissertation (Chapter 5) also found that male pet owners had a higher risk perception in some areas of pet food safety (Thomas & Feng, 2020). Similarly, a recent study with University students also found that female students had significantly higher food safety knowledge when compared to male students (Chuang et al., 2021). Some consumers within these demographic groups may include those who are considered high-risk for foodborne illness - adults over the age of 65 and children under the age of 5 (Centers for Disease Control and Prevention, 2019f). Along with that, those who are at-risk may be living with those who are not at-risk individuals, and the behaviors of both groups should be assessed. If a young healthy individual is practicing unsafe food handling practices, they may put others in their household at risk of foodborne illness or even death. Chapter 4 of this dissertation provides an example of food safety behaviors among demographics who live together (Thomas & Feng, 2022). Researchers discovered that younger age groups (25-44 years) practiced unsafe behaviors during the COVID-19 pandemic (washing produce with soap and water). These individuals also lived with younger children who are at a higher risk for illness. It is important to be aware of the health status of not only the consumer being assessed, but also individuals who live and interact with them.

The context of the environment an individual is exposed to may cause changes in risk perception and behavior. Major health events like pandemics and outbreaks can shift the environment. A past major pandemic was due to the influenza A (H1N1) virus in 2009 (Centers for Disease Control and Prevention, 2019a). When preparing for this pandemic, there was development of vaccines and stockpiling of anti-viral drugs, but these efforts were not enough to control the epidemic (Aledort et al., 2007). A previous study done on evaluating non-pharmaceutical interventions for influenza pandemics found that experts ultimately recommended hand hygiene, respiratory etiquette (covering the mouth when sneezing or coughing), self-isolation

for sick patients, and the personal protective equipment, face masks, for healthcare workers (Aledort et al., 2007) . However, the same study listed interventions that are not recommended due to the lack of evidence and ethical issues: mask-wearing for the public, mandatory social distancing, and closure of schools and workplaces. However, recently, as the COVID-19 pandemic progressed, the recommended practices increased. This included wearing masks, handwashing, social distancing, and limiting time outside of the home (Centers for Disease Control and Prevention, 2020l). Because of the increase in recommended practices, there may have been an increase in risk perception among people during the COVID-19 pandemic. This can also, in turn, cause an increase in food-related risk perceptions. A recent study on the food safety behaviors of Brazilian consumers during the COVID-19 pandemic found that, in contrast to past studies, attitudes were a strong predictor of food handling intention (Mucinhato et al., 2022). This same study by Mucinhato et al., (2022) also found that risk perception had a positive effect on all the Theory of Planned Behavior variables, and there was a strong relation between attitude and risk perception. The current dissertation covers studies outlining the impact the COVID-19 pandemic on consumer food safety through longitudinal qualitative and quantitative studies (Chapters 3-5) (M. S. Thomas & Y. Feng, 2021a, 2021b; Thomas & Feng, 2022). These studies show evidence of changes in behavior, risk perception, and food safety behavior intentions once the COVID-19 cases have decreased. Different from pandemic-related studies done in the past, the COVID-19 pandemic is ongoing, and changes may be continuing to occur. An important thing to note is that while increased risk perception may have caused consumers to adopt proper food handling (washing hands with soap and water), it has also caused consumers to adopt unsafe habits (washing fruits and vegetables with soap). Along with that, consumers are reverting to their previous habits including washing hands with water only (Thomas & Feng, 2022). The ongoing nature of this

pandemic may have caused caution fatigue which may be carried over to basic food handling procedures (Northwestern Medicine, 2020; Paul, 2020a).

Another factor that can also impact perceptions and practices of consumers is the type of food that involved. Traditionally, food safety is associated with high moisture foods, like meat, poultry, dairy, and eggs, because low moisture foods (water activity lower than 0.85) do not support the growth of foodborne pathogens (Batz et al., 2014; Wason et al., 2021). However, low-moisture foods like wheat flour, spices, and infant formula have been sources of foodborne pathogens because bacteria can survive in these environments (Mermelstein, 2018). A very recent outbreak of *Cronobacter* and *Salmonella* in infant formula was caused four to be hospitalized and the death of one infant (*Cronobacter* infection) (Food Safety News, 2022; U.S. Food and Drug Administration, 2022). Raw wheat flour and baking mixes made from raw flour are found in many households for making many foods like pizza, cake, cookies, and more. A previous study done by Feng & Archila in 2020, found that many consumers agree that low-moisture foods like flour do not pose a microbial risk (Feng & Archila, 2020). A study in this dissertation (Chapter 6) includes more current information about consumer perceptions of raw flour and baking mixes and researchers discovered that many consumers tasted raw batter or dough. Like the study by Feng & Archila (Feng & Archila, 2020), most of the participants believed that flour did not pose a microbial risk for reasons including that it is a dry product and shelf stable (Chapter 6). However, previous outbreaks prove that flour should be handled properly and raw dough or batter should not be ingested (Harris & Yada, 2019).

Similarly, pet food was not considered a vector for human foodborne pathogens because it is not a *human food*. However, past recalls and outbreaks prove that safely handling these foods is just as important for human health as they are for pet health because of cross contamination from

pet food to hands/tools to humans (Adley et al., 2011; Behravesh et al., 2010). A very recent outbreak caused by *Salmonella* in dry dog treats (chips) in February 2022 caused 3 people to become ill: two adults in 70's and one child. Several unopened bags of these dog treats all tested positive for *Salmonella* (Massachusetts Department of Public Health, 2022). While humans may not be becoming ill from eating pet food, pet owners may not be aware that if they don't wash their hands after feeding their pets, they may carry bacteria from the food to other foods or food-contact surfaces. Chapter 5 of this dissertation is a pet food safety needs assessment done for dog and cat owners (Thomas & Feng, 2020). This study highlights that many pet owners do not think pet food is a human-related food safety risk. This is especially true for dry pet foods (like low-moisture foods) such as dry foods and treats. Another type of pet food that pose a microbial risk is raw meat or raw animal part (RAP). Owners may not realize that bacteria from raw meat or animal products can transfer to them by being in close proximity to the pet (Morgan et al., 2017; Nüesch-Inderbinen et al., 2019). Moreover, these needs assessments indicate that consumers need to be made aware of these recalls and the dangers of foods that are not traditionally considered a microbial threat and foods that humans may handle but not directly ingest.

### **1.3 The complexities of behavior change**

Currently, there has been an influx of information being pushed by public health experts to change consumer behavior. A prime example is the spread of information in response to the COVID-19 pandemic, urging the public to properly wash hands, wear masks, and get vaccinated (Centers for Disease Control and Prevention, 2022). This spread of knowledge is important to keep consumers informed and to stop them from performing unsafe habits like washing fruits and vegetables with soap to kill coronavirus on their produce. While knowledge is essential, previous theoretical behavior change models suggests that a change in knowledge does not have a direct

impact on behavior change (Ajzen, 1991; Feng et al., 2019). While people may have knowledge of proper food handling behaviors, they may not practice it. For example, a past study showed that over 90% of people claimed they knew when and how to wash their hands properly but observations showed that 64% did not wash prior to meal preparation and 34% did not use soap (Bruhn, 2014). However a more recent study by Feng et al., observed students and found that when they were given more tools (positive deviance approach), they were more likely to follow correct food safety behaviors like properly checking the temperature of cooked meat (Feng et al., 2019). Although providing consumers with the tools to improve their food safety behavior may have some effect, other factors, like perceptions, may contribute to human behavior change. For example, Chapter 5 of this dissertation discusses consumer perception of flour safety messages after providing consumers with flour safety labels on commercial packages. Many consumers stated that they would continue to consume raw dough and batter while fully being aware that this behavior can cause foodborne illness. Behavior change theories can explain the phenomenon behind why and how people change their behaviors.

There are many behavior change models and some models that are related to public health include the Health Belief Model (HBM), Diffusion of Innovation (DOI) theory, and the Theory of Planned Behavior (TPB). The HBM was created to understand why people failed to adopt disease prevention strategies and then later used for patients' symptoms and compliance to medical treatments. This model suggests that the likelihood of a person adopting a behavior is based off the person's belief in personal threat of a disease and the effectiveness of the recommended health behavior (LaMorte, 2019). The HBM contains 6 constructs which include perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cue to action, and self-efficacy (LaMorte, 2019). Previous food safety-related studies have utilized this model to predict

compliance to and intentions in practicing food safety recommendations (McArthur et al., 2006; Rezaei & Mianaji, 2019). However, the HBM does have some limitations including that this model does not take into account attitudes, beliefs, and environmental/ economic factors that may influence a person's acceptance of a food safety behavior (LaMorte, 2019). The DOI theory is one of the oldest social science theories and it is used to explain how an idea or product gains momentum and "diffuses" through a population over time (LaMorte, 2019). With this theory, there are the innovators who try the innovation first and then four main adopters of an innovation listed from least to most conservative: early adopters, early majority, later majority, and laggards. Along with the different types of people, there are 4 factors that influence the adoption of an innovation: Relative advantage, compatibility, complexity, triability, and observability (LaMorte, 2019). While this model has been used in the past in food-related studies and literature, it is not used as often as the HBM or the TPB in food safety-related literature (Inwood et al., 2009; Shelomi, 2015). Other limitations of the DOI theory include that it is not used for preventing behaviors (more for adopting behaviors), it doesn't account for individual resources to adopt the behavior, and this theory did not originate from public health so it may be difficult to apply it (LaMorte, 2019). While the HBM and DOI theory are behavioral change models, the TPB has been used many times in previous studies and proves to be robust when predicting food safety habits of individuals (Mucinhato et al., 2022; Mullan & Wong, 2009).

Figure 1.1 shows the Theory of Planned Behavior (TPB) which uses the constructs of attitude, subjective norm, perceived behavioral control, and behavior change intention to predict actual behavior (Ajzen, 1991; Ajzen & Cote, 2008). Attitude refers to an individual's perception of anticipated events if a behavior is performed. For example, a recent review paper found that in many papers 24-69% of the participants had a positive attitude toward food thermometer use and

agreed that a food thermometer is the best way to tell when meat is completely cooked (Feng & Bruhn, 2019). However, that same paper found that observations proved only 0-5% of consumers actually using a food thermometer when cooking meat. The next construct are subjective norms which include attitudes of members of an individual's social group towards a particular behavior and the individual's attitude towards conforming to those norms. These social groups can include friends, peers, colleagues, and even family members. A study, about predicting adolescent safe food handling, found that subjective norm (people who were important to them) was the most significant predictor of behavior change intention (Mullan et al., 2013). Lastly, the construct of perceived behavioral control (PBC) includes perceptions about what aspects of the behavior change will make it easy or difficult and how much control an individual feels to have for the behavior change. For example, according to a review paper, some consumers did not know how to properly use a thermometer and one participant mentioned that they would use a thermometer if someone taught them how to use one (Bermudez-Millan et al., 2004; Brown et al., 2012; Feng & Bruhn, 2019). According to the theory, the interaction between attitude, subjective norms, and PBC are a direct influence on the most predictive variable of behavior change intentions. Behavior intention refers to an individual's plans to either perform or not perform a particular behavior (Ajzen, 1991). There may also be elements (trust, risk perception, tools, etc.) that influence the different constructs for behavior change and these elements can be addressed through interventions. The TPB also has some limitations including not accounting for emotions/ mood, changes in decision-making processes, and economic/ environmental factors (LaMorte, 2019). However, studies have been able to extend this theory to include elements like trust, knowledge, and risk perception (Mucinhato et al., 2022; Ruby et al., 2019) Because of its robust use in previous food safety studies and because it has been extended to include other elements, the TPB was chosen for

the theoretical framework for this dissertation. The first step to creating any intervention is to assess the needs of the population. This dissertation explores a variety of ways to gather needs assessments and these assessments are related to the TPB through the three constructs (Figure 1.2).

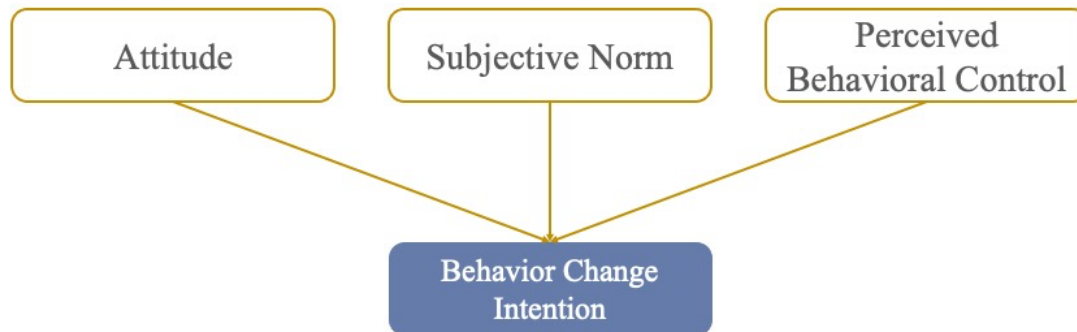


Figure 1.1 The Theory of Planned Behavior (TPB)

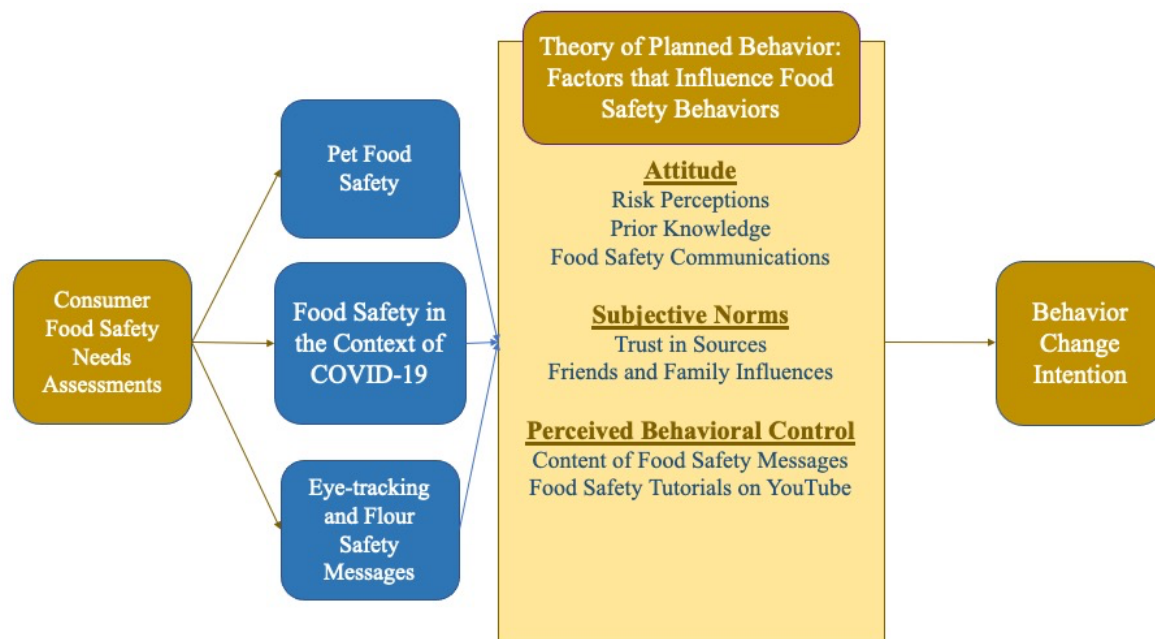


Figure 1.2. The Theory of Planned Behavior (TPB) in the context of needs assessments within this dissertation



Literature suggests that risk perception and knowledge can influence the constructs of the TPB (Gong et al., 2016; Young et al., 2017). A study done by Mucinhato et al., on behavioral predictors of household food safety practices during the COVID-19 pandemic, found that risk perception had a positive effect on all the TPB constructs with more robust relation to attitude and PBC (Mucinhato et al., 2022). This same study also found that knowledge had a strong effect on attitude as well which was consistent with an earlier study that explored predicting food handling intentions of consumers in Malaysia (Ruby et al., 2019). Figure 1.1 has the elements of risk perception, prior knowledge, and food safety communications under the construct of attitude because these elements may influence the attitudes of consumers.

Like risk perception and knowledge, literature also suggests that trust can also be a determinant of behavior within the TPB framework (Giampietri et al., 2018; Mazzocchi et al., 2008). The knowledge that a person receives may be processed differently depending on the source of information. Moreover, source of information may play a role in the TPB. Trust is a relational concept where those who trust have confidence in the intentions and expertise of the trusted individual (Baier, 1986; Romero, 2015). Studies suggest that level of trust can indicate whether or not a person will change their behavior (Balog-Way & McComas, 2020; Smollan, 2013). For example Giampietri et al., (Giampietri et al., 2018) found that consumers with higher trust levels had a higher intention to shop from short food supply chains. Past studies also reported that trust was an important part of consumer willingness to adopt preventative practices during infectious disease outbreaks (Balog-Way & McComas, 2020; Blair et al., 2017; Vinck et al., 2019). This trust in sources during a health crisis can be translated to the willingness of consumers to practice food safety practices. When it comes to food information, a previous study on the trust of food labels across multiple countries found that all the countries trusted “expert” sources for food information

(Rupprecht et al., 2020). Depending on the role in society that a person or source has, consumers may be more inclined to trust that person or source which in turn can lead consumers to change their behaviors. If the consumer is listening to advice from a source that they trust, they may follow all the directions blindly whether it be correct or not. Because subjective norms are social pressures that can be influenced by trusted sources, family, and friends, figure 1.1 has these elements under the construct of subjective norms.

Lastly, PBC has been shown to be a strong predictor of behavior change intention because of the increase in self-confidence and control (Mullan & Wong, 2009; Shapiro et al., 2011). A study by Shapiro et al., found that PBC was a strong predictor of behavioral intentions for food thermometer use and handwashing (Shapiro et al., 2011). Providing tools or instructions can enhance consumer confidence. In figure 1.1, PBC has two elements that can influence this construct: Content of food safety messages and food safety tutorials on YouTube. These elements were based off the findings in Chapter 2 and 6 in this dissertation as these instructions and tutorials can enhance how much control a consumer has in practicing food handling procedures.

#### **1.4 Consumer needs assessments for food safety: Quantitative and qualitative approaches**

Needs assessments are systematic approaches to identify gaps or needs in order to make decisions and improvements in a program or community (Witkin et al., 1995). The target communities within the studies in this dissertation include U.S. consumers, frequent flour users, and pet owners. The studies include approaches like surveys, focus groups, interviews, content analysis, and eye-tracking. This displays the different varieties of data collection that can be done to understand the consumer behavior from different angles. Each form of data collection can be used to create useful materials for anyone or any organization, we must know in what areas they are lacking or what areas they are seeking help.

These assessments can be broken up into quantitative and qualitative forms of data collection. Quantitative approaches are objective and rely on numerical data to identify statistical relationships between independent and dependent variables (McEvoy & Richards, 2006). These studies use sampling techniques that eliminate biases and usually have a large sample size so that the results can be generalized about a wider population. Meanwhile, qualitative studies have smaller samples and are non-numerical approaches (interviews, focus groups, observations) (McEvoy & Richards, 2006). Qualitative approaches use purposeful sampling based on how useful they may be for inquiry (Etikan & Bala, 2017). Qualitative research studies are not meant to be a generalization of a whole population like quantitative but they are meant to provide rich data and insight that may not be captured through numerical data (participant quotes, emotions, unknown information) or to provide groundwork for quantitative research. For example, if a researcher wants to study food safety in a specific community but has no background knowledge of the community, it may be helpful to conduct interviews or focus groups to find out widespread practices or perceptions. These practices and perceptions can later be quantified.

## **1.5 Food safety communications**

While creating materials for consumers is an important step in behavior change, properly disseminating science-based information is important in making sure the materials are effective. This includes utilizing platforms like social media, websites, and print materials to spread information. Utilizing science-based information is credible and spreading credible information can encourage recommended practices. With the challenge of foodborne illnesses in the U.S., government agencies and experts highlight food handling recommendations for consumers (cook, clean, chill, separate) to mitigate the risk (Centers for Disease Control and Prevention, 2020j; U.S. Department of Agriculture, 2020c). These practices include proper handwashing, washing fruits

and vegetables, separating cooked and raw foods, and proper chilling of leftover foods. Even with these recommendations in place, past studies highlight that consumers may not be aware of the risks or lack knowledge in proper food handling (Feng & Archila, 2020; Lin, 2018; Meysenburg et al., 2014). A previous study by Lin (Lin, 2018) found that many consumers reported using color as an indicator for the doneness of meat instead of using a thermometer to check the temperature. The method of using color to check for meat doneness may be misleading as color does not indicate bacterial death. While healthy individuals may not experience severe symptoms, improper food handling practices may cause foodborne illness which may cause mild to severe illness or even death in those who are in the high-risk population. To address this issue, previous studies have indicated that proper food safety information should be disseminated to the general public. As mentioned earlier in this literature review, sources of this information and level of trust for those sources can be impactful when changing consumer behavior especially for vulnerable population. Using these trusted sources can maximize efforts in behavior change.

Some current ways that food safety is being disseminated include social media platforms, websites, university extensions papers, and the government. However, while official websites are backed by science, many of these other platforms, like social media, can disseminate health misinformation (Bora et al., 2018; Hansen et al., 2016). With that being said, it is important to utilize multiple platforms to quickly reach a wider audience with scientifically backed information. One way to do this is to post infographics on social media using information from the official agency websites like the Centers for Disease Control and Prevention (CDC) (Centers for Disease Control and Prevention, 2020q, 2020r). Social media can spread information quickly and infographics provide easy to understand food safety information for the general public. Another important factor to take into account is that consumers may not understand why some

recommendations are put into place or why recommendations may change with as newer data becomes available. This may cause loss of trust towards the scientific community and confusion among consumers (Park, 2020).

Along with how the message is disseminated, another important thing to consider when communicating food safety messages is the content provided in the message. Although many studies have not explored this regarding food safety messages, previous studies have found that messages containing more information regarding benefits to safe handling or a new intervention technology (irradiation) were effective messages (Chapman et al., 2010; Feng et al., 2016). A study by Henley & Fu (2019) created a sign to display at the farmer's market to encourage consumers wash their produce with water. Researchers found that many consumers did not wash their produce for reasons including because it was organic but preferred these educational signs at the farmers market (Henley & Fu, 2019). Creating messages that resonate with the target audience is important when changing and maintaining behaviors. Previous research on pet food safety among consumers (Chapter 5) has shown that pet owners were affected more by the news of pets becoming ill from contaminated pet food when compared to the news of humans becoming ill (Thomas & Feng, 2020). While the news of humans becoming ill is just as important as the news of pets becoming ill, it is important to take note of how certain demographics (pet owners) feel. Messages should ideally be created based off scientific backing that they are effective at influencing consumer intent to change behavior. Our recent study used eye-tracking technology and interviews to explore the accessibility and perceptions of flour safety messages on food packages (Chapter 6). We found that many consumers preferred messages with some information on why consuming raw flour would cause them to become sick. This finding is similar to previous studies what consumers wanted (Feng & Archila, 2020; Feng et al., 2016).

This literature review is an overview and provides some important background information on the topics that will be discussed in greater detail within this dissertation. Consumers' practices and gaps may not be completely intuitive, and some gaps may go unaddressed because of situations like demographics or a major health event. Behavior change intention is not due to knowledge alone but also other factors like attitude, subjective norms, and PBC. Exploring these factors through various assessments (surveys, focus groups, interviews, etc.) can help food safety educators and researchers target the gaps and evoke positive behavior change.

## **CHAPTER 2. FOOD SAFETY IMPLICATIONS DURING COVID PANDEMIC #1: ONLINE INFORMATION CONTENT ANALYSIS**

A version of this chapter has been published in the *Journal of Food Protection* on January 11, 2021 [<https://doi.org/10.4315/JFP-20-463>]. Merlyn Thomas is the first author and the co-authors are Payton Haynes, Juan C. Archila-Godínez, Mai Nguyen, Wenqing Xu, and Yaohua Feng.

### **2.1 Introduction**

COVID-19 was first detected in late 2019 and has become a worldwide pandemic and public health emergency. COVID-19 is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and is transmitted via person-to-person contact and by touching contaminated surfaces or objects (Fathizadeh et al., 2020). As of 3 September 2020, over 6 million cases and 194,000 deaths have been reported in the United States and Canada (Centers for Disease Control and Prevention, 2020a; Government of Canada, 2020a). Countries throughout the world have implemented strict lockdown procedures, closing down restaurants, bars, retail stores, and other public venues. At the time of this writing, no universally recognized cure, treatment, or vaccine has been made available.

Although COVID-19 has not been considered a foodborne illness and there is no current evidence of foodborne transmission, food safety is one of four factors identified as important for the food industry during the COVID-19 pandemic (Centers for Disease Control and Prevention, 2020a; Galanakis, 2020). COVID-19 can be transmitted via person-to-person contact between retailers and customers in the food sector. During the pandemic, consumers may be looking to various resources, including on-line sources, for food safety information.

Popular media, including movies, television, and the Internet, are vital disseminators of food safety and health information to the public. For example, television celebrity chefs are viewed as role models, and consumers often practice behaviors of such role models; however, poor food

safety practices used by celebrity chefs could increase the risk of foodborne illness among viewers (Kaufhold et al., 2019; Woods & Bruhn, 2016). In a compliance study, among 39 episodes of 10 television cooking shows only 13% of episodes mentioned food safety practices (Cohen & Olson, 2016). Popular recipe blogs may also be a source of food safety information. A trend involving soaking almonds as shown in many popular blogs and videos promoted dangerous food safety practices, including unsafe times and temperatures that contribute to pathogen growth (Feng et al., 2020). A similar content analysis study revealed that on-line recipes had major food safety implications for flour handling (Barrett & Feng, 2020a). College students had a better perception of food safety skills after listening to an intervention lecture on Facebook (Mayer & Harrison, 2012).

YouTube is one of the most highly trafficked websites on the Internet. As of August 2020, data from Amazon's Alexa indicate that YouTube was the second most-visited site behind Google (Alexa Internet, 2020). By using both audio and visual communication, closed captioning, and other inclusive technology, YouTube is easily and freely available to a wide demographic. However, YouTube videos also can contain misleading or untrustworthy information that contradicts public health standards (Hansen et al., 2016; Madathil et al., 2015). During the 2016 Zika virus infection outbreak, researchers found that nearly 25% of YouTube videos surveyed contained misleading information about the Zika virus (Bora et al., 2018). In a similar study during the Ebola virus disease outbreak beginning in 2013, 26% of videos were classified as misleading (Pathak et al., 2015). In a recent study of YouTube videos for COVID-19 health information, 27.5% of videos contained nonfactual information, and those videos accounting for 24.1% of total viewership (64 million views). Researchers also found that videos from professional or governmental organizations provided the highest quality content, but these videos were



underrepresented among the total views (Li et al., 2020) . Authorship also plays an important role in dissemination of information on YouTube. Independent users who posted COVID-19 content were seven times less likely to upload useful information than were academic institutions or hospitals (Khatri et al., 2020). Because previous studies have indicated that false information had a significant impact on miscommunication of public health issues, the accuracy of food safety information on YouTube should be assessed, especially during the COVID-19 pandemic. The objective of this study was to assess the type of food safety information, the quality of this information, government citations, and professions of the people delivering this information in YouTube videos during the COVID-19 pandemic.

## **2.2 Materials and Methods**

### **2.2.1 Selection of YouTube videos for content analysis.**

With more than 2 billion users, YouTube is a popular Web site among internaunts (YouTube, 2020). In previous studies, researchers have used this video sharing Web site to gather public viewing data about public health emergencies (Bora et al., 2018; Pandey et al., 2010; Pathak et al., 2015) and food safety topics (Barrett & Feng, 2020a; Feng et al., 2020). In the present study, a YouTube search was conducted on 8 June 2020 using the key words “food and COVID-19,” “food safety and COVID-19,” and “groceries and COVID-19.” For each key word, videos were sorted by view count as a measure of video popularity. A sample of videos meeting all the specified inclusion criteria was listed on an Excel 2020 spreadsheet (Microsoft, Redmond, WA): (i) English speaking, (ii) .500 views, (iii) video specified as from the United States or Canada, and (iv) ,20 min long. The location for each video was found in the “About” section of the video author’s channel. The author was defined as the person or organization that posted the video. When the

location was unspecified, the video was excluded from the study. Descriptive information from the videos was collected, including title, URL, author, length, posting date, current views, number of likes and dislikes, number of subscribers to the channel, publishing category, number of viewer-contributed comments, and top five comments that viewers “liked.” Two researchers independently reviewed 386 collected videos to determine exclusions. Some videos were duplicated or triplicated because they were found under more than one key word. These videos were counted as a single video to proceed with the selection of the videos for data collection. The exclusion criteria were (i) the author used another channel’s video, (ii) absence of food safety and COVID-19 information, and (iii) upload date before 12 February 2020. When a video met one or more of the exclusion criteria, it was not included in the study. The upload date cutoff was chosen as the day after COVID-19 was named officially. According to the World Health Organization, the name COVID-19 (previously referred to as 2019 novel coronavirus) was given to the coronavirus disease on 11 February 2020 (World Health Organization, 2020d). Hence, the research team allowed a cushion of 1 day for the spread of the official name. A third researcher checked the exclusion process and listed the videos on a spreadsheet for data collection. The 85 videos, including some duplicates that were counted as a single video, that met the selection criteria were screen recorded for data collection on 23 June 2020 (Fig. 2.1).

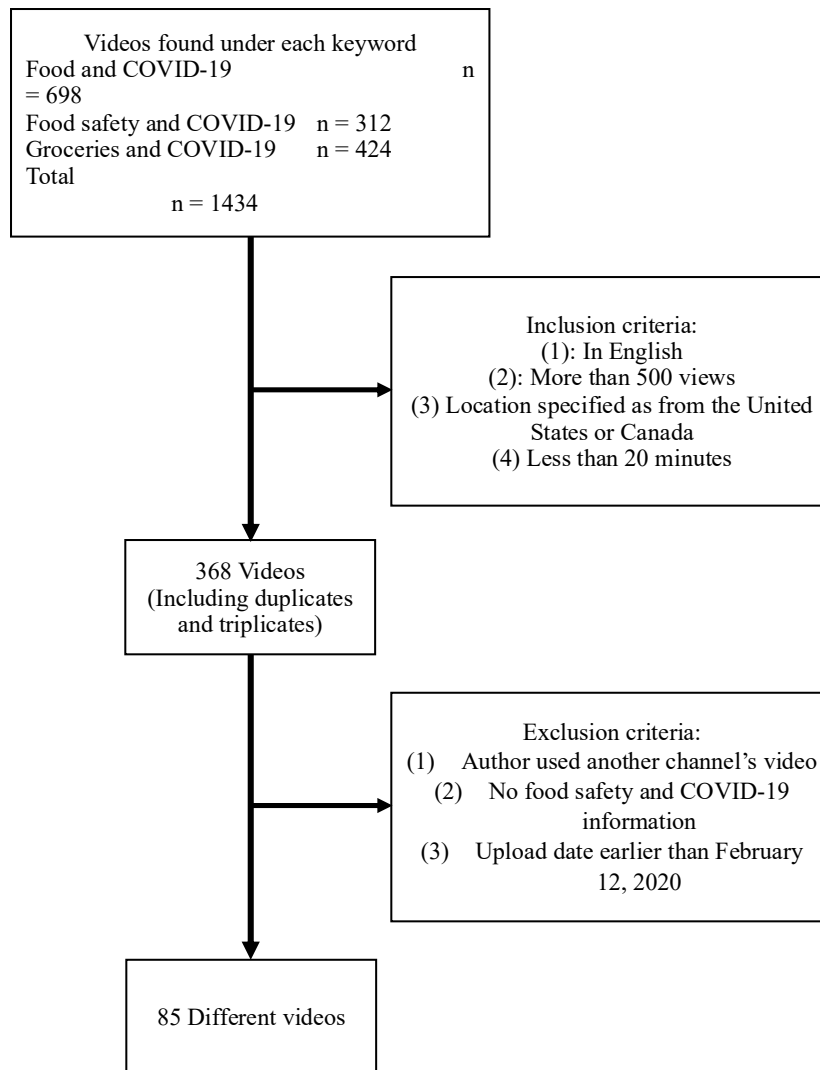


Figure 2.1 Flowchart of YouTube video selection process. Duplicates and triplicates are the same videos that were found with more than one keyword.

### 2.2.2 Coding system for video content analysis.

The coding system used for this study was adapted from previous content analyses of YouTube videos and cooking blogs (Barrett & Feng, 2020a; Feng et al., 2020; Morrison & Young, 2019). The focus of the coding system was to assess the quality of food safety information and safe handling of food in YouTube videos in relation to the COVID-19 pandemic. The topics that were coded in the selected videos include people in the video (hosts and guests), government agency citations (United States and Canada), hand washing procedures, package handling

procedures, kitchen sanitation, fruit and vegetable washing procedures, mentions of hazardous foods, food utensils or food packages, and take-out and grocery store practices. Food and utensils were coded as hazardous when the video mentioned that ingestion of those foods or use of those utensils can cause consumers to contract COVID-19. Specific information posed for each topic was carefully coded and analyzed. For example, government citations were further analyzed to identify miscitations. At the time of this study, food safety information during the COVID-19 pandemic had already been posted by the Centers for Disease Control and Prevention (CDC) (Centers for Disease Control and Prevention, 2020g), the U.S. Food and Drug Administration (FDA) (U.S. Food and Drug Administration, 2020d), the U.S. Department of Agriculture (USDA) (U.S. Department of Agriculture, 2020a), the National Institutes of Health (NIH) (National Institute of Health, 2020), and the Government of Canada (including the Canadian Food Inspection Agency and Health Canada) (Government of Canada, 2020b), which helped validate the information addressed in the video coding system. This food safety information was saved as a record for subsequent analysis of data.

Another Excel spreadsheet was used to introduce the coding system and to record quantitative and qualitative information. For this study, hosts were defined as people who led and spoke as authorities in the video, and guests were defined as people who were invited and interviewed by the host. The hosts could also be but were not always the authors of the videos. The professions of the guests and hosts were recorded for further analysis of the accuracy of the information given, as suggested in previous studies (Barrett & Feng, 2020a; Khatri et al., 2020; Li et al., 2020). Researchers evaluated host and guest self- presentation, the host's presentation of guests, and any label or caption presented on the video to address the professions. For the food safety procedures, when a video showed or mentioned the procedure, a written description was

required. When a topic from the coding system was not found in the videos, the reviewers marked it as “not applicable” to move forward with the coding.

The research team developed and reached a consensus on the coding system. Before starting the coding process, all researchers were trained to become familiar with each coding item. Two researchers independently coded the 85 screen-recorded videos, and any discrepancies during coding were reviewed by a third researcher to reach consensus. The data were collected from groups of 10 videos by the two independent reviewers to assure consistency of the data collected and to reduce reviewer fatigue.

### **2.2.3 Statistical analysis.**

The YouTube video content was analyzed both quantitatively and qualitatively. A descriptive analysis was conducted with Statistics for Windows (ver. 25.0, SPSS, IBM, Armonk, NY) for quantitative analysis of frequencies such as government agency food safety citations, number of people presented, and the occurrence of procedures that were coded in the videos. This data analysis procedure was adapted from that of Barrett and Feng (Barrett & Feng, 2020a) to fit the codes and information in this study. The qualitative analysis portion included analysis of citations from government agencies and analysis of procedures and practices for take-out food and grocery stores. Government agency citations were classified into seven categories (Appendix A) and analyzed for miscitations. Government agency miscitations were checked using currently available information from the government agency that was cited. A cross-reference analysis was conducted to assess possible connections between descriptive information (people in the video and number of views) from the videos, government agency citations, and food safety procedures that were coded.

## **2.3 Results**

### **2.3.1 Description of the videos**

Appendix B provides descriptions of the 85 videos selected for analysis. The majority (89%) of videos were produced in the United States, and the rest were produced in Canada. Many videos were retrieved under multiple key words: 52% were found under “food safety and COVID-19,” 48% were found under “groceries and COVID-19,” and 35% were found under “food and COVID-19.” As of June 2020, the video titled PSA Grocery Shopping Tips in COVID-19 (see important notes below) [www.DrJeffVW.com](http://www.DrJeffVW.com) had the most views, and more than 800 Cases of COVID-19 at 19 NC Food and Meat Processing Plants had the least views. Videos posted earlier (around March 2020) typically had a higher number of views than did those posted later (e.g., May 2020) for both the most- viewed and the least-viewed videos.

### **2.3.2 Hand washing and produce washing procedures.**

Different types of information related to COVID-19 and food safety were presented in each video (Table 2.1). More than half (69%) presented hand washing procedures, but only 41% used soap and even fewer (31%) displayed or mentioned the use of hand sanitizer.

Various fruit and vegetable washing procedures were also presented throughout the videos. The most common washing procedure was using water only (27%), as recommended by the CDC and FDA (Centers for Disease Control and Prevention, 2020h; U.S. Food and Drug Administration, 2018c). However, a high percentage of videos suggested washing procedures that were not recommended: 16% presented the use of soap, and 12% showed washing fruits and vegetables with other solutions, including homemade cleaners, and washing in a dishwasher (Table 2.1).

Table 2.1. Information gathered from videos, N=85

Information	Videos %(n)
Government agency citations	
<i>Centers for Disease Control and Prevention</i>	24(20)
<i>U.S. Food and Drug Administration</i>	15(13)
<i>U.S. Department of Agriculture</i>	12(10)
<sup>a</sup> <i>Government of Canada</i>	2(2)
<i>National Institutes of Health</i>	5(4)
<i>U.S. Environmental Protection Agency</i>	2(2)
<i>National Science Foundation</i>	1(1)
Healthcare professional or professor/expert	60(51)
Videos with handwashing procedures	69(59)
Videos with soap for handwashing	41(35)
Videos with hand sanitizer	31(26)
Fruits and vegetable washing procedures	
<i>Water only</i>	27(23)
<i>Soap and water</i>	16(14)
<i>Scrub surfaces</i>	9(8)
<i>Commercial produce disinfectant</i>	5(4)
<i>Other<sup>b</sup></i>	12(10)
Kitchen disinfection	26(22)
Package handling procedures	55(47)
Grocery store practices	54(46)
Take-out procedures	32(27)
Hazardous food	
<i>Food that you share</i>	1(1)
<i>Food plated and cooled</i>	1(1)
<i>Frozen food</i>	2(2)
<i>Take-out food</i>	2(2)
<i>Produce</i>	8(7)
<i>No food</i>	39(33)
Hazardous food packaging	24(20)
Hazardous food utensils	2(2)

<sup>a</sup> Government of Canada includes agencies like Canadian Food Inspection Agency and Health Canada. Videos did not mention specific agencies but referred to it as “Government of Canada”

<sup>b</sup> Other practices include homemade cleaners and, in one instance, a dishwasher

### **2.3.3 Grocery store and take-out food practices.**

Most of the videos (86%) discussed take-out food practices, grocery store practices, or both and suggested to the viewers some procedures and practices that they could follow to reduce the risk of contracting COVID-19 associated with these practices (Appendix C). Some videos focused on safe food handling practices. In videos mentioning take-out food, suggestions included changing containers (59%) and heating or reheating food (30%). Among those videos mentioning heating or reheating food, the use of a microwave was recommended, but only one video offered a specific temperature (149.8F [65.8C]) and time (3 min) for that action, which was below the USDA recommendation for reheating (U.S. Department of Agriculture, 2020b). Among grocery store practices videos, 28% mentioned the need to purchase or commit to the items you touched, and only one video suggested separating raw meat from ready-to-eat foods. Another video advised viewers to “stick to food that can be cooked, peeled, or washed.” Other practices from videos mentioning grocery stores or take-out foods referred to cleaning surfaces, hand washing, and other practices to protect viewers from getting COVID-19 (Appendix C).

### **2.3.4 Profession of host and guest.**

Video hosts and guests came from a variety of scientific and health care backgrounds. Backgrounds were divided into two groups: (i) health care professionals and (ii) professors or experts in various fields of study. Figure 2.2 displays the number of videos containing hosts and/or guests from each background group. The majority of videos (68%) featured a guest professor or expert, and 32% featured a health care professional guest. More videos had health care professionals (62%) than professors or experts (38%) as hosts (Appendix D).



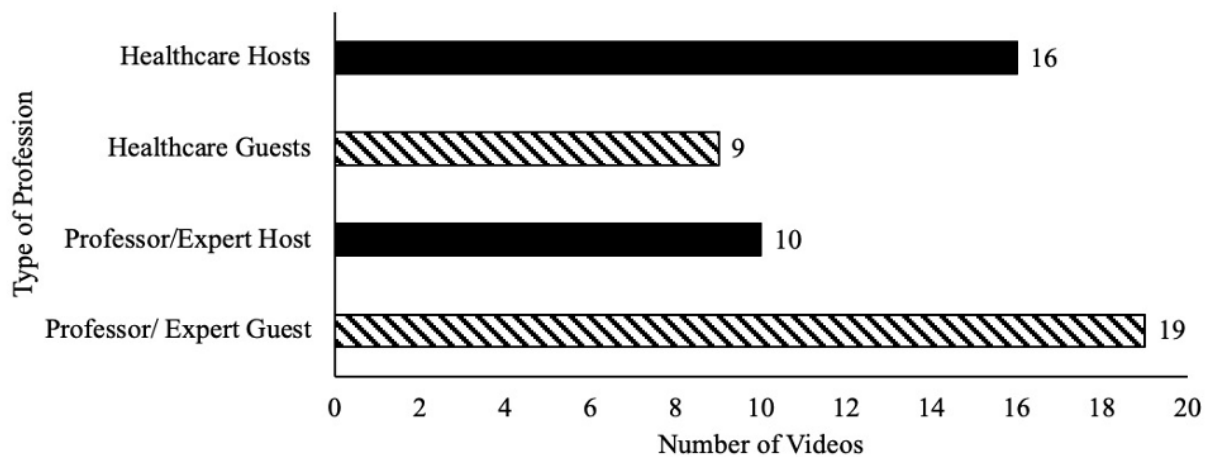


Figure 2.2 Professions of hosts (solid bars) and guests (hatched bars) in the videos.

### 2.3.5 Citations and miscitations.

In 38% of the videos, at least one government agency guideline or recommendation was cited. The top three government agencies cited were the CDC (24%), the FDA (15%), and the USDA (12%). Over half of the videos that cited a government agency (60%) cited more than one agency. Those that cited a government agency from Canada referred to it with the umbrella term “Government of Canada” and did not specify which agency. The citations in those videos addressed seven specific topics used as categories to identify all the citations (Table S1). Seventy citations were collected among the videos with a government agency citation: 37% were for hazardous foods or food packages, 17% were for sanitizing surfaces, 14% were for washing fruits and vegetables, and 10% were for survival on surfaces (Appendix A). Of the overall citations, only three were not aligned with the guideline or information given by the government agency cited and were scored as miscitations (Appendix E). The miscitations incorrectly cited the NIH, FDA, and CDC and were categorized as hazardous food or food packages and grocery store practices.

The first misquotation stated, “Following the logic of the National Institute of Health, we could keep those groceries in our garage or porch for 3 days” (health care professional). The other two were in the same category and stated, “There is no clear guidance from either the CDC or the FDA [groceries handling]” (health care professional), and “Safety tips for shopping: Throw out plastic bags, cardboard” (profession not mentioned). In contrast to the claims in these videos, government agencies did develop basic guidelines or information for different practices during the COVID-19 pandemic (Fig. 2.3).







Handwashing	Fruits and vegetable washing	Take-out/Online food shopping	Food preparation	Surface disinfection	Grocery store practices
Wash hands with soap and water for at least 20 seconds, then rinse and dry hands. Use the cleanest water possible. Use an alcohol-based hand rub (check FDA list) that contains 60% alcohol if soap and water are not available.	Wash Fruits and vegetables under running water, even if the peel is not going to be consumed (unless the produce package says it is pre-washed or ready-to-eat). Use a clean produce brush to scrub firm produce.	(1) Use contactless payment. (2) Ask for contactless delivery. (3) Examine the box packaging; make sure the company uses insulated packaging. (4) Make sure the food was delivered at a safe temperature. (5) Refrigerate or freeze the delivery. (6) Wash hands after handling delivery.	There is no evidence of food or food packaging being associated with the transmission of COVID-19. Always follow safe food handling and hygiene practices. Clean - Separate - Cook - Chill	Clean first, and then disinfect surfaces. Use EPA-registered disinfectant list (United States) and list of hard-surface disinfectants (Canada). Always wear skin protection, ensure adequate ventilation, and follow the instructions on the disinfectant label.	(1) Stay home if sick. (2) If possible, order online or use curbside pickup. If going to the store, prepare a shopping list. (3) Protect oneself while shopping. (4) Practice hand hygiene. (5) Unpack safely at home, and do not use disinfectant designed for hard surfaces. – There is no evidence of food or food packaging being associated with the transmission of COVID-19. (6) Follow safe food handling practices.
					
<i>(Centers for Disease Control and Prevention, 2020l; Gronvall et al., 2006; Van Doremalen et al., 2020)</i>	<i>(Centers for Disease Control and Prevention, 2020h; Government of Canada, 2020b; U.S. Food and Drug Administration, 2020b)</i>	<i>(Centers for Disease Control and Prevention, 2020s; Government of Canada, 2020b)</i>	<i>(Centers for Disease Control and Prevention, 2020g; Government of Canada, 2020b; U.S. Food and Drug Administration, 2020e)</i>	<i>(Centers for Disease Control and Prevention, 2020d; Government of Canada, 2020d; U.S. Food and Drug Administration, 2020e)</i>	<i>(Centers for Disease Control and Prevention, 2020n; Government of Canada, 2020b)</i>

Figure 2.3 Basic guidelines for food safety measures during the COVID-19 pandemic. Guidelines were created for the public by government organizations in the United States and Canada.

## **2.4 Discussion**

### **2.4.1 Government agency roles.**

Government agencies play a vital role in the dissemination of information about COVID-19. More than one-third of videos included in this study cited a government agency; the top three were the CDC, the FDA, and the USDA. Because social media and YouTube are pervasive, government agency public health information should be abundantly available on those platforms. In a previous study, less intrusive public health government interventions were more effective than intrusive interventions (Diepeveen et al., 2013). YouTube, which is a form of casual entertainment, is not intrusive in that it does not require any physical activity except viewing videos. At the time of publication, the FDA had posted 10 videos related to COVID-19 to YouTube, and 2 of those videos were related to food. Of those two videos, only one mentioned food safety.

Appendix E provides a list of government citations in the videos. Of 70 government citations, 3 miscitations were found. The first miscitation was found in video code 1: the author stated that groceries must be kept in the garage or porch for at least 3 days because the NIH said the virus could live on surfaces for up to 3 days. Although a study was conducted on the survival of SARS-CoV-2 on various surfaces (Van Doremalen et al., 2020), no current evidence supports the survival and transmission of the virus from food or food packaging. The second miscitation was found in video code 28, where the host mentions that there is “no clear guidance” from the CDC or FDA on grocery shopping, even though both agencies operate on-line Web sites with resources for grocery shopping (Centers for Disease Control and Prevention, 2020g; U.S. Food and Drug Administration, 2020d). The final miscitation occurs in video code 58, in which the author suggests disposing of plastic and cardboard grocery packaging. This miscitation is similar to the first one; no government agency had suggested disposing of food packaging to avoid

transmission. These miscitations indicate a disconnect between what government agencies advise and how the consumer is receiving information.

#### **2.4.2 Role of scientists, experts, and medical professionals.**

In the present study, many of the guests and/or hosts were professors and experts in infectious disease, food microbiology and safety, public health, and environmental science. The CDC has stated that scientists and experts, such as epidemiologists and microbiologists, are key players in an outbreak response (Centers for Disease Control and Prevention, 2019b). Scientific experts and microbiologists have also been key players in major previous health events (Centers for Disease Control and Prevention, 2018a; Gronvall et al., 2006; Johnston & Fauci, 2008). As for the COVID-19 pandemic, during the 2003 SARS outbreak scientists used their expertise to provide information that affected medical treatments, travel restrictions, political decisions, and trade policy (Gronvall et al., 2006). With this combination of food safety and health expertise, scientific experts play a critical role during a pandemic. However, the rapid spread of the pandemic, emerging research projects around the world, reactive emergency policy changes, and media demand for eye-catching stories have put scientific experts under pressure. Intentional and unintentional misquotations and misinterpretations have led to confusing and contradictory information, which may also have led consumers to use risky food safety practices to avoid getting COVID-19 from food (Park, 2020).

Health care professionals have also been a crucial part of this frontline fight (Centers for Disease Control and Prevention, 2020c; Nguyen et al., 2020; U.S. Food and Drug Administration, 2020c). Given their experience in dealing with SARS-CoV-2, people may look to health care professionals for information, including information on food safety. During the COVID-19 pandemic, possible transmission via food may be a consumer concern; 85% of Americans made

some changes in the food they ate or how they prepared it (Institute of Food Technologists, 2020). Past studies indicate that very few health care providers delivered food safety information to their patients, and some were not confident of their knowledge about foodborne illness (Chen et al., 2020; Wong et al., 2004). Chen et al. (Chen et al., 2020) explored the attitudes and practices of health professionals in China, Peru, and the United States and found that although food safety concerns differ between countries, almost all the health professionals recognized the need to provide food safety education. However, not all professionals actually delivered this information. The lack of food safety knowledge disseminated by health professionals may cause consumers to adopt improper food handling practices, such as washing produce with soap and water as suggested by some of the videos in the present study. In the present study, one health care professional was the author and host of two videos at different times, and after consulting food scientists and microbiologists he corrected his statement about washing fruits and vegetables in soapy water by telling viewers to use just water. Because of the risk that produce could absorb harmful chemicals, soap, disinfectant, or commercial products are not recommended for washing fruits and vegetables; plain water and a vegetable brush if necessary should be used (Government of Canada, 2020b; U.S. Food and Drug Administration, 2018c). Although his second video contains “revised” in the title, the first video was still available to the public at the time of data collection. This mixed message can cause confusion among consumers; some might watch the first video without watching the second video.

### **2.4.3 Trust in the experts and in science.**

Because a majority of the videos contained health care professionals, professors, or experts as hosts or guests, consumer trust in these figures should be explored. According to a 2018 food and health survey from the International Food Information Council Foundation, consumers

reported that they consider health professionals the most trustworthy sources of food safety information (International Food Information Council Foundation, 2018). The Foundation survey also revealed that 38% of consumer respondents trusted government agencies, including the USDA, Environmental Protection Agency, CDC, and FDA, for food and nutrition information. Evidence from previous health events also indicates that trust is important in times of infectious disease outbreaks (Smith, 2006). The level of trust that consumers have in these experts can influence how much consumers will practice behaviors that the experts promote (Balog-Way & McComas, 2020).

In addition to trust in experts, trust in science may be an influencing factor for the spread of information. According to the Johns Hopkins COVID-19 Civic Life and Public Health national opinion survey (41), a split in trust of science exists: 54% of respondents reported trusting science “a lot,” and 46% trusted science “some,” “not much,” or “not at all.” Researchers concluded that this split might be the reason misinformation has spread so quickly during the COVID-19 pandemic (Barry et al., 2020). Despite this mistrust, Americans’ trust in medical scientists has grown since the outbreak began (Funk et al., 2020). Plohl and Musil (Plohl & Musil, 2020) found that people who had a greater trust in science and scientists were more likely to follow COVID-19 guidelines. With this increased trust in scientific material, food safety guidelines may be more likely to be followed now than before the pandemic. Experts must provide accurate and consistent food safety guidelines to avoid a decrease in public trust of experts and science.

#### **2.4.4 Food safety and social media.**

Today’s consumers regularly seek out information from social media or YouTube, especially for news and safety practices. Social media health interventions have been effective in the short and long term and among disadvantaged populations (Hunter et al., 2019; Welch et al.,

2016). Because social media content can be easily created by almost anyone, consumers may be exposed to incorrect or dangerous misinformation.

Video hosts and authors have a responsibility to provide the most accurate information available at the time. They must also disseminate it to a broad audience in the most appropriate way considering the opposition they could face from proponents of alternative health care approaches, such as those against western medical practices (Stellefson et al., 2020). Although many videos in this study contained correct information on food safety practices, some did not. Over half of the YouTube videos contained hand washing instructions, but only 41% showed soap being used (Table 2.1). In 16% of videos, produce washing was mentioned or shown, but the produce was washed with soap and water, which contradicts USDA guidelines for washing produce (U.S. Department of Agriculture, 2020c). Consumers can conflate hand washing with produce washing; most health authorities agree that a 20-s hand scrub with soap and water is the best way to prevent transfer of virus particles from the hands to the face, but this same method has not been shown to prevent transfer of virus particles from produce to the face (Centers for Disease Control and Prevention, 2020k). No current evidence supports the transmission of COVID-19 via food, and use of detergents to wash produce may result in gastrointestinal distress (U.S. Department of Agriculture, 2020c; U.S. Food and Drug Administration, 2020d).

Many videos also mentioned virus survival on grocery items, including plastic packaging, metal cans, and cardboard boxes. Video authors frequently inferred that the 3-day survival rate on plastic and stainless steel would also apply to food packaging, citing a study published in the New England Journal of Medicine in April 2020 (Van Doremalen et al., 2020). In that study, the survival of SARS-Cov-2 on plastic and stainless steel was tested, but food products were not tested. Scant



evidence supports the video authors' claims that groceries should be left unattended for up to 3 days to prevent virus transmission.

#### **2.4.5 How to use social media for dissemination of food safety information.**

The present study explored the use of YouTube as a platform to spread food safety information, although other platforms such as Facebook and Twitter have also been key players in spreading information during the COVID-19 pandemic (Goel & Gupta, 2020). With the vast and increasing use of the Internet, social media have become quick and inexpensive ways to spread disaster and public health information to consumers (Gatewood et al., 2020; Harris et al., 2017). However, the chaotic use of social media by consumers during disaster events can lead to the dissemination of false or inconsistent information (Kaufhold et al., 2019). Because of the power of social media, government agencies and institutions have taken advantage of these platforms to help spread correct information about COVID- 19 by providing posts tailored to different types of social media platforms (Centers for Disease Control and Prevention, 2020r; National Institute of Health, 2020; U.S. Food and Drug Administration, 2020b). These agencies also have their own posts and graphics with reliable food safety information that the public can share (Centers for Disease Control and Prevention, 2020p, 2020q; U.S. Food and Drug Administration, 2017). With the use of such reliable materials, social media can be a resourceful way of reaching consumers and delivering food safety messages.

In the present study, authors who had a high number of subscribers or are experts in their field could be considered authority figures, such as health care professionals (individuals), scientists (individuals), and government agencies (entities). Those individuals and entities in these positions must be aware that people who watch their videos are likely to follow their advice. For all social media platforms, content creators with thousands of followers and scientific experts have

some power to influence their followers. In a famous experiment, Milgram (Milgram & Ity, 1969) concluded that ordinary people are likely to follow orders given by an authority figure. Other researchers have corroborated this finding (Caspar et al., 2020; Grzyb et al., 2018). People in positions of authority must provide accurate food safety information to help their followers avoid harmful practices.

Although this study was designed carefully, some limitations remained. Because of the size of the project, this study focused on videos produced in only the United States and Canada. The COVID-19 pandemic has been a global event; thus, some videos from other countries may contain food safety information related to COVID-19 and may be available for watching in the United States and Canada. Another limitation is the existence of more videos that could have been accessed with other key words; only three key words were used here. A third limitation is the fact that YouTube videos can be added, deleted, or updated even after publication of the original video. Videos displaying accurate or inaccurate practices or videos that were edited after the data capture date were not included in this study. The following are recommendations for YouTube hosts, guests, and food safety educators.

(i) Along with regular content creators, health care professionals and scientific experts utilized YouTube to spread food safety information during COVID-19. Those in these professional and scientific fields must be aware that consumers are likely to follow their guidance because of their positions in society and relevance to pandemic issues. Past studies have indicated that those in authoritative positions have the power to influence others to practice certain behaviors (Milgram & Ity, 1969). Providing reliable and scientifically sound material will mitigate the risk of consumers using poor food safety practices.

(ii) Food safety educators should be aware of YouTube as a means to spread food safety information. Some YouTube hosts and guests presented helpful information, but others suggested practices that could be harmful to consumers. Food safety awareness of YouTube hosts and guests should be promoted through educational interventions. Educators can also utilize this medium to spread more accurate information and avoid the chaotic spread of misinformation, especially during health events such as the COVID-19 pandemic.

(iii) Food safety educators can also provide food safety materials to health care professionals. Various studies have revealed a food safety knowledge gap in the health care field that must be addressed (Chen et al., 2020; Wong et al., 2004). Educators can also view updated food safety materials and assist in incorporating these materials into medical program curricula.

In conclusion, with the novel status of the SARS-Cov-2, consumers may be searching for information that can help keep them safe. Although COVID-19 has not been identified as a foodborne illness, some consumers are now more aware of food safety recommendations than before the pandemic and are concerned about contracting the disease from their foods. Social media can be used as an inexpensive and rapid way to reach consumers with food safety information. Platforms such as YouTube have been key players in the spread of information related to COVID-19 and food safety. With the accessibility of YouTube, anyone can post videos regardless of their expertise or knowledge of food safety practices. Some videos pose risks to consumers because the authors transmit (and implicitly recommend) food safety practices without scientific support, presenting viewers with false information regarding food safety. The findings of this study highlight the need for educational interventions to improve the food safety knowledge of YouTube authors and the importance of using this platform during major health events such as COVID-19.

## **2.5 Acknowledgements**

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## **CHAPTER 3. FOOD SAFETY IMPLICATIONS DURING THE COVID-19 PANDEMIC #2: CONSUMER PERCEPTION AND PRACTICES OF FOOD SAFETY IN THE FIRST 5 MONTHS OF THE PANDEMIC (APRIL TO AUGUST 2020)**

A version of this chapter has been published in two journal articles and combined for the purpose of this dissertation. One paper was published in the *Journal of Food Protection* on March 5, 2021 [<https://doi.org/10.4315/JFP-21-006>] and the other paper was published in *Food Control* on June 7, 2021 [<https://doi.org/10.1016/j.foodcont.2021.108279>]. Merlyn Thomas is the first author for both publications and the co-author was Yaohua Feng for both publications.

### **3.1 Introduction**

The coronavirus disease 2019 (COVID-19) pandemic has affected how people think about food and food safety in the United States. According to the 2020 Food & Health Survey conducted by the International Food Information Council (IFIC) (International Food Information Council, 2020), COVID-19 was the top food safety issue for food handling and preparation in the United States. Almost half of Americans had concerns about food prepared outside the home, while 30% had concerns regarding meal preparation at home (International Food Information Council, 2020). Although severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has not been proven to be transmittable through food at the time of this article, concerns that the virus survives on raw foods of animal origin have persisted (Pressman et al., 2020; World Health Organization, 2020b).

During past pandemics, longitudinal survey studies assessed consumer risk perception and behavior (Bults et al., 2011; de Zwart et al., 2010; Gidengil et al., 2012). A previous study conducted during the 2009 H1N1 pandemic evaluated longitudinal trends in risk perceptions and vaccination intentions (Gidengil et al., 2012). Although many studies have evaluated consumer food safety knowledge and perceptions, few longitudinal studies have evaluated consumer food safety risk perceptions and practices during a pandemic. The available longitudinal studies evaluated food safety topics, including risk perceptions and behavioral changes during

interventions (Barrett & Feng, 2021; Majowicz et al., 2017). Because of the lack of research related to consumer food handling practices during a pandemic, the present study utilized a longitudinal approach to assess consumer food handling practices that may have been impacted by the evolving COVID-19 pandemic.

Risk perception is a significant determinant of behavior change; behavior models confirm that peoples' level of risk perception can lead to certain behaviors in health-related situations (Ye et al., 2020). Risk modeling includes three elements: the attitude of the person, risk sensitivity, and personal fear (Sjöberg, 2000). Depending on the presence of these three elements, a person's risk perception can drive behavioral change. Many of the behavior changes in response to COVID-19 may be due to changes in consumer risk perception during the pandemic (Loxton et al., 2020; Yuen et al., 2020). In addition to concerns about the virus surviving on food and surfaces, fear of contracting the highly contagious SARS-CoV-2 virus may cause consumers to take extra precautions beyond official recommendations (Centers for Disease Control and Prevention, 2020e).

Another potential factor driving consumer changes in food handling practices is information sources, whether they be government agencies, healthcare professionals, scientists, or social media. The level of trust can play a role in whether a consumer follows the advice of certain sources or entities (Balog-Way & McComas, 2020). The IFIC's 2018 food and health survey reported that consumers considered healthcare professionals, such as registered dietitians, to be the most trusted source of food information (76% for older adults ages 65+, and 65% for younger adults), and some (38%) trusted government agencies, including the U. S. Department of Agriculture (USDA), U.S. Environmental Protection Agency (EPA), Centers for Disease Control (CDC), and the U.S. Food and Drug Administration (FDA), for nutritional information

(International Food Information Council Foundation, 2018). A past study (Rolison & Hanoch, 2015) on the knowledge and risk perception of the Ebola virus in the United States reported that most respondents had the greatest trust in the Internet as a source of information, followed by the government, and then the media. Consumers' level of trust during a health crisis may influence whether they adopt certain recommended food safety behaviors.

While survey data indicate what is happening, focus group discussions can provide insight into why something is happening: researchers listen and collect qualitative data that include a range of opinions across several groups. Open-ended questions in a group setting allow participants to share their thoughts and feelings about an issue, product, or service (Krueger, 2014). Previous studies on food safety have utilized focus groups as a method to collect consumer thoughts on food safety, food safety practices, and barriers to food safety (Parra et al., 2014; Trepka et al., 2006; Yang et al., 2019). Longitudinal focus group discussions have also assessed changes in thoughts and practices over time (Derrett & Colhoun, 2011; Grey et al., 2017; Ungar et al., 2011). With technological advancements and the increased popularity of the Internet, online focus groups have become a popular research method (Synnot et al., 2014; Wilkerson et al., 2014). Online focus groups overcome some of the challenges of face-to-face focus groups. Online focus group discussions allow participants to comfortably join the discussion from anywhere in the world, as long as they can access the Internet. This allows researchers to recruit a wider range of participants and reduce transportation costs (Woodyatt et al., 2016). Research also suggests that the online environment provides participants with a subtle sense of anonymity since they are behind a screen, which allows them to discuss sensitive topics more openly (Nicholas et al., 2010; Ybarra et al., 2014). Using online longitudinal focus groups is a novel approach in food safety research. The current study used online longitudinal focus group discussions to assess the changes in perceptions,

attitudes, and practices of people in the United States in relation to food safety and the COVID-19 pandemic.

A mixed-method approach increases the validity of and confidence in the results, thereby addressing the shortcomings of using only quantitative or qualitative methods (Hurmerinta-Peltomäki & Nummela, 2006; McKim, 2017) . Published studies have used a mixed-method approach by combining survey data with data from interviews or focus group discussions to assess different consumer groups' food safety knowledge and risk perceptions (Meysenburg et al., 2014; Parra et al., 2014). The inclusion of both quantitative and qualitative methods can help researchers understand behaviors and perceptions, which can then assist in theory building or theory testing (Taylor & Rostron, 2018).

This study's objective was to assess food safety education needs and identify food handling behavior changes and risk perceptions among consumers during a major pandemic. Researchers employed a longitudinal mixed-method approach using surveys and online focus group discussions to gain a comprehensive understanding of hand hygiene, produce washing, food thermometer use, risk perceptions, and trusted sources during the COVID-19 pandemic.

## **3.2 Materials and Methods**

Research protocols were approved by the Institutional Review Board (IRB) before data collection began (IRB no. 2020-558).

### **3.2.1 Survey pilot study**

The researchers developed survey items and distributed surveys using convenience sampling to pilot test face validity. A total of 26 pilot test surveys were completed. In order to test for internal consistency of the different scales, a Cronbach alpha test was conducted on the piloted



survey items, and the alpha ranged from 0.65 to 0.91 (Pallant, 2010). A few items were added and revised based on respondents' suggestions.

### **3.2.2 Survey longitudinal study**

In order to assess the changes in risk perception and food safety behaviors, the survey was administered over 5 months. Each wave occurred once a month from April 2020 to August 2020. A longitudinal study is a research design that involves repeated observations of the same variables (e.g., people) over time. We were able to collect focus group discussion data among the same group of participants over 3 months. We were unable to collect survey data from the same exact people over time; however, we were able to make sure the participants were recruited from the same consumer panel through Qualtrics XM (Seattle, WA, and Provo, UT).

### **3.2.3 Survey respondents**

For each of the 5 months, survey respondents were recruited from an online consumer panel of Qualtrics XM, an external online survey company (Feng & Archila, 2020; Thomas & Feng, 2020). The survey was sent to participants across the United States via e-mail invitation or through respondents' panel portals. Qualtrics ensured that a minimum of 700 respondents completed the survey each month (de Zwart et al., 2010). Although respondents were not the same people each month, Qualtrics guaranteed respondents were selected from the same pool of consumers. Qualtrics worked with researchers to ensure that each participant who completed the survey received a \$5 incentive.

### **3.2.4 Survey items**

Survey items were created based on previous studies related to past pandemics or food safety (Bangerter et al., 2012; Barrett & Feng, 2021; de Zwart et al., 2010). The first survey in April 2020 had 46 items in total (three items were used to recruit participants for focus group discussions). The remaining four surveys were the same as the April 2020 survey but did not include the recruitment questions for the focus groups. Question topics included preventative practices (hand washing and sanitizing, produce washing, and thermometer usage) for COVID-19 and food safety. Current practices and changes in practices were assessed by asking if respondents practiced certain behaviors before the pandemic and/or during the pandemic and how much they anticipated practicing these behaviors after the pandemic. Participants were required to use a rating scale from 0 to 100, with 0 indicating “never” practice and 100 indicating “always” practice. The topics of these practice questions focused on personal hygiene, food handling, and kitchen cleanliness. All participants were asked about general food safety, including questions regarding their perceptions of food safety, their general concerns about food safety, their confidence levels in their own food safety measures, and trusted sources for information. Survey questions are included in Appendix F.

### **3.2.5 Survey screening and demographics**

The first two screening questions were, “Are you the primary food preparer in the household?” and “Are you the primary grocery shopper in the household?” These questions ensured that all survey participants were primary food preparers and primary grocery shoppers. The demographic screening questions helped match participants’ characteristics to the general U.S. population (United States Census Bureau, 2010). These questions included gender, age, ethnicity, state, income, and education. Other demographic questions included years of meal preparation

experience, if there were people in the household who had health conditions, whether anyone in the household worked outside the home, and if anyone in the household had been tested for COVID- 19. If anyone in the household had been tested for COVID-19, a follow-up question inquired if the test was positive.

Two questions contained answers like “if you are paying attention, please do not select this option” to detect participants’ level of disengagement. We referred to these questions as “instructional manipulation checks” (IMCs); previous studies showed that some online survey respondents did not pay attention when answering questions (Oppenheimer et al., 2009). An IMC acted as an additional screener to improve the quality of the study.

### **3.2.6 Survey data analysis**

Descriptive data, data within each month, and longitudinal data between successive months were analyzed using SPSS version 26 (IBM Corp., Armonk, NY). A paired-sample t test assesses significant differences between two means for the same participants or matched pairs of data (Laerd Statistics, 2015b; Xu et al., 2017). This study used a paired-sample t test to assess the difference in means between the levels of practices (washing hands, washing fruits and vegetables, using hand sanitizer, etc.) before, during, and (anticipated) after COVID-19. A paired sample t-test was also conducted to analyze any significant differences between the perception of food safety and COVID-19 for each. A McNemar test was used to analyze differences in categorical data. This test assessed the significance of trusting sources for food safety information versus trusting the same sources for COVID-19 information (Adedokun & Burgess, 2012; Laerd Statistics, 2015a).

One-way ANOVA was also used for longitudinal assessment of significant differences between level-of-practice changes from month to month and to assess significant difference

between food safety and COVID-19 risk perceptions of respondents across all five months (Laerd Statistics, 2017b). One-way ANOVA was also used to inquire whether social determinants, including gender, income, ethnicity, age, education, and health condition affected risk perceptions (Centers for Disease Control and Prevention, 2019g).

A delta ( $\Delta$ ), or difference, in levels of practice (before–during and after–during) assessed behavioral changes in practice based on social determinants that included gender, income, ethnicity, age, education, and whether there were any people in the household with health conditions. Negative deltas for before–during indicated that respondents increased their behavior in response to the pandemic. Similarly, negative deltas for after–during meant that respondents anticipated that they would decrease a behavior after the pandemic. Further longitudinal analysis using one-way ANOVA was conducted to determine if these social determinants had any significant effect on the delta (behavioral change) from month to month (Laerd Statistics, 2017b). Statistical significance was determined at a p-value < 0.05.

### **3.2.7 Focus group pilot test**

The focus group script was pilot tested through six sessions, with an average of four participants per session. The purpose of the pilot study was to obtain feedback and make minor revisions to the script’s questions. Questions were adjusted to allow the moderator to avoid stumbling over words and to provide clarity so participants could understand the questions. The pilot study also allowed researchers to create further probing questions or questions that would evoke further thoughts from participants on a certain topic (Krueger, 2014).

### **3.2.8 Focus group script**

The focus group script contained 11 questions related to COVID-19, separated into three sections: preventative measures, food safety concerns, and food safety information. The first section assessed current practices participants used to protect themselves from COVID-19 and whether they thought these practices protected them effectively. The second section addressed food safety concerns, food safety practices, food purchasing habits, and participants' plans to continue those preventative practices after the end of the pandemic. The third section obtained data regarding the quantity and quality of food safety information participants received during the pandemic, trusted sources of food safety information, and preferred delivery formats and topics of food safety communication during the pandemic. During the 3-month longitudinal study, similar questions were asked, with the addition of minor changes to assess the difference between the months. During the third month of the focus groups, an additional question was asked to assess whether participants had been aware or cautious of foodborne illness before the COVID-19 pandemic. This allowed researchers to obtain a baseline of attitudes toward foodborne illness before the pandemic.

### **3.2.9 Focus group participant recruitment**

Focus group participants were recruited from the pool of respondents during the April 2020 wave of the survey. Those who volunteered for focus group sessions were split initially into three groups, low, medium, and high, based on the number of COVID-19 cases in the state in which they resided. This grouping helped assess any differences in perception and practices based on the number of cases in a state. Researchers compiled a list of all states plus Puerto Rico and the District of Columbia (52 "states" total) and the number of cases in each on 27 April 2020 (Johns Hopkins Coronavirus Resource Center, 2020). In order to maintain proportionality, any states with over

10,000 cases at the time were considered high, and the remainder were split in half and considered medium and low. This arrangement left 18 states in the high category, 17 in the medium, and 17 in the low (Appendix G).

After categorizing participants based on the number of cases in their state (low, medium, or high), a convenience sample of up to 12 participants was recruited for each group. Researchers initially planned to have at least three groups of individuals from each type of state to obtain a wide range of opinions across several groups (Krueger, 2014). However, due to a low participation rate from low and medium states, researchers combined these groups to create low-medium groups. After recruitment, there were initially two low-medium (LM1 and LM2) groups and four high groups (H1 to H4). By the end of the study, there was one low-medium group and four high groups due to participants dropping out of the study or not showing up to the sessions.

### **3.2.10 Online longitudinal focus groups**

Online longitudinal focus groups were used to assess changes in perception, attitudes, and practices of people in the United States in relation to food safety and the COVID-19 pandemic. Due to the COVID-19 pandemic and the participant locations, the focus group sessions were conducted online via a video-calling service known as WebEx 2020, version 40.2.14.19, from Cisco (San Jose, CA) (Morrison et al., 2020; Richard et al., 2018; Woodyatt et al., 2016). The sessions lasted a maximum of 90 min and were video and audio recorded for record-keeping and transcription purposes. A moderator and a co-moderator conducted the sessions: the moderator asked questions and directed conversational flow, while the co-moderator took notes. After each session, the moderator and co-moderator debriefed and discussed the highlights of the session. The sessions occurred once a month for three consecutive months, May, June, and July of 2020 (Grey et al., 2017; Ungar et al., 2011).

### **3.2.11 Focus group data analysis**

Each session was transcribed word-for-word by one person and checked for accuracy by a different person. The transcriptions were uploaded into NVivo version 12 (QSR International, Burlington, MA) to be coded and analyzed. One researcher reviewed and coded all the transcriptions from the first-month sessions and developed an initial codebook using an inductive and deductive approach with different types of coding methods (Braun & Clarke, 2006; Saldaña, 2015; Thomas, 2006). The study employed a deductive approach by using the questions asked during the focus group sessions as a template and coding participant responses. The study used an inductive approach by coding noteworthy responses and allowing themes to emerge from the data directly (Fereday & Muir-Cochrane, 2006). These coding methods included attribute, descriptive, emotion, and process coding (Saldaña, 2015). Attribute coding logs descriptive information about the participants, including gender and age. Descriptive coding refers to codes that summarize the topic of the data, while emotion coding logs the feelings of the participants. Lastly, process coding logs the actions that the participants describe (Saldaña, 2015).

A separate researcher evaluated the codebook and independently coded two transcripts from the first month using the initial codebook. This step minimized bias in codebook development. The two researchers discussed any discrepancies and made changes to the codebook. Because this was a longitudinal study, additional codes apart from the first-month codes were expected. The codebook development occurred throughout the 3-month period to allow these additional codes to be included in the codebook. These additional codes were developed after focus group sessions when the moderator and co-moderator discussed the highlights of the discussion. Six codes in total were added after the initial codebook development. The final codebook (Appendix H) was developed completely and finalized with the consensus of the two researchers. The codebook contained the codes, the definition of each code, the coding method, and an example

directly from the transcriptions. After the final codebook was complete, the first researcher used the codebook to code the remainder of the sessions and the second researcher checked the transcriptions coded under each code for accuracy.

Categories and themes were developed and analyzed using inductive and deductive approaches as well (Table 3.1). Both methods allow research questions to be addressed and emergent themes to be discovered. This method ensures a comprehensive review and exploration of all data (Yang et al., 2019).

Table 3.1. Focus group codes, categories, and themes generated

Codes <sup>a</sup>	Categories <sup>b</sup>	Theme <sup>c</sup>
Practices Cleaning Groceries Cooking to Kill the Virus	Current COVID-19 and Food Safety Preventative Measures	Development of Safe and Unsafe Food Practices
Hand Cleaning Beyond COVID Produce-washing Beyond COVID	Future COVID-19 and Food Safety Preventative Measures	
Practices Hand Sanitizer Woes Not Cleaning Groceries	Avoiding Practices	Fear of People over Food
Not Concerned about Food Exposure to Food	Perception of Risks	
Trusting Healthcare and Experts Trusting Family and Friends Trusting the Government Trusting TV News Trusting Social Media Hard to Trust Anyone	Trust of Food Safety Information During COVID-19	Scientific Evidence
Food Safety Platforms Food Safety Information	Food Safety Information	

<sup>a</sup> Select codes from the full list were used in this report

<sup>b</sup> codes were compiled into different categories depending on similarities

<sup>c</sup> Themes emerged from codes and categories



### 3.3 Results

#### 3.3.1 Survey respondents and focus group participants.

A total of 3,584 respondents completed the online survey and passed the IMC, with over 700 respondents per month for each of the 5 months from April to August 2020 (Table 3.2). Slightly more than half were female, approximately 20% were aged 65 years and older, and a majority were white (non-Hispanic). Because the survey was designed to match the U.S. population, the demographic results (gender, age, ethnicity, income, and education) were consistent through- out the 5 months. Most respondents had over 5 years of experience in preparing meals, and at least 37% in each month reported having someone in the household with one health condition listed (Table 3.2). Most households reported a total of one or two people.

Table 3.2. Overview of survey demographics from April to August

<b>Characteristics</b>	<b>April N=703 %(n)</b>	<b>May N=732 %(n)</b>	<b>June N=707 %(n)</b>	<b>July N=716 %(n)</b>	<b>August N=726 %(n)</b>
<b>Gender</b>					
Male	51(358)	51(375)	53(375)	52(375)	50(365)
Female	49(345)	49(357)	47(332)	48(341)	50(361)
<b>Age</b>					
18–24	12(86)	13(94)	13(95)	13(95)	13(92)
25–34	18(127)	18(131)	19(131)	18(131)	18(129)
35–44	15(102)	17(123)	17(123)	17(123)	17(123)
45–54	19(131)	17(126)	15(107)	15(107)	17(122)
55–64	17(119)	16(119)	16(112)	17(121)	17(121)
65 and above	20(138)	19(139)	20(139)	19(139)	19(139)
<b>Ethnicity</b>					
White (non-Hispanic)	81(571)	76(556)	76(539)	81(581)	78(566)
Hispanic	6(41)	10(73)	6(39)	5(38)	7(53)
Black or African American	8(53)	8(60)	9(65)	8(55)	8(59)
Asian or Pacific Islander	5(32)	5(35)	7(46)	3(25)	4(29)
Other	1(4)	1(7)	2(15)	1(10)	2(11)
Native American	0(2)	0(1)	0(3)	1(7)	1(8)
<b>Income</b>					
Less than \$10,000	6(42)	6(47)	6(43)	5(36)	8(56)
\$10,000–\$29,999	22(156)	19(138)	21(146)	22(156)	21(153)

Table 3.2 continued

\$30,000–\$49,999	19(130)	19(141)	19(133)	19(139)	18(129)
\$50,000–\$79,999	23(159)	24(176)	24(168)	24(169)	23(165)
\$80,000 and above	28(197)	28(208)	27(192)	28(199)	27(195)
Prefer not to answer	3(19)	3(22)	4(25)	2(17)	4(28)
<b>Education</b>					
Not a high school graduate	2(14)	2(13)	1(10)	3(24)	3(22)
High school or GED Degree	38(269)	41(298)	40(281)	41(290)	44(316)
Bachelor's degree	39(277)	39(282)	38(266)	33(238)	32(233)
Graduate degree	19(132)	17(123)	18(130)	21(149)	19(139)
Prefer not to answer	2(11)	2(16)	3(20)	2(15)	2(16)
<b>Experience in preparing meals</b>					
Less than 1 year	1(8)	2(13)	1(9)	2(13)	2(16)
1–3 years	8(57)	7(50)	9(61)	9(68)	8(59)
3–5 years	9(60)	8(56)	8(60)	7(53)	8(55)
Over 5 years	82(578)	84(613)	82(577)	81(582)	82(596)
<b>Total people in the household</b>					
1	28(198)	30(216)	27(193)	26(186)	24(175)
2	33(229)	30(221)	33(232)	33(239)	32(232)
3	18(123)	18(128)	18(124)	16(111)	18(130)
4	15(105)	15(107)	15(109)	15(104)	15(110)
5	5(32)	5(37)	4(31)	8(56)	8(57)
More than 5	2(16)	3(23)	3(18)	3(20)	3(22)
<b>Conditions of people living in the household (select all that apply)</b>					
People age 65 and over	21(145)	19(138)	18(130)	19(136)	18(134)
Diabetes	15(105)	13(93)	14(102)	14(102)	14(99)
Lung conditions	7(48)	6(43)	7(48)	8(59)	6(45)
Children younger than age 5	5(36)	9(66)	8(58)	10(69)	11(79)
Cancer	3(22)	3(19)	3(23)	2(17)	3(25)
Immunocompromised, including organ transplant patients	3(22)	2(18)	4(26)	4(27)	1(10)
Liver or kidney diseases	3(18)	2(12)	3(18)	3(23)	2(14)
HIV/AIDS	0(2)	0(2)	1(4)	0(2)	1(6)
At least one of the health conditions listed in household	37(263)	38(279)	38(268)	40(287)	38(276)

After the final recruitment of focus group participants, the first session contained two low-medium (LM1 and LM2) groups and four high groups (H1 to H4). The turnout rates, or the percentage of participants who showed up for the first focus group session, were 70, 40, 67, 83, 75, and 50% for LM1, LM2, H1, H2, H3, and H4, respectively. After the first focus group session, LM1 and LM2 were combined due to the low turnout rate of only three people in LM2 (40%), as focus groups usually consist of at least five members (Krueger, 2014). The second session's turnout rate was 100% for all groups except LM and H2 (90%). Finally, the last session's turnout was 100% for all groups except LM (78%) and H3 (89%). In total, 38 of 43 people completed the study, with 7 people in the one low-medium group and 31 people in the high groups (8 in H1, 9 in H2, 8 in H3, and 6 in H4). Overall, there was no apparent difference in responses from high groups versus low groups. This may be due to a varied number of cases in different cities within the same state or due to the type of people who volunteered for these discussions. The demographic characteristics of focus group participants are shown in Table 3.3. A little over half (56%) were female, and the focus groups members included a wide range of ages, with 26% being 45 to 54 years old. Most (81%) identified as white (non-Hispanic). The demographics for the survey were similar to these findings.

Table 3.3. Overview of demographics for all focus group members, N=43

	LM <sup>a</sup> (n=10)	H1 <sup>b</sup> (n=8)	H2 (n=10)	H3 (n=9)	H4 (n=6)	Total
Age						
18–24	2	0	3	1	0	6
25–34	2	0	0	5	0	7
35–44	2	1	0	0	0	3
45–54	1	4	1	2	3	11
55–64	2	1	3	1	1	8
65+	1	2	3	0	2	8
Ethnicity						
White (non-Hispanic)	9	7	8	8	3	35
Black or African American	0	1	1	0		4
Hispanic	1	0	1	1	0	3
Asian or Pacific Islander	0	0	0	0	1	1
Gender						
Male	5	4	2	5	3	19
Female	5	4	8	4	3	24

<sup>a</sup> LM Represents the focus group with participants from low-medium states for COVID-19 cases in April 27, 2020 (under 10,000)

<sup>b</sup> H Represents the focus groups (1-4) with participants from the high states for COVID-19 cases in April 27, 2020 (over 10,000 cases)

The survey respondents answered questions about safe food handling practices during the COVID-19 pandemic and focus group participants elaborated on and discussed why they were doing certain practices. This mixed-method approach provided researchers with more in-depth insights on why people might be engaging in certain practices during this major health event. In the sections below, “survey respondents” are those who contributed to survey results, while “focus group participants” are those who contributed to focus group results.

### 3.3.2 Practices: Hand hygiene

Hand cleanliness cannot only reduce the spread of COVID-19 but is also a vital food safety practice that can decrease the risk of foodborne illness. Although survey respondents reported high

levels of handwashing with soap during the pandemic, they anticipated a significant decrease after COVID-19 within all months surveyed (Appendix I). In contrast, while there were low levels of handwashing with just water during the pandemic, survey respondents anticipated significantly higher levels of washing their hands after the pandemic with water only as opposed to using both soap and water.

Many focus group participants mentioned handwashing as a practice to avoid contracting COVID-19 from people and food. Although most focus group participants did not mention if they used soap while washing, one participant admitted to previously using only water at times: “So when I was at work, I have this peer pressure. You’re around people, and in a public restroom you must do the full hand wash . . . I was just pretty much a water-and-go person here in the house, and now I’m doing the whole happy birthday song with soap” (female, 45 to 54, H1, May). When asked if they would continue the practice of washing hands after the pandemic, almost all the focus group participants said they would continue. However, their reasons varied as to why they would continue after the pandemic: (i) increased awareness of diseases or risk, (ii) newly formed habits during the pandemic, and (iii) increased awareness of personal hygiene practice. However, some focus group participants also agreed that human nature would “kick in,” and the level of practice might decrease over time.

Hand sanitizer use is not a recommended safe food handling practice but was recommended during the pandemic for the prevention of SARS-CoV-2 transmission (Centers for Disease Control and Prevention, 2020k; University of Minnesota Extension, 2018). Hand sanitizing was considered a practice that would be reduced after the pandemic. Appendix I shows the decline of anticipated hand sanitizer use after the pandemic in all months during the survey study, which was similar to the focus groups. When assessing longitudinal differences for practices during COVID-19, the

levels of hand sanitizer use were significantly lower in April than in July and August 2020. Throughout the 3-month-long focus group study, many participants anticipated stopping the use of hand sanitizers after the pandemic or even during the pandemic for these reasons: it is an additional step, it irritates the skin, perceptions that it may be toxic to the body, and that it could kill “regular” germs on the skin. Some people also noted that they did not use it often before the pandemic, so they anticipated that this practice would simply fade after the pandemic. Similar to hand hygiene, consumers reported changes in the method and levels of produce washing during the COVID-19 pandemic, as we discuss in the following section.

When analyzing the effect of social determinants on the behavioral change for handwashing, gender and income had a significant impact on the behavioral changes in response to the pandemic and anticipated change after the pandemic in most months. Meanwhile, education and age only had an impact in 1 or 2 months (Appendix J). When examining the behavioral change in response to the pandemic, males had a greater change than females in washing hands with soap in response to the pandemic. Similarly, respondents with higher incomes (\$50,000+ annually), education levels ( $\geq$  bachelor’s degree), and ages (55+ years old) showed greater changes in washing hands with soap in response to the pandemic. When examining the anticipated behavioral change after the pandemic, males, respondents with higher income (\$50,000+ annually), and older adults (55+ years old) anticipated themselves as significantly more likely to maintain their behavior of washing hands with soap after the pandemic.

### **3.3.3 Practices: Produce washing**

The survey also assessed fruit- and vegetable-washing levels, both with water only and water plus soap (Appendix I). In each month, there was a significant increase in produce washing with water only and with water plus soap during the pandemic compared with (what they

remembered doing) before the pandemic. Although respondents' anticipated levels of produce washing (after the pandemic) with just water remained the same in April, May, and June, there was a significant decline in July and August. The anticipated levels after the pandemic for water plus soap stayed nearly the same for all months until August, when there was a significant decline (Appendix I).

Although many focus group participants reported using only water to wash fruits and vegetables in May and June, some used soap, or even vinegar, to "kill the virus." By July, many participants had started washing their produce with just water instead of using soap and water. One reason participants identified for washing their produce was their fear of people "breathing" on the food or touching it at the grocery store. One participant expressed her concern in this way: "I just have nightmares of people going into stores touching everything and leaving it behind for someone else. . . . making sure that I take care of any fruit or vegetables. Even my bananas before I eat them" (female, 65+, H1, May). Although many focus group participants reported feeling more comfortable about not contracting COVID-19 from food by the third session, some still used water plus soap or vinegar.

When analyzing the effect of social determinants on the behavioral change for produce washing with water only, age had an impact in one of the months where older adults (55+ years old) anticipated themselves as significantly more likely to maintain their behavioral change of produce washing with water only after the pandemic (Appendix J). However, gender, age, and education had an impact in 1 of the 5 months for produce washing with soap. When examining the behavioral change in response to the pandemic, females, and those with higher education levels ( $\geq$  bachelor's degree) had significantly changed their behavior and washed produce with soap more in response to the pandemic. When examining the anticipated behavioral change after the

pandemic, older adults (55+ years old) anticipated themselves as significantly more likely to quit their behavioral change of produce washing with soap after the pandemic.

When comparing overall behavioral change in response to the pandemic from month to month, respondents were more likely to change their behavior in produce washing with soap in response to the pandemic in April than in later months (June and July). When examining the impact of social determinants on behavioral change from month to month, in April, those with higher education levels ( $\geq$  bachelor's degree) had a significantly increased level of produce washing with soap, while in June and July, the behavioral changes were similar for both levels of education (data not presented in the tables).

### **3.3.4 Practices: Thermometer use**

The use of food thermometers and refrigerator thermometers was reported during the survey study (Appendix I). Most consumers claimed they used food thermometers at least “sometimes” during the pandemic. Compared with before the pandemic, there was a significant increase in food thermometer use during the pandemic. The increase was significant in each survey for each of the 5 months. However, when assessing longitudinal differences for food thermometer use during COVID-19, significantly more survey respondents said they used food thermometers in July than in May.

In contrast to the survey results, only a few focus group participants mentioned using food thermometers to check the doneness of foods: “Chicken is supposed to be 155 or 165. I have a marker in there, and so I just keep my food thermometer, and I just measure everything” (female, 45 to 54, LM, June). Some focus group participants mentioned cooking food as a practice to kill the virus. One participant purchased a food thermometer in response to the pandemic: “I just bought a food thermometer, and I know that I probably should have had one before” (male, 35 to



44, LM, July). Among the focus group participants who did not use food thermometers, only one provided the rationale that he had a “good grip” on meat doneness.

When analyzing the effect of social determinants on the behavioral change in response to the pandemic for thermometer use, age had an impact in 2 of the 5 months, while income and education had an impact in 1 of the 5 months (Appendix J). Gender did not have an impact on the behavioral change of thermometer use in any of the months. When examining the behavioral change in response to the pandemic, younger adults (55+ years old), those with a higher income (\$50,000+ annually), and those with a higher education level ( $\geq$  bachelor’s degree) had a greater change in their behavior for using food thermometers in response to the pandemic.

### **3.3.5 Perceptions of the most likely source of contracting COVID**

Throughout all five months, survey respondents perceived a significantly higher risk of contracting COVID-19 from people rather than food (Appendix K). Respondents perceived a medium risk (51.11–54.68) of contracting COVID-19 from people and a less-than-medium risk (27.56–31.38) of contracting it from food. Throughout the focus group sessions, some people expressed similar views: they felt that they were more likely to get the virus from other people rather than food. This was especially apparent in July, when they had not heard of anyone getting COVID-19 from food: “I haven’t heard much about people getting it from food so as long as I’m taking care of it the way that I have been you know washing and making sure I’m cooking things as thoroughly as I usually do . . . I don’t really feel like I’m too worried about that” (Female, 25–34, H3).

This study also assessed consumers’ perceived risk of takeout foods from restaurants. The survey study reported less-than-medium perceived risk (mean  $<50$ ) for takeout food (Appendix L). For takeout food overall and hot takeout foods, the survey reported a significant decrease in risk

perceptions from April to May but an increase from May to June. For food packaging, the survey reported a significant decrease from April to May and then a significantly lower risk perception in August when compared to April. Focus group participants shared similar sentiments about takeout food posing very minimal risks. By July, most focus group participants were not concerned about the food itself but were concerned about the food container: “We do take out like every weekend . . . just try to take it out of the container throw it out, and that’s about it . . . I don’t think about it as like that’s how I’m going to get it—like not from the food itself—maybe from the delivery driver touching it or something like that, but I haven’t thought about it as far as like the food itself” (Female, 25–34, H3). Other common practices that focus group participants mentioned were wiping down the outside of packaging, washing/sanitizing hands, and using no-contact delivery.

The effect of social determinants on risk perceptions was only analyzed for the survey study (Appendix M). When analyzing the social determinants of risk perceptions of getting COVID-19 from food, ethnicity, and age had a significant impact in each of the five months. Those who were not white (non-Hispanic) and younger adults (< 55 years old) had a significantly higher risk perception of contracting COVID-19 through food. Furthermore, gender, education, household health conditions, and income had a significant impact in three or fewer of the months. For the significant values, males, respondents with higher education levels ( $\geq$  bachelor’s degree), those who did not have any at-risk individuals in the household, and those who made a lower income (<\$50,000 annually) had a higher risk perception of contracting COVID-19 through food.

When analyzing the social determinants of risk perceptions of getting COVID-19 from people, income and education had an impact in two of the five months, while ethnicity, age, and household health conditions had an impact in only one of the months. Gender did not have a significant impact in any of the five months (Appendix M). Respondents who had a higher income (\$50,000+

annually), higher education levels ( $\geq$  bachelor's degree), were not white (non-Hispanic), younger adults ( $<55$  years old), and those who had at least one at-risk individual in the household, perceived a significantly higher risk of contracting COVID-19 from other people in some of the months.

### **3.3.6 Handwashing and risk perceptions**

Survey respondents had a significantly higher perception that handwashing protects them from COVID-19 compared to protecting them against foodborne illness (Appendix N). In high and low-medium (H and LM) groups throughout the three months, many focus group participants included handwashing as a practice to avoid getting COVID-19 from other people and from food. In May, one participant noted: “[I] wash my hands at least five times a day so. I feel like I’m doing my part it’s up to everybody else to do theirs” (Male, 25–35, H3). The COVID-19 pandemic caused most participants to become more aware of handwashing: “We don’t really wipe things down when they come into the house or anything, but we do have been pretty hyper-aware about washing our hands doing hand sanitizer . . . before doing anything with food and everything” (Female, 18–24, LM, July).

However, one focus group participant in July did not directly connect handwashing with food safety, even though he engaged in the practice: “I don’t know if it’s related to food or what, when I come from the supermarket or having packages, I’ll wash my hands before I do anything else. I put the food away and then I wash my hands” (Male, 65+, H2).

The social determinants of beliefs of handwashing effectiveness on COVID-19 and foodborne illness were analyzed using the survey data (Appendix M). For handwashing effectiveness on COVID-19, age had a significant impact in four out the five months, while gender had an impact on two. The ethnicity, education, and health condition of people in the household all had an impact in one of the months. For significant values, respondents who were older (55+ years old), female,

non-white (non-Hispanic), with higher education levels ( $\geq$  bachelor's degree), and had at least one at-risk individual in their household, had a higher level of belief that handwashing protects against COVID-19. For handwashing effectiveness on foodborne illness, education showed an impact in only two of the months. In July, respondents with lower education levels ( $<$ bachelor's degree) had a significantly higher level of belief that handwashing would protect them from foodborne illness. However, those who had higher education levels ( $\geq$  bachelor's degree) had a higher level of belief in August.

### **3.3.7 Trusted sources of information**

Survey respondents trusted different sources for COVID-19 and food safety information (Figure 3.1). Throughout the five months, respondents trusted the FDA significantly more for food safety information than for COVID-19 information. Similarly, the FDA was also the most trusted source of food safety when compared to other sources; healthcare professionals came in second. However, respondents trusted the CDC, WHO, and healthcare professionals significantly more for COVID-19 information than for food safety information. When asked “Who do you trust to give you food safety information during COVID-19,” many focus group participants throughout all three months mentioned government agencies, healthcare professionals, and scientists. Many connected scientists to the government since “most of them are working for government agencies” (Female, 45-54, H1, July). A major theme for these choices was that these were credible sources and were backed by science: “Microbiologists understand microbes. We know, you know, it has an effect on this virus. They’re saying a lot of things that are scientifically proven, and all those are safety things” (Male, 55-64, LM, May).

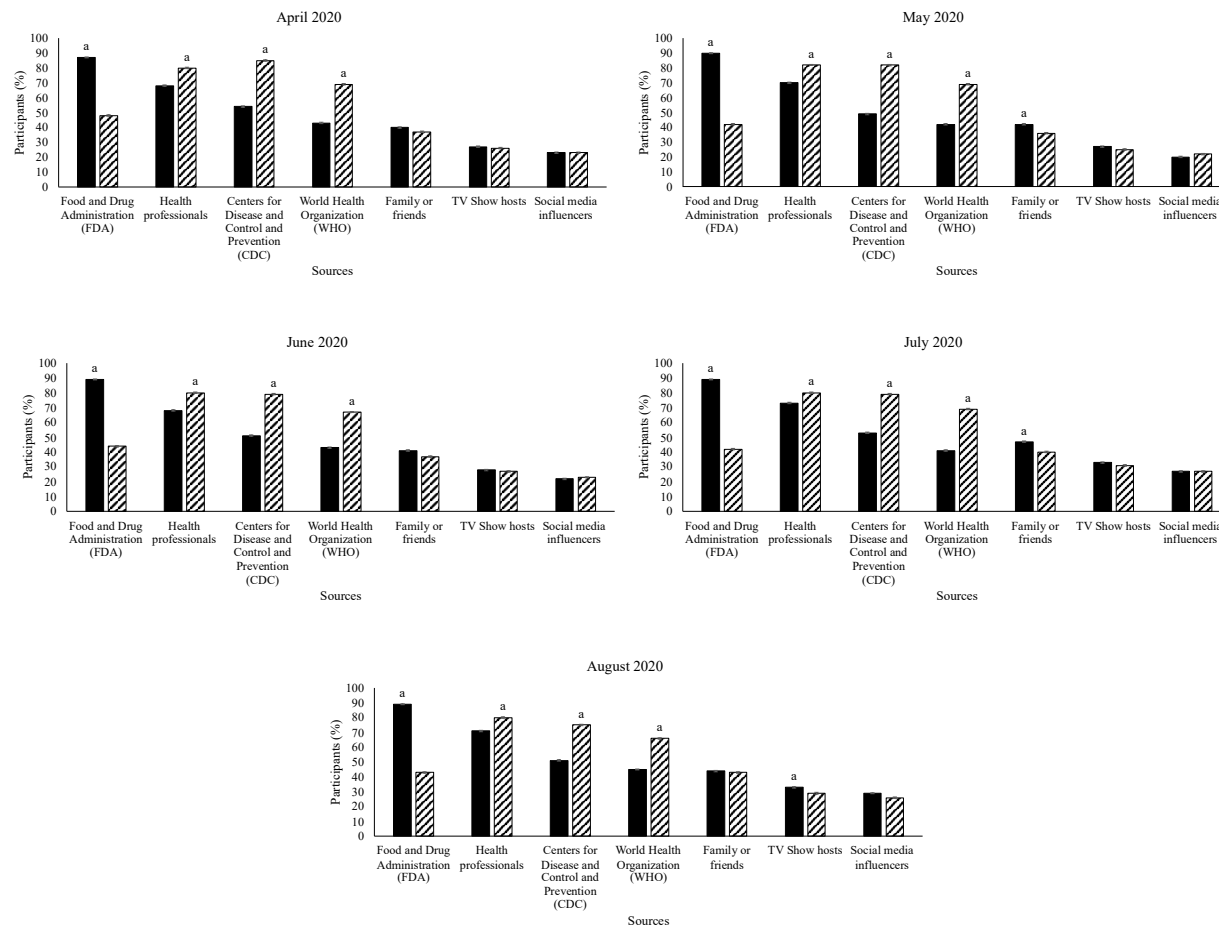


Figure 3.1. Trusted sources of food safety information (solid bars) and COVID-19 information (hashed bars) from April to August 2020

Although most leaned toward trusting the government, a few focus group participants mentioned they were wary of trusting the government because they may have political motives, personal agendas, they provided contradictory information, or because they lacked information. Throughout the three months, most focus group participants said they did not receive any food safety information from any source during the pandemic, other than that the idea that the virus might be on packaging or news of people using bleach to kill the virus: “I haven’t heard at all since last month. Food safety . . . the only thing I heard was that thirty percent of all Americans are using bleach as a disinfectant are actually using it on food” (Male, 45–54, H1, July). Some even

mentioned that the government could have disseminated this information earlier: “The CDC I won’t say they dropped the ball, but they haven’t mentioned anything about food safety and they did send a postcard to all 330 million Americans . . . which was basically printed guidelines, basically handle sanitation and very basic things. No food safety was mentioned, just basically washing your hands” (Male, 45–54, H1, May).

Some focus group participants even expressed a lack of trust in anyone as a source of information. One participant mentioned that he did not know who to trust because of contradictory information received, offering the example of how CDC reversed their decision on masks: “[T]he CDC first said don’t wear a mask. It won’t help. And, of course, that’s reversed. Just kind of knowing that kind of a thing in other countries and has been for a long time. You question that a little bit too . . . it’s like, well, who you can really trust at all? (Male, 25–34, LM, May). Another participant mentioned trusting their instincts with food safety: “The CDC contradicts itself WHO contradicts itself. Nobody really knows right now; you just kind of have to go with your gut instinct” (Female, 45–54, H4, July). Although more people expressed this concern in May, a few participants were still questioning who to trust in June and July.

As seen in Figure 3.1, social media was the least-trusted source of both types of information throughout the five-month survey study. Focus group participants shared similar sentiments during the three-month study. Participants agreed that social media spread “misinformation.” Some mentioned inconsistencies on social media platforms: “I didn’t do social media because I can listen to one network and then they’ll tell me one thing, and then I flip over to another network and it’s completely different so ah, I don’t believe them” (Female, 65+, LM, June). However, some mentioned they would trust social media but only if the information was verified scientifically: “So, I think social media is just it’s like I said grain of salt. Sometimes if I see that it is from [a]

health professional, I can back that up by googling that name um then okay this is something to take serious, otherwise it's just this is clickbait or this is just yeah weird stuff" (Male, 35–44, LM, May).

Relatedly, when asked which platform would be the best for disseminating food safety information, some focus group participants throughout the three months of discussions mentioned that social media is a good way to “get the word out” or to “advertise”: “Even if a credible source was presented on Facebook or social media that wouldn't necessarily be a bad thing because I have seen some things from the CDC on social media um and of course I went out and checked their website there it was so I mean if I think we're all responsible enough to kind of you know, know that just blindly believing isn't a good idea” (Female, 55–65, H2, July).

### **3.4 Discussion**

#### **3.4.1 Risk perceptions and behavior change**

The COVID-19 pandemic has caused behavior and lifestyle changes in many consumers, including the addition of stress-coping mechanisms and preventative practices (Mason et al., 2020; M. Thomas & Y. Feng, 2021). A recent study by Yuen et al. (Yuen et al., 2020) on panic-buying during a health crisis concluded that consumers with a high-risk perception of contracting a disease were more likely determined to partake in activities to protect themselves in order to lower those risks. Likewise, some of these changes in preventative practices may be due to increased risk perceptions of contracting COVID-19 due to the highly contagious nature of the virus (Centers for Disease Control and Prevention, 2020e; M. Thomas & Y. Feng, 2021). The present study reported that survey respondents and focus group participants were more concerned about getting COVID-19 from other people rather than from food, which may be due to SARS-CoV-2 not being declared

a foodborne pathogen (Desai & Aronoff, 2020; Olaimat et al., 2020). However, this study still reported some perceived risks of contracting the virus through food. Reasons for this perceived risk may be due to recent news (June, 2020) about food becoming contaminated with SARS-CoV-2, which was then contracted by those who handled the food (BBC News, 2020; Pang et al., 2020). This change in risk perception may have prompted consumers to adopt not only good food-handling practices but also poor ones, like washing fruits and vegetables with soap (M. Thomas & Y. Feng, 2021). Food safety educators need to be aware of increased risk perceptions during a time of health crisis to help consumers adopt good food-handling behaviors and to continue them even after the health crisis.

### **3.4.2 Decline in post-pandemic hand hygiene**

Hand hygiene and proper handwashing was the earliest and most important recommendation that experts gave to consumers when the COVID-19 pandemic hit the United States (Centers for Disease Control and Prevention, 2020l; World Health Organization, 2020a). In this present study, the survey data and focus groups confirmed an increase in handwashing during the pandemic compared to before the pandemic. This finding is similar to recent studies focused on hand hygiene and the COVID-19 pandemic and previous studies about the H1N1 pandemics (Haas et al., 2020; Park et al., 2010). The increase in handwashing during these health events may be due to the emphasis on this practice as a preventative measure for diseases in general (Centers for Disease Control and Prevention, 2020o). However, survey and focus group results showed a significant reduction in anticipated handwashing with soap and hand sanitizer use after the pandemic.

This decrease in proper hand hygiene throughout the pandemic, and as anticipated after the pandemic, may be attributed to people becoming less responsive to risks involved in decreased



hand hygiene or, as focus group participants mentioned, human nature “kick[ing] in.” This phenomenon, coined “caution fatigue,” describes people reducing their vigilance in taking precautionary measures (Kossakowski, 2020; Northwestern Medicine, 2020). This lack of vigilance not only increases the risk of spreading SARS-CoV-2 but can cause the spread of other diseases as well. When assessing hand sanitizer use separately, some focus group participants were concerned it was harmful; this may be due to reports of harmful ingredients. In June 2020, the U.S. Food and Drug Administration (FDA) warned against using certain alcohol-based hand sanitizers because they may contain ingredients like methanol, which may be toxic and cause adverse effects if used or ingested (U.S. Food and Drug Administration, 2020a). Another reason for less hand sanitizer use might be due to the low availability of hand sanitizer during the pandemic (Rebmann et al., 2020).

Because a large percentage of foodborne disease outbreaks are caused by lack of hand hygiene, a decline in handwashing and hand sanitizing may cause an increase in consumers’ risk of contracting a foodborne illness (Centers for Disease Control and Prevention, 2016). Hand hygiene is an important component of food safety messages to ensure consumer safe food-handling practices. Consumers should also be educated on the importance of hand hygiene not only for the pandemic but to prevent cross-contamination and foodborne diseases.

### **3.4.3 Produce washing and thermometer use**

Consumers implemented fruit and vegetable washing practices as a preventative measure against COVID-19. There may be a connection between produce-washing and new COVID-19 cases in the United States. This present study reported that anticipated levels of produce-washing after the pandemic with water only and water plus soap declined in August. This may be due to the declining case numbers by August 2020 (Centers for Disease Control and Prevention, 2020f;

CNN Health, 2020). Consumers might have been less afraid of contracting SARS-CoV-2 from their food because of the declining number of cases. Although water was the primary method used to wash produce, some focus group participants in this study reported using other techniques, like soap or vinegar, to clean their fruits and vegetables. A recent content analysis of food safety information in YouTube videos during the COVID-19 pandemic (June, 2020) found that some people, including healthcare professionals, suggested that people should wash their fruits and vegetables with soap (Thomas et al., 2021). The content analysis study also found that some people suggested this practice because it was the same as the recommended practice for proper handwashing. This dissemination of misinformation may be one reason consumers in the United States wash their produce with water plus soap instead of water only. Another recent study found an increase in calls to poison control centers about exposure to cleaners and disinfectants, which may be due to consumers using these products on food (Gharpure et al., 2020). Many experts warn against washing fruits and vegetables with anything but water only since detergents may not rinse off the produce, which can make consumers ill when the produce is ingested (U.S. Department of Agriculture, 2020c; U.S. Food and Drug Administration, 2018c).

Survey participants increased their food-thermometer use in response to the pandemic and focus group participants also mentioned using heat while cooking food to kill the virus. The increase in thermometer-use during the pandemic may indicate that consumers have become more aware of food safety measures during the pandemic by connecting the safe-food handling to killing the virus on food. The current survey also reported a significant increase in the use of thermometers in July compared to May. There are two potential factors that may contribute to this longitudinal change. There were higher numbers of new COVID-19 cases in the United States in July compared to May, which may have influenced consumers to take extra precautions in July (Centers for

Disease Control and Prevention, 2020m). Another possible reason may be connected to the outbreak of COVID-19 in Beijing, which was reported to be associated with the imported salmon (BBC News, 2020). The increasing number of people becoming ill from May to July and the raw-food-related outbreak news may have influenced consumers to take extra steps to make sure the virus is eliminated. Because the current study concluded an increase in food-thermometer use, it is important to spread information on proper food thermometer techniques and correct endpoint temperatures (Feng & Bruhn, 2019). A previous study found that although most food workers understood the importance of using a food thermometer when cooking meat and poultry products, very few knew the endpoint temperature needed to ensure product safety (Bruhn, 2014).

Food safety experts and educators should be aware of heightened food safety concerns during major health events so that evidence-based, proper cleaning methods can be disseminated to consumers earlier during the pandemic so as to avoid consumers harming themselves with improper techniques such as using soap to wash produce. Increased awareness of food safety practices is also beneficial to consumers and food safety educators who should use this time during the pandemic and other similar health events to provide consumers with correct information while food-safety attention levels have increased.

#### **3.4.4 Social determinants of food-handling practices during COVID-19.**

Many demographic characteristics are social determinants of health: conditions that affect a wide range of health, functioning, and quality-of-life outcomes and risks (Centers for Disease Control and Prevention, 2019g). Exploring the impact of social determinants for consumer food-handling practices can aid food-safety and health experts to develop audience-targeted educational materials. Social determinants, including gender, income, education level, and age, were reported in the five-month survey results.

Male respondents significantly changed their behavior in handwashing with soap than females (Appendix J). The difference between genders could be caused by the fact that males tended to have a lower compliance rate of handwashing with soap before the pandemic. The gender difference in handwashing was also reported in other studies. A recent CDC study reported that men were less likely to remember to wash their hands than women during the COVID-19 pandemic (Centers for Disease Control and Prevention, 2020b). Previous studies also found that gender played a role in health engagement (Ek, 2015; Wellstead, 2011). Ek's (Ek, 2015) study on the effect of gender on health information behavior found that being female was a strong predictor of being more involved and proactive in health-related issues than males. The lack of male involvement around health issues may be a reason for lower levels of handwashing before the pandemic. However, the pandemic resulted in males having a significantly greater change in washing hands with soap than females, which may indicate that the fear-inducing nature of the COVID-19 pandemic may have influenced males to make greater changes.

Most months indicated that those with \$50,000+ in annual income had higher levels of handwashing with soap than those with incomes lower than this annual figure. Some months also displayed that those in this higher-income category were more likely to use a food-thermometer more during the pandemic than those in the lower-income category. Previous studies have assessed food safety knowledge and practices of low-income groups (Kwon et al., 2008; Wenrich et al., 2003). A study by Wenrich, Cason, and Kassab (Wenrich et al., 2003) found that many low-income adults in Pennsylvania had risky food practices and beliefs. These included being unaware of correct refrigeration temperatures, cross-contamination, and a lack of disinfection practices. Low-income individuals may have multiple barriers preventing safe food-handling practices or acquiring food safety knowledge. These individuals may not have access to proper food safety

courses due to distance, internet availability, or insufficient funds to pay for such courses. An observational study also found that families making less than \$1,000 per month were less likely to use cutting boards, paper towels, and soap (Dharod et al., 2007; Trepka et al., 2006). Therefore, it is important to consider how some consumers may not have opportunities or access to information and resources due to their financial situation. A higher income can also allow consumers to have more food safety resources like thermometers and disinfectants, which were necessary to perform certain safe food-handling practices. It has been shown that the pandemic had a major economic impact on the United States (Han et al., 2020). With the decline in employment and earnings during the pandemic, those with lower income may be even less inclined to practice safe food behaviors due to the barriers; they may be more focused on providing the essentials for themselves and their families.

Much like income, those with a bachelor's degree or higher had greater levels of handwashing with soap and thermometer-use during the pandemic than those with lower education levels. Similar results were seen in a previous study where researchers assessed food safety practices and risk perceptions of Mexican-Americans and found that those with a college degree or higher acknowledged that food-thermometer use is important and handwashing was a method to reduce the risk of food poisoning (Parra et al., 2014). Another more recent study (Her et al., 2020) on consumer perceptions of food safety found that those with higher education levels were more likely to own a food thermometer. People with higher educational degrees may be more likely to seek information and put preventative measures into practice.

Education also had an effect when assessed longitudinally. Those with higher education levels practiced washing produce with soap more in April, but the changes started to even out between education levels in June and July. This may be explained by the dissemination of false

information earlier on during the pandemic and how those with higher education levels may have heard about it first. However, as more information about proper practices emerged, the levels of washing produce with soap declined as well. Food safety educators should find ways to reach people from all educational backgrounds during major health events like the COVID-19 pandemic and under normal circumstances.

Age played some role in consumers' preventative measures during the pandemic. The current survey results showed that, in some areas, older adults tended to be more careful with hand hygiene in response to the pandemic. These findings are similar to a previous health study where older adults (45 to 64 years old) were more engaged in diabetes risk-reduction activities (Ali et al., 2019). However, this study also found that younger adults (<55 years old) had a significant increase in using thermometers in response to the pandemic. This contradicts previous studies where younger participants (<34 years old) had a lower usage of food thermometers and less knowledge on how to use one (Brennan et al., 2007; Feng & Bruhn, 2019; Murray et al., 2017). This shift in behavior during the COVID-19 pandemic may be due to the increased awareness of food safety during this time. It also needs to be noted that the previous studies reported the age group of the participants were younger than 34 years old, while in the current survey, the younger participants referred to those who were younger than 55 years old. The differences could also be contributed to the age-group differences between the studies.

### **3.4.5 Social determinants of risk perceptions during COVID-19**

As social determinants may also influence overall risk perceptions, they can be valuable in deciding which groups need food safety materials (Centers for Disease Control and Prevention, 2019g). In this study, males perceived a greater risk of contracting COVID-19 from food. A previous study that assessed consumer pet-food safety found that males had a higher risk

perception of children becoming ill from pet food compared to females' risk perceptions (Thomas & Feng, 2020). Males' higher risk perceptions in food handling situations may be due to lack of confidence and knowledge about food preparation (Schaeffer, 2019; Taillie, 2018). However, female respondents had a greater belief that handwashing would protect from COVID-19. This may indicate that although males have a higher risk perception, they may not be following proper guidelines to prevent becoming ill with COVID-19. This may mean that males, as a group, are not taking preventative health measures for other diseases, including foodborne illness. Previously, men have been found to take part in risky behaviors, which may ultimately lead to lower life expectancies compared to women (Baker et al., 2014).

This study revealed that age also had an impact on risk perception and behavior. For all months, younger adults (< 55 years of age) perceived a greater risk of contracting COVID-19 from food than older adults. This contrasts with previous studies in which younger people were found to have a lower risk perception of food safety prior the pandemic (Kim, 2007; Millstein & Halpern-Felsher, 2002). However, a recent study by Gerhold (Gerhold, 2020) of risk perceptions and coping strategies of Germans during the COVID-19 pandemic, found similar results to the current study: older adults believed they were less likely to be infected with COVID-19. There may be a connection between trust in preventative practices and risk perceptions. For almost all months, older adults believed that handwashing could protect against COVID-19 compared to younger adults. Therefore, this elevated belief that handwashing is protection against COVID-19 may lower their perceived risk.

Lastly, ethnicity was another noteworthy social determinant in the current study. Similar to younger adults, those who were not white (non-Hispanic) perceived a higher risk of contracting COVID-19 from food. Similar to the findings of this study, previous studies found that whites had

a lower risk perception of exposure to environmental risk and health risks (Finucane et al., 2000; Flynn et al., 1994; Freimuth et al., 2017).

### **3.4.6 Trusted sources and dissemination of information**

Depending on the level of trust, sources of information can influence consumers to decide whether to partake in certain activities (Balog-Way & McComas, 2020). The survey data showed that most people trusted the FDA for food safety information while the CDC, WHO, and health professionals were more trusted for COVID-19 information. Focus group participants emphasized they trusted these sources for food safety information during COVID-19 because they were the experts and had scientific credentials. A previous study on the trust of food labels across multiple countries found that all the countries trusted “expert” sources for food information, but the United States had very low trust in government-derived food information (Rupprecht et al., 2020). Similarly, focus group participants in this study expressed frustration and a lack of trust toward government agencies due to contradictory information and a lack of information throughout the pandemic. For example, WHO reversed its initial recommendation against wearing masks (CNN World, 2020; World Health Organization, 2020c). A previous focus group study investigating consumers’ trust of food-related information, showed that consumers loss trust when they perceived the information source being less transparent (Bruhn & Feng, 2021). Although consumers trust the government, they may not understand how the government makes decisions based on available information. Previous studies show that governments all over the world adopt policies through different pathways, including through learning, negotiated agreements, and the diffusion and transfer of ideas across governments (Hunter, 2020; Sabatier & Weible, 2014; Weible et al., 2020). Due to the novel nature of the COVID-19 virus, it is important to update the public throughout the pandemic. However, as seen in the present study, a change in information



may cause a decline in consumer trust. Government agencies need to be aware of how the transparency of their decisions can have an impact on consumers.

This study found that consumers trusted health professionals for food safety information. However, previous studies have reported that health professionals are not confident of their own food safety knowledge (Chen et al., 2020; Wong et al., 2004). A recent study on YouTube video content analysis of food safety and COVID-19 information by Thomas et al. (Thomas et al., 2021) found that a popular video hosted by a healthcare professional contained improper food safety practices. Similar to government agencies, healthcare professionals need to understand their impact; they should conduct research on a topic to ensure their information is accurate. This will reduce the risk of consumers practicing harmful behaviors, like washing fruits and vegetables with soap (Government of Canada, 2020c; U.S. Food and Drug Administration, 2018c)

Although social media was not a highly trusted source of food safety information among consumers in this study, focus group participants said it would still be a useful platform to disseminate information. Because of a continuous increase in internet usage, social media has become a budget-friendly way to spread information rapidly about health and food safety (Abedin et al., 2017; Overbey et al., 2017; Zhang et al., 2019). However, because consumers seek out health information online, the spread of misinformation may cause them to practice poor food safety behaviors (Chou et al., 2018; Suarez-Lledo & Alvarez-Galvez, 2021). It is necessary for food safety experts to collaborate with social media influencers to provide more accurate, science-based information on popular and trusted platforms.

### **3.4.7 Conclusions**

This study concludes that the COVID-19 pandemic has impacted consumer food-safety handling practices in the United States. While some safe food-handling practices increased, such

as hand hygiene, washing produce with water, and food-thermometer use, some potential mishandling practices identified may be due to the spread of misinformation, like washing produce with soap. One major change brought on by the COVID-19 pandemic was an increase in handwashing practices. However, many consumers may not be connecting this practice to food safety, which may cause them to decrease their handwashing frequency after the pandemic. The level of risk perception that consumers have may coincide with the preventative practices they take. Higher levels of risk perception may mean that they are more willing to make changes. Food safety educators need to guide consumers on proper food safety habits so that consumers will continue to practice these habits, even after the pandemic is over and risk perceptions decrease. When disseminating food safety information, educators need to consider trusted sources and most frequently used platforms. Food safety educators can use these platforms to engage with consumers, continuing to remind them of the importance of mitigating the risk of foodborne illness. Scientists can help consumers retain confidence in authority figures by providing scientific evidence to present through these figures when recommendations change over time. It is critical to engage the public in learning about safe food-handling practices earlier on during major health incidents, like the COVID-19 pandemic. More research needs to explore social determinants' impact on behavioral change during a pandemic. This study's findings provide timely information to guide future food-safety education and communication during health crises and pandemics.

### **3.4.8 Acknowledgments**

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## **CHAPTER 4. FOOD SAFETY IMPLICATIONS DURING COVID PANDEMIC #3: CONSUMER PERCEPTION AND PRACTICES OF FOOD SAFETY IN 13 MONTHS OF THE PANDEMIC (APRIL 2020 TO MAY 2021)**

### **4.1 Introduction**

Foodborne illness is not a new topic, and while advancements are continuously being made to further mitigate the risks, consumers can use established methods to protect themselves (Centers for Disease Control and Prevention, 2020i). However, risk perception and changes in practices can occur due to major shifts in lifestyles. Along with that, behavior models have shown that levels of risk perception can lead to behavior changes in health-related situations (Ye et al., 2020). Due to the increased risk perceptions during major health events, pandemics may trigger consumers to become hyperaware of their general practices, including those related to food handling (Loxton et al., 2020). The Coronavirus 2019 Disease (COVID-19) pandemic has caused many consumers in the United States to change their perceptions and food handling habits to protect themselves from contracting SARS-CoV-2 (M. S. Thomas & Y. Feng, 2021a, 2021b). While many of these changes can be positive ones, like washing hands with soap, some can be negative, like washing fruits and vegetables with soap and water. It is important to understand the levels of food handling practices because these practices may or may not be followed as the pandemic continues or once it is over. The practices that consumers adopt may affect not only themselves but also those around them, including individuals who may be at a higher risk for disease (Centers for Disease Control and Prevention, 2019f).

Previous longitudinal studies have assessed consumer behaviors and perceptions during past pandemics (Bults et al., 2011; de Zwart et al., 2010). However, very few investigators have assessed food safety and food handling practices during a pandemic. This present study is a

continuation of an online longitudinal study that utilized surveys in combination with focus groups and was conducted earlier in the COVID-19 pandemic (April–August) which is highlighted in chapter 3 of this dissertation (M. S. Thomas & Y. Feng, 2021a, 2021b). While very valuable information was found within the first five months, little longitudinal change in behaviors occurred. This prompted researchers to continue the study with the use of a total of nine surveys to cover 13 months of the pandemic.

Along with the surveys, an extra online focus group discussion was conducted to collect qualitative data that may help explain the quantitative survey data. Focus groups allow people to express their thoughts and opinions about an issue, product, or service through a facilitated discussion (Krueger, 2014). Using a quantitative-qualitative mixed-methods approach can increase confidence in results and further explain not only *what* is happening but also *why* it could be happening. Previous studies have utilized this mixed methods approach to assess consumer food safety perceptions and behaviors (Meysenburg et al., 2014; Parra et al., 2014).

The objective of this study was to assess consumer risk perceptions and practices throughout a one-year period during the COVID-19 pandemic using a mixed-methods approach. The data can be used by policymakers and food safety educators to understand consumer reactions regarding food safety, and they can use this information to better reach and educate consumers in the event of another major health event.

## **4.2 Materials and Methods**

Research protocols were approved by the Institutional Review Board (IRB) before data collection began (IRB # 2020-558). This study used both quantitative (online surveys) and qualitative (online focus groups) approaches to explore food safety perceptions and behavior changes among U.S. consumers. The protocols were reported in previous studies done by the

authors and in chapter 3 of this dissertation (M. S. Thomas & Y. Feng, 2021a, 2021b). In contrast to the previously reported studies, this study collected and analyzed data to identify changes over time.

#### **4.2.1 Survey study procedures**

To assess changes for 13 months, surveys were distributed in nine waves (M. S. Thomas & Y. Feng, 2021a, 2021b). Each wave occurred once a month from April to August 2020, and in October 2020, January 2021, March 2021, and May 2021. While the researchers did not gather data from the same people each month, at least 700 respondents were recruited each month from the same consumer panel, managed and distributed by Qualtrics XM. This sample size and collection method is similar to previous study assessing risk perceptions related to avian influenza from 2006-2007 (de Zwart et al., 2010).

The inclusion criteria for survey respondents were that they had to be primary food preparers, primary grocery shoppers, and at least 18 years old. Demographic screening questions regarding age, gender, income, and other characteristics were included to match the general U.S. population (United States Census Bureau, 2010). Additional demographic questions were asked to gauge the effect of household conditions on food safety practices and perceptions. For example, respondents were asked if anyone in their household would be considered at high risk for foodborne illness (Centers for Disease Control and Prevention, 2019f).

The survey design was based on previous studies related to pandemics and food safety (Bangerter et al., 2012; Barrett & Feng, 2021; de Zwart et al., 2010). Survey items included topics related to food handling practices and perceptions during the COVID-19 pandemic. To detect the respondents' level of disengagement, two survey items contained choices like "if you are paying attention, please do not select this option." These items are known as "instructional manipulation

checks” (IMCs). This study used IMCs as an additional screening component to improve the quality of information gathered because past studies showed that online survey respondents did not necessarily pay attention when completing the survey (Oppenheimer et al., 2009). Prior to launch, the survey was pilot tested among 26 consumers for face validity. Along with that, a Cronbach’s alpha test was conducted to assess internal consistency among the various scales within the survey; the alpha ranged from 0.65 to 0.91 (Pallant, 2010).

The survey data was analyzed using SPSS version 26 (Armonk, NY: IBM Corp.). Analysis was done for descriptive data, data within each month, and longitudinal data across the months. A paired samples t-test is used to assess significant differences between matched pairs of data (Xu et al., 2017). For this study, a paired samples t-test was used to compare food safety vs COVID-19 perceptions within each month. Welch’s t-test is used to compare means of two independent groups among which variance is unequal (Kent State University, 2021). Welch’s t-test was used in this study to compare levels of food handling practices against demographic data within each month. Longitudinal data was analyzed using one-way ANOVA and Games-Howell Post-hoc tests to assess differences in level of practices across the months with and without demographic factors taken into consideration (Laerd Statistics, 2017b).

#### **4.2.2 Focus group study procedures**

Survey data provide information on what was occurring, while focus group discussions among participants who engage in a discussion using open-ended questions aid in explaining these occurrences (Krueger, 2014). Previous studies related to food safety and consumer behavior have utilized this method to gather insight (Parra et al., 2014; Trepka et al., 2006). This present study uses two sets of focus group discussions; one set was conducted earlier in the pandemic as a longitudinal study in May, June, and July of 2020 (2020 sessions), and the second set was

conducted in June 2021 (2021 sessions) to gauge changes in consumer behavior and collect additional insight that may explain changes in the present study's survey data. The authors utilized the data from the 2020 sessions in previous studies that examined consumer food handling behavior, risk perceptions, and trusted sources for food safety information in the first five months of the pandemic (M. S. Thomas & Y. Feng, 2021a, 2021b). The original focus group script was also pilot tested among a convenient sample of consumers. The pilot tests gave insight to researchers that helped them create probing questions designed to evoke further thoughts and discussion from participants (Krueger, 2014).

The 2020 sessions were conducted online via WebEx (version 40.2.14.19 from Cisco, San Jose, California, USA) and the 2021 sessions were presented by means of Zoom video communications (version 5.7.6, San Jose, California, USA). Online video chatting was utilized because participants resided in different states throughout the U.S. and doing so enabled social distancing during the pandemic (Morrison et al., 2020; Woodyatt et al., 2016). The sessions lasted a maximum of 90 minutes each, with a moderator asking the questions and co-moderator taking notes. After each session, the moderator and co-moderator discussed important highlights from the session, which later aided in data analysis.

The recruitment process for the first sessions can be found in the previous studies that the authors published (M. S. Thomas & Y. Feng, 2021a, 2021b). For the June 2021 session, focus group participants were recruited from the pool of survey respondents from the May 2021 wave of the survey using purposeful sampling. Purposeful or purposive sampling is done when the researcher needs the best information from a group of people in order to reach an objective (Etikan & Bala, 2017). Volunteers for the focus groups were contacted and placed into groups based on the times and dates that they were available to meet. Because they were recruited from the pool of

survey respondents, focus group participants met the same inclusion criteria: primary meal preparers, primary grocery shoppers, and at least 18 years old.

The focus group script consisted of questions related to the COVID-19 pandemic and was separated into sections based on three topics: preventive measures, food safety concerns, and food safety information. Preventive measures included questions about the practices that participants took to protect themselves from contracting COVID-19, and their thoughts on the effectiveness of these practices. Food safety concerns include questions about participants' food safety practices, food purchasing habits, and their plans on continuing their food handling practices after the pandemic is over. In order to create a baseline understanding of how the participants felt toward food safety prior to the pandemic, researchers also asked if the participants had been aware and/or cautious of foodborne illness prior to the COVID-19 pandemic. The last section assessed the food safety information that participants had received during the pandemic, their trusted sources for this type of information, and preferred delivery format.

The focus group discussions were audio/video recorded and transcribed word for word by one researcher while the transcriptions were checked for accuracy by another researcher. The transcriptions were uploaded into N-Vivo version 12 (QSR International, Burlington, Massachusetts, USA) to be coded and analyzed using thematic analysis (Hatch, 2002). For this study, data from the 2020 sessions were compared to the 2021 sessions set to explain changes in behavior and attitudes. A separate data analysis of the 2020 sessions can be found in the previous papers and in chapter 3 of this dissertation (M. S. Thomas & Y. Feng, 2021a, 2021b). The analysis for the 2021 sessions was done by two researchers. The transcriptions were initially reviewed and analyzed by researcher 1 (R1) using an already established codebook that was previously created by the same two researchers for the first set of focus group discussions (M. S. Thomas & Y. Feng,



2021a, 2021b). Along with the deductive approach of using an already established codebook, R1 also used an inductive approach and added six additional codes that classified noteworthy responses from the participants (Fereday & Muir-Cochrane, 2006) (Appendix O). After R1 coded all the data, the second researcher (R2) verified the accuracy of the additions to the codebook and the transcriptions that were added under each code. Both researchers worked together to gain consensus and reduce bias. From these codes, both researchers selected a few that explain the data found in the survey and organized the codes into themes. The selected codes, themes, and representative participant codes are displayed in Table 4.1.

Table 4.1. Focus group codes and themes and representative quotes from participants

Code	Example quote(s)	Theme
Not concerned about food	“Not really food but ... I am scared of getting it from other people but not from food too much” (male, 35–44, May 2020).	
	“I think at first, we had food delivered and there was a salad involved and I was like, ‘Oh my gosh, should I eat this because someone else touched it?’ But I ate it anyway and then, you know, evolved after that and realized you’re not going to get COVID from eating food. It’s an airborne thing” (female, 55–64, June 2021).	
	“I thought in the beginning, like I said, I was very wary about touching anything, and then as time moved on, I said okay, I’ll eat the apple, [but] I’ll still wash it” (male, 55–64, June 2021).	
Exposure to food	“Because the times I been in the store people have been walking around touching everything and moving on, just leaving it there and, you know, I’m just not comfortable with that” (female, 65+, June 2020)	
	“It is scary though when you go to the grocery store and see someone without a mask, breathing on peppers, picking it up, smelling it, and putting it back down again. Produce has still got to get washed” (female, 55–64, June 2021).	Food Safety Perception
	“I’ve kind of avoided going to buffet style restaurants because we’re all getting up and getting food from the same container or pot, so it doesn’t seem like a good idea to me” (female, 55–64, June 2021).	
Back to Normal*	“I think just because of my lack of knowledge, I was definitely more careful. I wiped down my groceries when I got home from the store, I would leave them in the garage for two or three days to, like, disinfect or whatever. Honestly, that didn’t last long, that lasted about three weeks and I’m like, this is utterly ridiculous. So, then I honestly just pretty much went back to my normal food habits. So, nothing, no extra precautions because of COVID” (female, 45–54, June 2021).	
	“I think everything is normal here. People wear masks sometimes, people don’t sometimes, but everything is pretty much open, and I don’t feel very affected at all” (male, 45–54, June 2021).	

Table 4.1 continued

Cleaning groceries	<p>“Yeah, I do actually use the dish soap and I have an antibacterial dish soap and I just wash it off and I take a paper towel and dry it. Like if it’s an apple, for example, but if it’s a banana I don’t do that. Anything that I know that somebody else has touched the surface I would wash all the produce. For example, I have not washed the outside of an avocado because when they cut it open...there’s just certain things that...celery lettuce those are the things that I would wash” (female, 45–54, June 2020)</p> <p>“When it first started, I remember I was living with my parents, [and] we would wash every single thing we bought no matter what it was. As time went on, it kind of became more ‘well, if this is going to sit in the fridge for a couple days or sit outside, if we are not going to touch this box of crackers for a few days,’ we didn’t worry about it” (female, 18–24, June 2021).</p> <p>“Other than washing produce, I mean, meat too, you kind of have to be careful with. Before I would cook meat, get it from the store, I would run it through a little bit of cold water just to make sure, getting rid of some of that blood or chicken juice, whatever that kind of stuff, for precautionary measures. Other than that, it’s always handy to have a little spray bottle of bleach water once you’re done with everything, a bottle of bleach water, spray it around the kitchen area and everything, it seems it does good at disinfecting” (male, 55–64, June 2021).</p>
Heightening awareness of foodborne illness <sup>a</sup>	<p>“Certainly, COVID made it heightened. Absolutely, for me it heightened my awareness. Before, I probably [would] eat anything if I went into a supermarket. I might even grab a grape and steal a grape. Now I won’t do that anymore. I’m very, very cautious” (male, 65+, June 2021).</p> <p>“I think for us it did make us more aware because neither of us have backgrounds in food or anything like that, so it did make us aware” (male, 65+, June 2021).</p>

Table 4.1 continued

Awareness of foodborne illness	<p>“I would say that I pretty much been aware of, you know, foodborne illness most of my life. I mean I grew up on a ranch and so you know. You talked about, you know, you got to cook your pork, you know, this and that” (male, 55–64, July 2020)</p> <p>“Yes, I’ve always been especially conscious about foodborne illness. My mother was a dietitian and former food inspector, so I grew up with making sure I temp [check the temperature of] everything and that everything is cooked, and everything is handled appropriately, so it’s just second nature to me” (female, 35–44).</p> <p>“I’m completely guilty of not washing stuff in between because I just don’t think about it, but all the same, you see just as many reports about E. coli, spinach and stuff like that. I probably should, like, wash my vegetables longer and not just do the, run it under the sink real quick. But outside of that, I mean I check expiration dates because I did notice that especially during COVID, like, I don’t know if they were just short employees at the store or what, but there was a few times when I got stuff home and it was already expired. They just weren’t pulling stuff off the shelves” (female, 35–44).</p>
Food safety practices pre-COVID	<p>“Yeah, I think we wash fruits and vegetables — it’s just something that we’ve always done and seems like the right thing to do before COVID as well” (female, 65+, July 2020)</p> <p>“I just washed it with regular dish soap. I know it’s probably not that effective but it’s what I’ve always done” (male, 55–64).</p> <p>“I think with produce, I’m actually more concerned about pesticides and things like that than I am contamination of viruses or <i>E coli</i> or whatever. I try to buy organic whenever I can. And when I buy organic, I just rinse it off under the sink. Anything that’s not organic, and I don’t know how effective it is. I’ll buy that fruit and veggie wash that’s supposed to remove most of the pesticides from it. So, I would definitely say my concerns about pesticides and things like that are higher than my concerns about catching some foodborne illness from produce” (female, 45–54).</p>

Table 4.1 continued

Hand cleaning beyond COVID	<p>“I think it’s kind of like habit forming. I don’t think it’s a bad thing to wash your hands a lot so [I’ll] probably keep doing it” (female, 25–34, June 2020)</p> <p>“Good hand washing is personally the way to go. I mean, yeah, I’ve been using hand sanitizer more frequently, but it cannot replace hand washing, you know, I don’t think it ever will” (male, 35–44, June 2021).</p> <p>“Yes, because it’s limited the amount of colds, flus, and other viruses that can spread throughout the community” (female, 35–44, June 2021).</p>	Hand Cleaning
Practices	<p>“I’m still very diligent in washing my hands and using the hand sanitizer” (female, 45–54, July 2020).</p> <p>“At home I constantly wash my hands. Even this morning, I was washing my hands and my wife called me ‘you still wash your hands’ I’m used to washing up. I’m already vaccinated. Yeah, but I’m still scared” (male, 35–44, June 2021).</p> <p>“I’ve gotten [into the] habit of washing my hands and my face when I get home from anything with soap and water” (female, 18–24, June 2021).</p>	
Hand sanitizer woes	<p>“The sanitizer breaks my hands out, so I try to wash my hands more often. The alcohol really breaks my hands out” (female, 65+, May 2020).</p> <p>“I did not use hand sanitizer before. I really never used before, during, and I won’t use after. I’m very conscious about what I put on my skin because of what you put on your skin, you absorb into your body. I don’t freak out about it, but I would prefer that I don’t use a lot of chemicals on my body” (female, 35–44, June 2021).</p> <p>“I agree with [other participant on] the hand sanitizer. I don’t really like it. I never liked it. It, it dries my skin out and I really hate the smell. So I probably definitely won’t do that” (male, 35–44, June 2021).</p>	

Table 4.1 continued

Food delivery and takeout practices	<p>“[I] use the hand sanitizer and try to ... the two times that I got takeout, they didn’t set it down, they handed it to me, but I avoided touching their hands and then used hand sanitizer right away” (male, 55–64, May 2020).</p> <p>“When I order takeout, I would leave the outer bag outside and take the inner bag inside, and sometimes I would transfer food to another container and wash my hands thoroughly” (female, 55–64, June 2021).</p> <p>“I noted, like, if I go out that, like, I might go pick up some food that we ordered to go out, we bring it home and, like, we’ll remove it from the container and put it onto a plate. We wash our hands” (female, 35–44, June 2021).</p>	Cleaning Food and Thermometer use
Cleaning groceries	<p>“I’ve been washing, you know, produce and vegetables and fruit. I mean it’s just like running water and a kitchen brush. I don’t use soap or anything. Just run it through water for a minute or so” (male, 45–54, June 2020).</p> <p>“I used to just use water sometimes and then if I’m on the go sometimes, you know, I forget to wash my fruit, but with COVID I’ve been more careful and been washing my produce with just water. But before then I wasn’t really doing that as much” (female, 25–34, June 2021).</p> <p>“I just washed it [fruits and vegetables] with regular dish soap. I know it’s probably not that effective but it’s what I’ve always done (male 55–64, June 2021)</p>	
Not cleaning groceries	<p>“I don’t sanitize my food much and I still get fresh fruits and vegetables. My whole thing is if, you know, I sanitize my hands after getting the things before and after, I feel relatively safe as they say this is more of an airborne disease than spread by hands, even though it can possibility get on the stuff by airborne” (male, 45–54, July 2020)</p> <p>“Early on I was reading things about people need to wash down the boxes that the cereal came in and bleach your food and vegetables and that sort of thing. I never did any of that” (male, 65+, June 2021).</p> <p>“No, I did that. I did that [wiping down packages] for the first two weeks, and then I said, this is ridiculous” (male 55–64, June 2021).</p>	

Table 4.1 continued

Produce cleaning beyond COVID	<p>“Yeah, it’s all going to become second nature. It’s just going to be in our routine now” (male, 45–54, July 2020).</p> <p>“I definitely feel like I needed to be more cognizant of it because I do to worry about pesticides, and then there’s also the risk of E. coli and stuff like that because places don’t do proper handling of food. So, I don’t know that I would buy the fruit and vegetable wash. I’ve tried it before and I wasn’t sure if it made a difference or not, but I definitely know that just sticking, like, a zucchini under the water for, like, five seconds, isn’t cutting it” (female, 35–44, June 2021).</p> <p>“Yeah, I think I’ll keep using the soap for a while at least just to be safe” (male, 18–24, June 2021).</p>
Cooking to kill the virus	<p>“If it can be cooked, it’s cooked. I’m assuming that temperature will help kill virus so we’re cooking everything that can be cooked” (female, 55–64, May 2020).</p> <p>“I may have already mentioned it, but I would get food that I could reheat in the microwave because I figured that the microwave would kill any viruses before the food got too hot, so my main safety precaution with restaurant food was just reheating” (female, 18–24, June 2021).</p> <p>“We set everything down [takeout food], we go to wash our hands, and then he takes everything and microwaves it” (male, 55–64, June 2021).</p>

<sup>a</sup>This code was not used in the 2020 sessions

## 4.3 Results

### 4.3.1 Participant demographics

Appendix P includes all survey respondent information and demographics tabulated by month. A total of 6,496 respondents (700+ respondents per month) completed the survey. The survey was quota-controlled for participants’ sociodemographic characteristics to be nationally representative. In all months, 37–45% of respondents were living in a household with at least one high-risk individual, including older adults (65+) and young children (>5). Table 3.3 from chapter

3 of this dissertation display the demographics of the 43 online focus group participants who joined the 2020 sessions while Table 4.2 displays the 32 participants who joined the 2021 sessions. Most of the participants were White (non-Hispanic) and female. The 2020 sessions began with 5 sets with 6-10 people in each group and the 2021 sessions 7 sets with 3-7 participants in each group.

Table 4.2. Focus group demographic in 2021 Sessions (June 2021)

	S1 (n=4)	S2 (n=5)	S3 (n=4)	S4 (n=3)	S5 (n=5)	S6 (n=7)	S7 (n=4)	Total (n=32)
Age								
18–24	2	0	0	1	0	0	0	3
25–34	0	1	0	0	1	0	1	3
35–44	0	1	3	0	0	2	1	7
45–54	0	0	1	0	0	1	0	2
55–64	1	2	0	2	4	1	2	12
65+	1	1	0	0	0	3	0	5
Ethnicity								
White (non-Hispanic)	2	5	5	3	4	6	3	28
Black or African American	1	0	0	0	0	0	0	1
Hispanic	1	0	0	0	1	1	1	4
Asian or Pacific Islander	0	0	0	0	0	0	0	0
Gender								
Male	2	2	2	0	1	7	1	15
Female	2	3	2	3	4	0	3	17

S1 through S7 indicate the 7 different sessions that occurred in June 2021

#### 4.3.2 Food safety perceptions during COVID-19

Appendix Q displays the mean scores (0–100) of survey respondents’ food safety perceptions with significant differences throughout the pandemic, and Figure 4.1 displays a chart to visualize the trend. The concern about food safety fluctuated throughout data collection; however, the concern was lower in May 2020 than in October 2020 (Fig. 4.1). Consumers’



confidence in their food safety measures ranged from 74.75 to 78.58 throughout the months but was significantly higher in October 2020 than in April 2020. For months April 2020 to March 2021, consumers were above “somewhat concerned” (50) about contracting COVID-19 from other people, but this average dropped to less than “somewhat concerned” in May 2021 (43.31) — which was significantly lower than all other months. For all months, consumers had low risk perception of contracting COVID-19 from food, with the lowest point in May 2021 — significantly lower than April 2020, October 2020, and January 2020 (Appendix Q). When comparing perceived risk of contracting COVID-19 from people in contrast to food, the risk of contracting COVID-19 from people was significantly higher in all months (significance not shown in table).

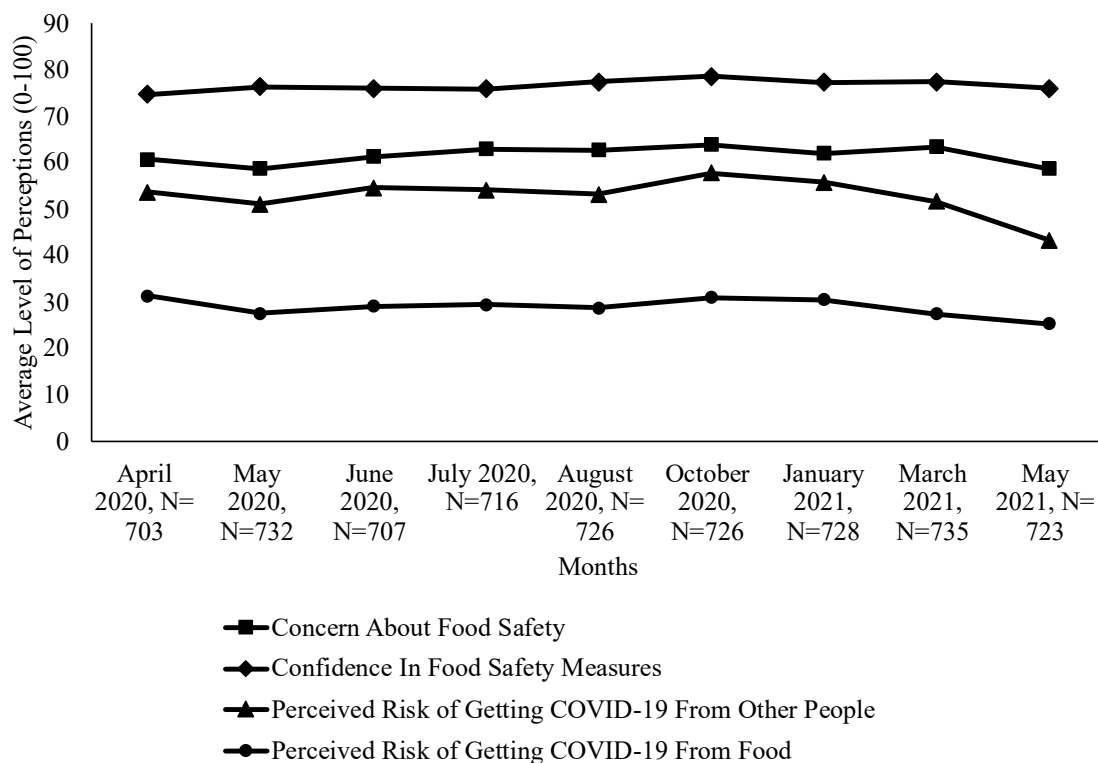


Figure 4.1. Food safety perceptions during COVID-19 (April 2020-May 2021)

Earlier in the pandemic, some focus group participants were more concerned about contracting COVID-19 from other people rather than from food: “Not really food but ... I am scared of getting it from other people, but not from food too much” (male, 35–44, May 2020). Similarly, many of the participants from 2021 sessions were not as concerned about food safety in June 2021 as they were back when the pandemic had started: “In the beginning, like I said, I was very wary about touching anything, and then as time moved on, I said, ‘OK, I’ll eat the apple, [but] I’ll still wash it’” (male, 55–64, June 2021). Those who were not concerned about contracting COVID-19 from food mentioned that it was because the virus was airborne. For both sessions (2020 and 2021), those who were concerned about their food being contaminated with the virus were uneasy about the exposure of food to other people: “It is scary, though, when you go to the grocery store and see someone without a mask, breathing on peppers, picking it up, smelling it, and putting it back down again. Produce has still got to get washed” (female, 55–64, June 2021).

While participants in the 2020 sessions mentioned different practices to protect themselves from contracting COVID-19 from food, some focus group participants in the June 2021 sessions mentioned that everything was going “back to normal” regarding their food practices. This includes how their grocery cleaning habits are more relaxed now than compared to earlier in the pandemic: “When it first started...we would wash every single thing we bought no matter what it was. As time went on, it kind of became more ‘well, if this is going to sit in the fridge for a couple days or sit outside, if we are not going to touch this box of crackers for a few days,’ we didn’t worry about it” (female, 18–24, June 2021). Some participants from both the 2020 and 2021 sessions mentioned they abided by food safety practices prior to the COVID-19 pandemic. However, one participant from the 2021 sessions claimed to implement these practices due to increased worry about pesticides rather than from bacteria and viruses. Similarly, a few

participants from the 2020 sessions indicated intention to continue washing produce because of pesticides: “I do [wash fruits and vegetables] just for pesticide use. That was what I did before, and that’s what I continue to do it for” (female, 45–54, July 2020). One participant from the 2021 sessions also described how he would also wash meat before cooking it (Table 4.1). While many participants said that they were aware of foodborne illness before the pandemic, a few noted that the pandemic had “heightened” their awareness (Table 1). While the concern of contracting COVID-19 from food was not high in either the surveys or focus groups, focus group participants still mentioned various techniques to reduce the risk of contracting COVID-19, foodborne illness, and pesticides from food. These techniques may or may not align with recommended food safety practices.

#### **4.3.3 Handwashing**

Handwashing has been a key preventive measure against SARS-Cov-2 virus and, for years, it has been a key player in preventing foodborne illness (Centers for Disease Control and Prevention, 2020k). Appendix R displays average levels of handwashing perceptions and significant differences between each month, while Figure 4.2 displays a chart to visualize the trend. During all points of data collection, consumers expressed a significantly lower perception that handwashing protects them from foodborne illness when compared to COVID-19 (significance not shown in table). Consumers in May 2021 had a significantly lower belief that handwashing protects them from COVID-19 compared to all the other months except March 2021. Consumers in May 2021 had significantly lower belief that handwashing protects them from foodborne illness than did consumers in March 2021. Likewise, the belief that handwashing offers protection from foodborne illness was higher in March 2021 in comparison to May 2020 (Appendix R).

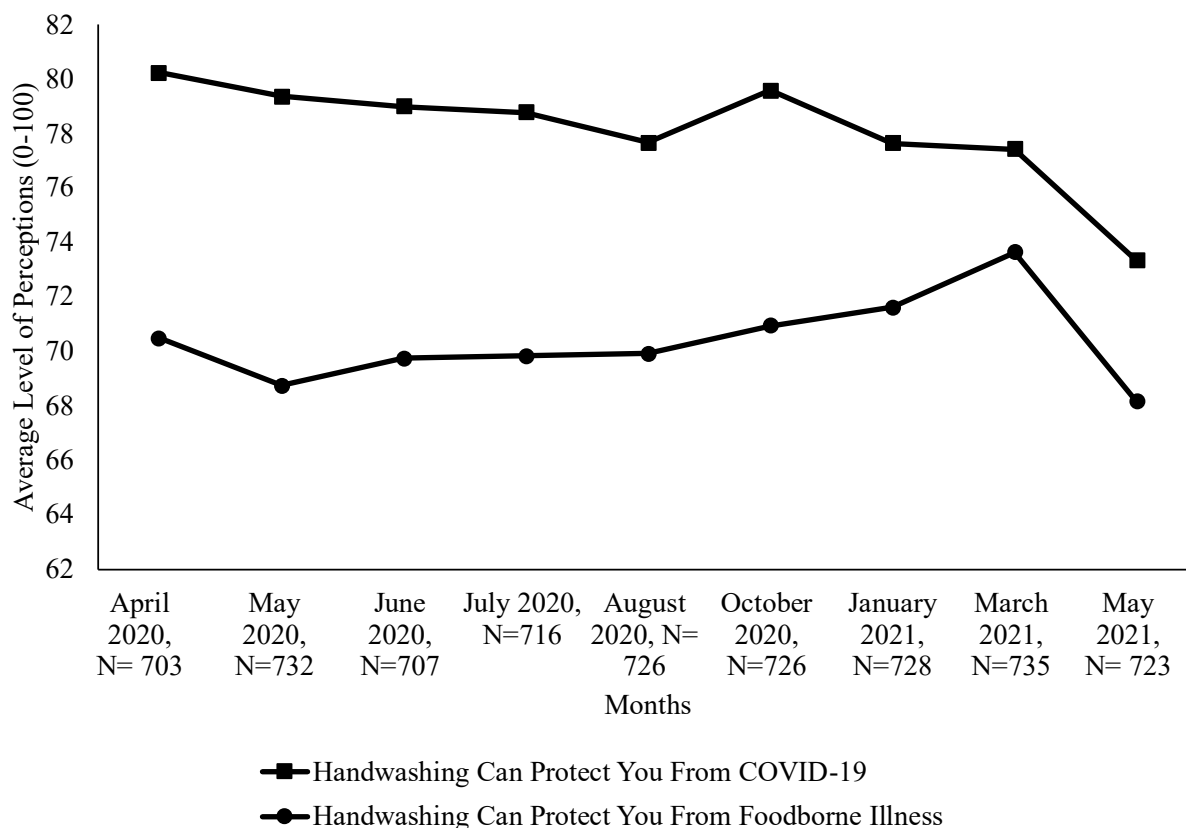


Figure 4.2. Belief of protective effect of handwashing (April 2020- May 2021)

Appendix S displays the average levels of handwashing with significant differences between months, and Figure 4.3 shows the trends visually. January 2021 had the highest level of handwashing with water only and was significantly higher than April, May, and June 2020. Overall, handwashing with soap exhibited a decrease across the months with lowest level in May 2021. This was significantly lower than what was reported in April–October 2020. Also, April and May of 2020 had significantly higher levels of handwashing with soap than January 2021. Hand sanitizer use increased from April to August 2020 but then decreased overall from August 2020 to May 2021. August 2020 levels were significantly higher than both April 2020 and May 2021. October 2020 was also significantly higher than April 2020 (Appendix S).

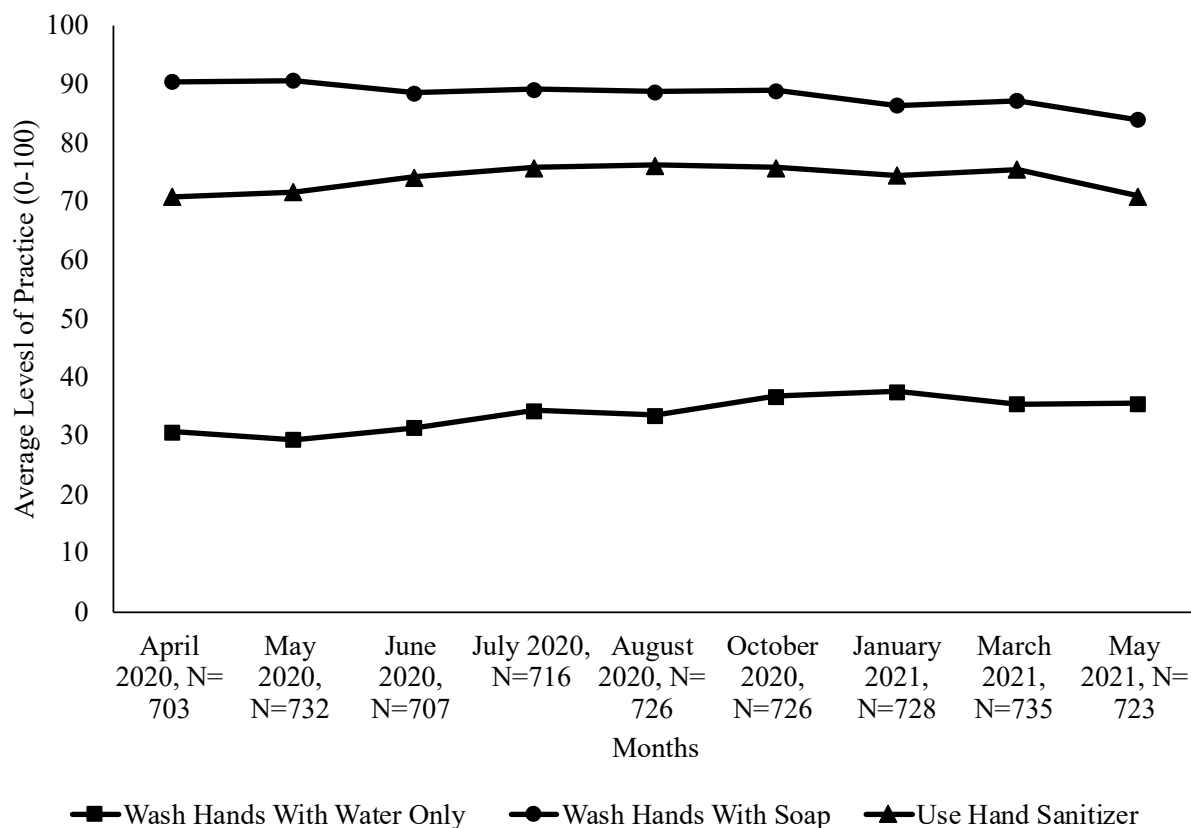
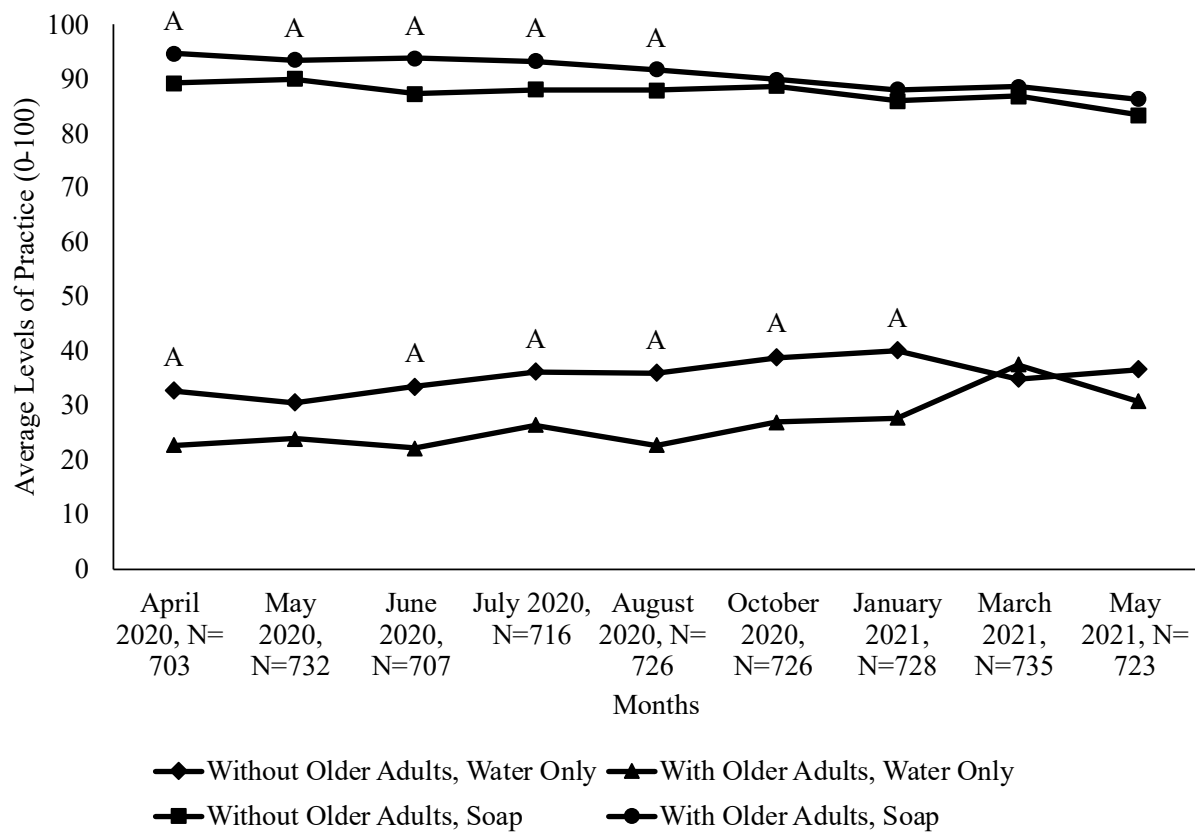


Figure 4.3. Levels of hand hygiene during COVID-19 (April 2020 to May 2021)

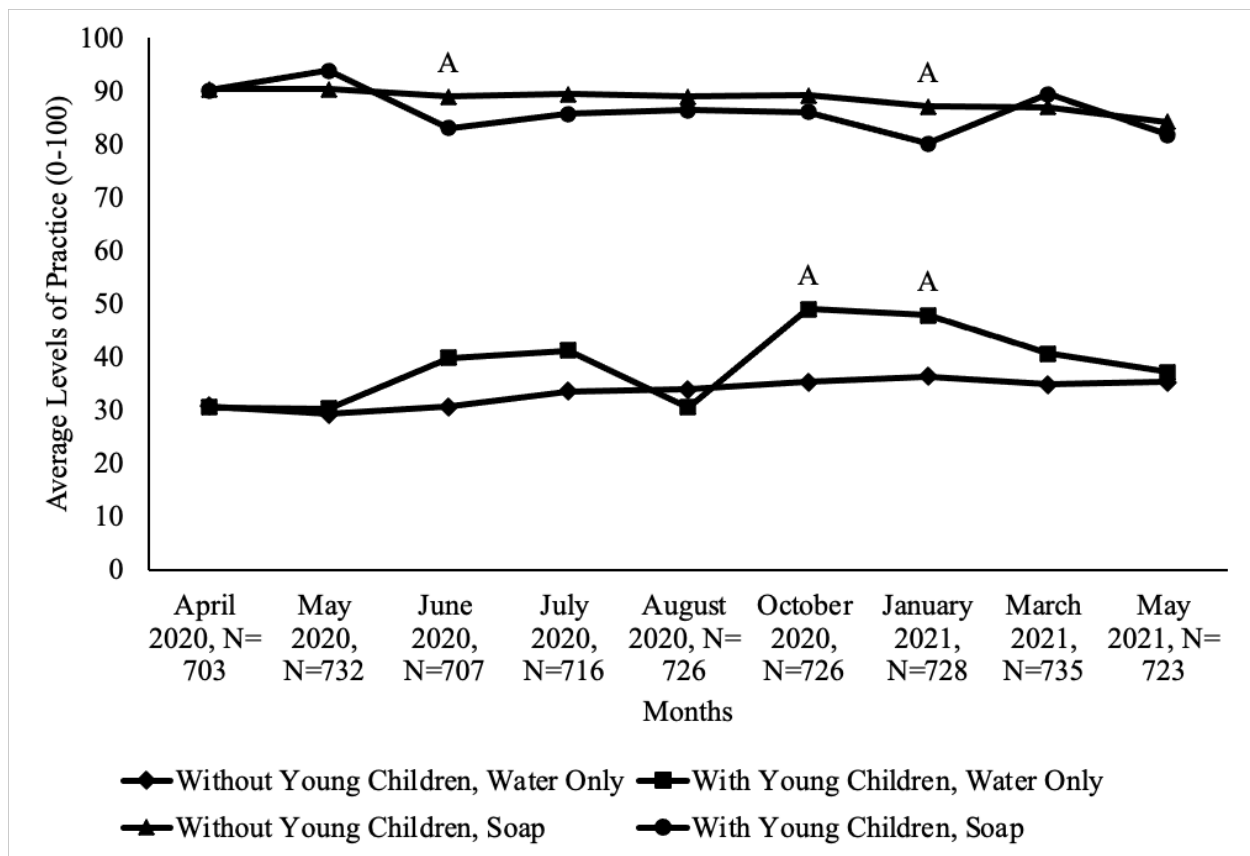
To assess high-risk individuals, researchers analyzed households with older adults (age 65+) (Fig. 4.4), and households that had young children (Fig. 4.5). For all months except March 2021, households without older adults had higher levels of handwashing with water only, with significant differences in April 2020 and June 2020 to January 2021. Conversely, for all months, households with older adults had higher levels of handwashing with soap and water, with significant differences from April 2020 to August 2020. Trends for both handwashing practices (water only and with soap) were similar; households were growing closer in their levels of practice as time moved forward during the pandemic (Fig. 4.4). While both populations washed their hands more with soap and water when compared to water only, in May 2020 and January 2021, households without children had significantly higher levels of handwashing with soap than

households with children (Fig. 4.5). However, in October 2020 and January 2021, those with young children had significantly higher levels of handwashing with water only.



*Uppercase letters indicate significant differences between handwashing practices (water only or soap) of those living with older adults and those living without older adults.*

Figure 4.4. Comparing levels of handwashing between households who have or don't have older adults (age 65+)



Uppercase letters indicate significant differences between handwashing practices (water only or soap) of those living with older adults and those living without older adults.

Figure 4.5. Comparing levels of handwashing between households who have or don't have young children (age < 5)

While participants from both the 2020 and 2021 sessions mentioned handwashing, most reported doing so more to protect themselves from contracting COVID-19 rather than foodborne illness: “At home I constantly wash my hands. Even this morning, I was washing my hands and my wife called me, ‘you still wash your hands.’ I’m used to washing up. I’m already vaccinated. Yeah, but I’m still scared” (male 35–44, June 2021) (Table 1). One participant from the 2020 session even mentioned that, prior to the pandemic, peer pressure in public restrooms caused her to wash her hands with soap: “So when I was at work, I have this peer pressure. You’re around people, and in a public restroom you must do the full hand wash.... I was just pretty much a water-

and-go person here in the house, and now I'm doing the whole happy birthday song with soap" (female, 45–54, May 2020). Focus group participants from the 2021 sessions mentioned that their practices were reverting to normal but almost all participants from both sessions claimed that they would continue washing their hands after the pandemic. They attributed this continuation to reasons including protection from other "germs," maintaining a practice that they had established before the pandemic, and because it was generally a good practice to have (Table 4.1). Many focus group participants indicated they would stop using hand sanitizer because they never used it before, it was irritating to the skin, and/or the smell was uncomfortable.

#### **4.3.4 Cleaning food**

Appendix T displays the average levels of produce-washing and food thermometer use with significant differences between months, and Figure 4.6 shows the trends visually. While survey respondents reported regularly washing their produce with water only in all the months, the lowest level occurred in May 2021, significantly lower than all the other months except January 2021. Produce washing with soap was consistent among almost every month (34.70–40.26) and while no significant difference was observed among the months, the data indicates that this practice was steady and may continue later.



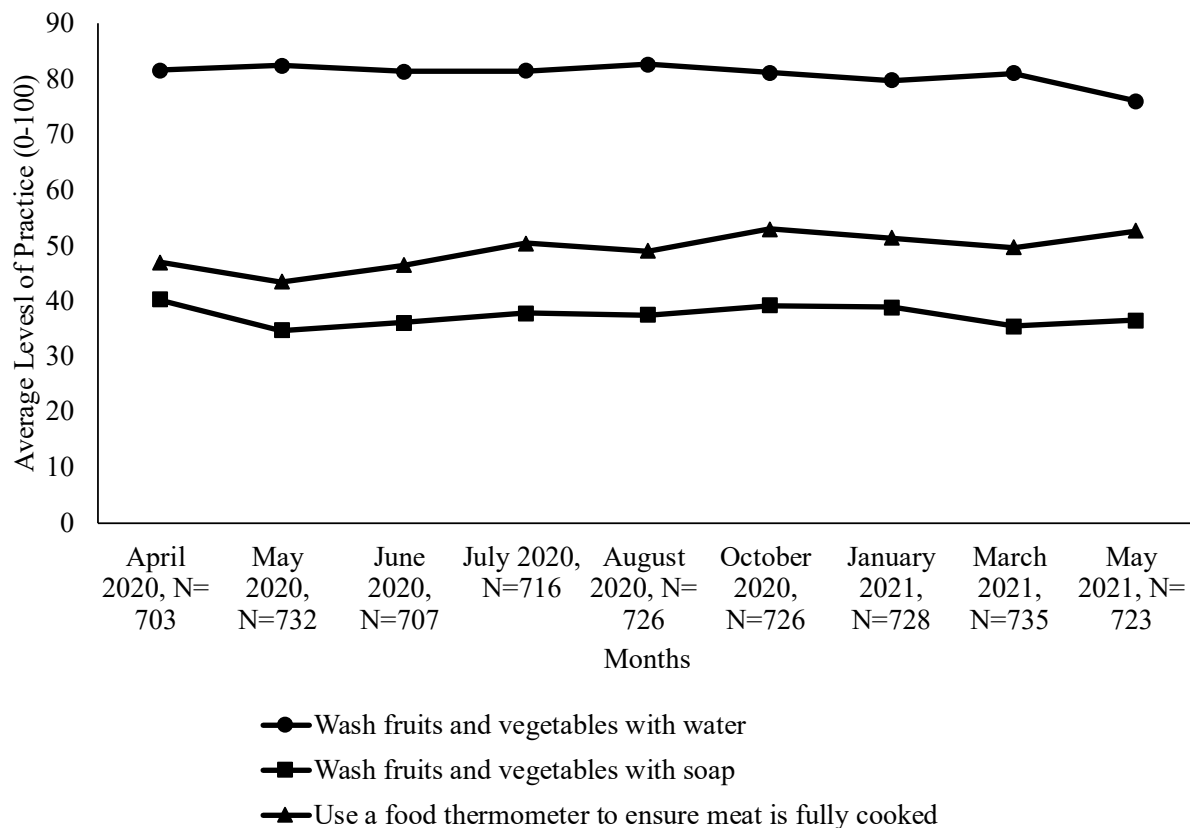
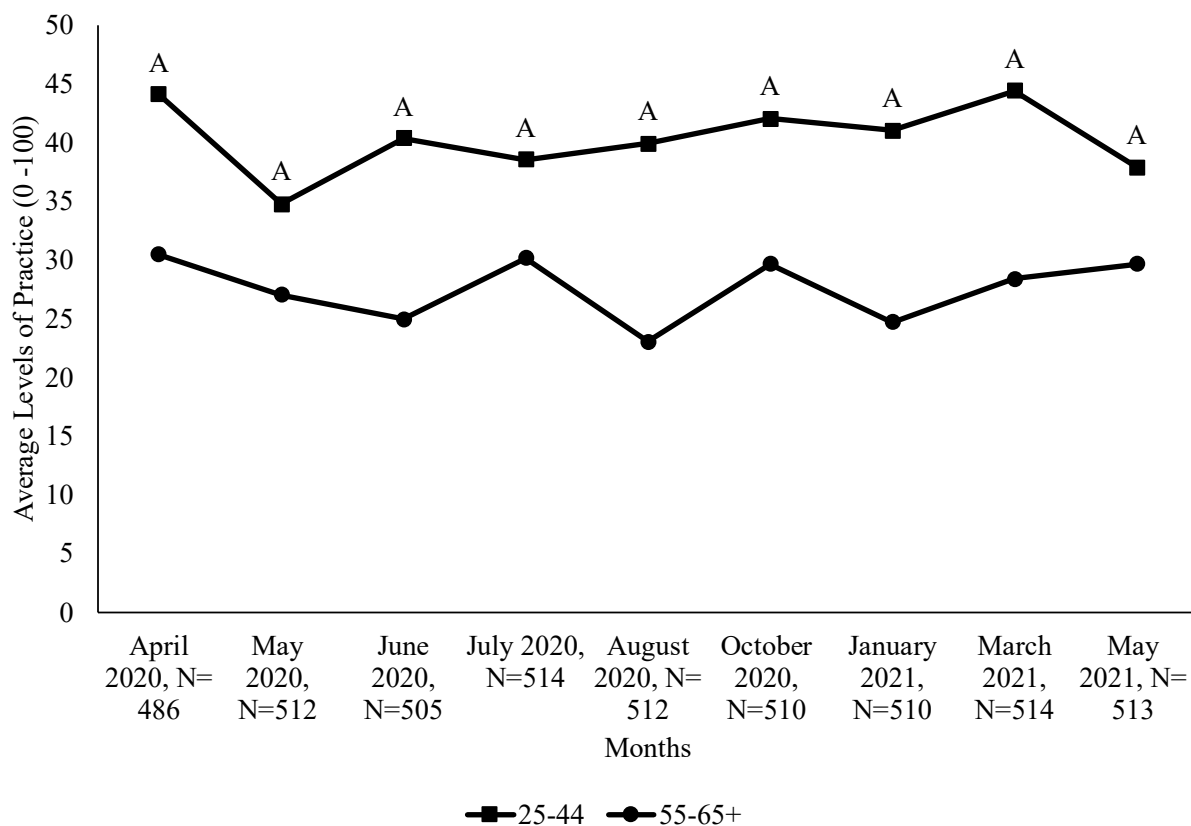


Figure 4.6. Levels of produce washing, and thermometer use during the COVID-19 pandemic (April 2020-May 2021)

The findings also revealed some differences in levels of produce washing with soap among survey respondents in different age groups; especially apparent between those who were 25–44 years old and those who were 55–65+ years old (Appendix U). The younger age group (25–44 years) had significantly higher levels of produce washing with soap when compared to the older age group (55–65+) (Fig. 4.7). Also, for every month of data collection, people in younger age groups lived with younger children (<5 years) while older age groups lived with older adults (65+years) (Appendix V).



*The uppercase letter indicates significant difference between age groups.*

Figure 4.7 Levels of washing produce with soap for those who were 25-44 years old and 55-65+ years old.

While focus group participants in 2021 said that they were resuming normal routines, participants from both sessions discussed food safety practices to prevent themselves from contracting COVID-19 from their food. Very few people mentioned that they didn't do any cleaning of food at all and most participants from both 2020 and 2021 sessions indicated that they would wash their produce with water (Table 4.1). Although more people reported washing their produce with soap and other methods (vinegar and commercial fruit washes) during the 2020 sessions, one participant from the 2021 sessions acknowledged still washing fruits and vegetables with dish soap. When asked about their intention to continue washing their produce after the

pandemic, both sessions agreed that they would continue to do so for reasons including to wash off residue from pesticides, to get rid of microorganisms, and as a good practice.

## **4.4 Discussion**

### **4.4.1 Back to normal perceptions**

The results from this study suggest that food handling practices are reverting to what they were pre-pandemic, and aspects of this change in behavior need to be assessed and explained. According to the Theory of Planned Behavior (TPB), knowledge does not directly influence behavior change; instead, other elements, including attitudes or the degree to which an individual favors the behavior, have stronger correlations with behavior change (Ajzen, 1985, 1991; Ajzen & Cote, 2008). This present study assessed attitudes in the form of consumer perceptions.

Overall, the survey and focus group data suggest that consumers were reverting from their risk perceptions and practices that they had associated with reducing transmissibility of COVID-19 from food. When compared to contracting it from other people, the data even highlighted that consumers' risk perceptions of contracting COVID-19 from food was also lower earlier in the pandemic. As focus group participants mentioned, this initial low perception may be because the SARS-CoV-2 virus is an airborne pathogen and not foodborne (Kingsbury et al., 2020).

Handwashing was a major preventive control during the pandemic as well as in everyday food handling. During the entire duration of data collection, consumers had believed that handwashing protected them more from COVID-19 than from foodborne illness. However, consumer confidence in the effectiveness of handwashing for both declined in the later months in comparison to the earlier months of data collection. According to an Ipsos poll conducted on behalf of the American Cleaning Institute, Americans were still washing their hands frequently in 2021, but 9

out of 10 had made some type of change in their handwashing habits since the pandemic began (Ipsos, 2021). Consumers may not be aware or concerned about contracting foodborne illness from unclean hands, which may cause the decline in handwashing habits to continue later in the pandemic or after the pandemic.

Along with perceptions and practices reverting to pre-pandemic levels, consumer confidence in their food safety measures was also significantly higher in October 2020 than in April 2020. One reason for this increase in confidence and decrease in risk perception may be that consumers were letting their guard down after six months of the pandemic, evidenced by the spike in COVID-19 cases around October and November 2020 (Centers for Disease Control and Prevention, 2021b). Along with the spike in cases, the number of people being vaccinated against COVID-19 around January 2021 was slowly increasing (Centers for Disease Control and Prevention, 2021c), which may explain the decreased risk perception. Even though risk perceptions decreased, some focus group participants mentioned that the pandemic had heightened their awareness of foodborne illness. While awareness and knowledge can be increased, doing so may not guarantee changes in practices or perceptions (Feng et al., 2019).

#### **4.4.2 Caution fatigue and subjective norms**

Along with lower risk perceptions, levels of recommended food safety practices such as washing hands with soap and washing produce with water decreased over time. This may be explained by lower risk perceptions of contracting COVID-19 from food and by “caution fatigue” which, according to Gollan at Northwestern University, is like an aging AA battery; people feel energized and ready to combat the virus earlier in the pandemic, but as time goes on, they feel depleted and have low motivation to stay safe (Paul, 2020b; WebMD, 2020). The lower levels of practices also may be due to optimism bias or the belief that negative consequences are less likely

to occur to oneself when compared to others (Sharot, 2011). This bias can cause consumers to engage in unsafe practices and ignore public health warnings (Van Bavel et al., 2020).

An interesting point made by one of the focus group participants was that while he was still washing his hands persistently, a comment that his wife made indicated that she had lowered her levels of handwashing. Others in the household may prompt a reduction in handwashing practices. This can be explained by subjective norms, another element of behavior change, according to the TPB. Subjective norms are attitudes of members of an individual's social group toward a behavior, in combination with the individual's attitude about conforming to those norms in response. These social pressures for behavior change can come from people the individual considers important (Ajzen, 1991). A previous study had been conducted to observe food safety practices of students and researchers found that subjective norm was a factor in their food safety practices and perceptions. These influences came from their peers and also from the cooking techniques that their parents used (Barrett & Feng, 2020).

When looking at historical evidence of past pandemics, previous research on preventive practices of people in Spain during the 2009 influenza A (H1N1) pandemic found trends similar to those observed in the present study — a decrease in the adoption of preventive measures during the pandemic (Agüero et al., 2011). Conversely from this present study, however, the previous study collected data starting from the peak of the H1N1 pandemic (December 2009) to the declining phase of the pandemic (February 2010). Meanwhile, during the data collection of the present study, the COVID-19 pandemic is ongoing, and changes are novel when compared to previous pandemic and food safety research.

#### **4.4.3 Reaching different demographics**

The data from the present study indicate that differences in demographics, especially age groups, can cause people to change or have certain hand hygiene and food handling behaviors. Older adults (ages 65+) and younger children (ages < 5) are considered at-risk populations for foodborne illness as well as other diseases, including COVID-19 (Centers for Disease Control and Prevention, 2021a; U.S. Food and Drug Administration, 2019). Washing produce with soap was significantly higher among the younger age groups (25–44 years) than the older age groups (55–65+). This difference between age groups may be due to the increased use of social media among the younger generation of consumers (Sayyed & Gupta, 2020). A previous content analysis study of YouTube videos during the beginning of the pandemic found that some of the content was ill-advised, advocating poor food handling procedures such as washing produce with soap (Thomas et al., 2021). Because information can be spread quickly digitally especially during the pandemic, this practice may have been adopted before science-based information was widely distributed. That was particularly concerning because the people in younger age groups tend to live with young children, to whom improper food handling practices may pose a health threat. Attention must be paid not only to the details about individuals but also to their household situations. It is also important to remind households that while certain individuals may be healthy, others may be at a higher risk.

This yearlong study provided valuable findings about the impact that a global health event can have on food handling practices and food safety perceptions in the context of the COVID-19 pandemic. While risk perceptions and food handling practices of consumers were heightened at the beginning of the pandemic, their initial diligence dwindled as the pandemic progressed. The causes of the “back-to-normal” phenomenon can be very complex since human behavior is not just an outcome of knowledge or awareness. While there may be even more hidden reasons,

researchers found that major events during the pandemic (surges in cases or vaccines), attitudes, subjective norms, and demographics can influence the behavior of consumers, prompting them either to adopt new practices or revert to their prior habitual behaviors. The present study also indicates that health communicators, researchers, and food safety educators need to reach different demographic groups through different platforms with science-based information.

#### **4.4.4 Acknowledgements**

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## CHAPTER 5. FOOD SAFETY COMMUNICATIONS #1: PET OWNERS' AWARENESS OF PET FOOD SAFETY

A version of this chapter has been published in the *Journal of Food Protection* on July 1, 2020 [<https://doi.org/10.4315/JFP-20-108>]. The co-author is Yaohua Feng.

### 5.1 Introduction

Pets play important roles in modern American families. Pet owners are careful to select nutritious pet food and treats for their beloved animals. Pet foods and treats have not been historically considered a source for human foodborne pathogens, but recent *Salmonella* infection outbreaks in humans have been linked to humans handling contaminated pet food (Adley et al., 2011; Behravesh et al., 2010). Various pet foods, treats, and raw animal product (RAP) diets were the source of these outbreaks. In 2018, the U.S. Food and Drug Administration (FDA) documented 90 confirmed cases due to *Salmonella* in raw ground turkey food for pets (U.S. Food and Drug Administration, 2018a). In October 2019, the Centers for Disease Control and Prevention (CDC) in the United States, documented 154 confirmed cases of *Salmonella*-infected individuals in 34 states due to improper handling of dried pig ear treats for dogs (Centers for Disease Control and Prevention, 2019e). Although *Salmonella* is the most prevalent pathogen in pet foods, previous studies have concluded that raw pet food and jerky-type treats may be contaminated by *Listeria*, *Campylobacter jejuni*, and *Yersinia* spp., which may cause illness in pets as well as owners (Morley et al., 2006; Nüesch-Inderbinen et al., 2019).

A pet's diet is one of the most important decisions a pet owner makes since it can affect the overall health of the animal (Connolly et al., 2014). Diet needs may be influenced by various factors, including the pet owners' knowledge of nutritional needs, their perceptions regarding the safety of ingredients, their views on the food industry, and trusted sources of information regarding



the needs of their pet (Michel et al., 2008; Thomson et al., 2008). Pet owners can choose from a wide array of foods, including dry pet food, canned food, meat or vegetable-based treats, homemade foods, and even raw meat or raw animal product (RAP) diets (Nüesch-Inderbinen et al., 2019; Zicker, 2008). Owners who choose to feed their pets raw meat and RAP diets claim it is “biologically appropriate”—more natural and healthier for dogs and cats than conventional pet foods (Morgan et al., 2017). Owners may or may not be aware of the risks associated with feeding their pets raw meat or RAP diets.

Pets have become treasured members of American households by providing security, therapeutic support, and companionship for their owners (Finley et al., 2006). According to the 2019-2020 American Pet Products Association’s (APPA) National Pet Owners Survey, 67% of households in the United States own a pet; cats and dogs are the most popular (American Pet Products Association, 2020). Many owners consider their pet to be a member of their family, thus close personal contact and shared environments are common practices (Chomel & Sun, 2011; Finley et al., 2006). There may be food safety risks involved when interacting with pets. Because pet owners share the same environments with their pets, the microbial risk of contamination from pets to humans may increase. A previous study by Chomel and Sun (Chomel & Sun, 2011) suggested that 50% of owners allow their dogs to sleep in the owner’s bed, while 62% of cats sleep with their adult owners. Past studies have also isolated *Staphylococcus aureus* from household pet cats and dogs which can be a source of illness for pet owners (Abdel-Moein & Samir, 2011; Bierowiec et al., 2016; Scott et al., 2009). Other common owner practices include petting, cuddling, kissing, allowing the pet to lick them, and feeding pets (Chomel & Sun, 2011).

Pet food handling practices vary depending on multiple factors: Prior knowledge, sources of information, and awareness (Laflamme et al., 2008). Feeding practices may include the tools

pet owners use (scoops, bowls, feeding toys etc.), where they feed their pets, and how often they wash their hands after feeding pets. Depending on the practice, there may be some food safety risks involved. For example, feeding pets away from human food can decrease the risk of cross-contamination from pet food or pets to human food (Centers for Disease Control and Prevention, 2017).

Risk perception is an individual's or group's judgment of the magnitude and likelihood of a negative outcome resulting from an action (Gough, 1990). This judgment may be influenced by experience, prior knowledge, and personal beliefs. Pet owners' adoption of feeding practices can be influenced by their risk perception. Therefore, an owner with a higher risk perception may have different feeding practices compared to an owner with lower a risk perception. It is imperative to understand owners' current knowledge of food safety and risk perception in order to further educate pet owners about how to mitigate potential risks. Understanding these while creating education material may ultimately reduce the number of foodborne pathogen outbreaks caused by handling pet food.

The present study utilizes an online survey to understand consumers' pet food and treat handling practices, interactions with their pets, and their knowledge of food safety risks related to pet food and treats. Along with that, this study assessed perceptions of pet owners when presented with pet-centric vs human-centric headlines. This study focused only on pet owners with dogs or cats as a convenience sample because, although there are many different types of pets, they are the most popular pets in the United States (American Pet Products Association, 2020).

## **5.2 Materials and Methods**

### **5.2.1 Pilot study**

Before data collection, the research protocol was approved by the Institutional Review Board (IRB) at Purdue University. The questions were developed by the authors and were distributed to a convenient sample of 59 dog and/or cat owners in Indiana to pilot test the face validity. Some questions were added based on participants' suggestions. The results from the pilot study highlighted some wording challenges, which included grammatical errors and overly complicated vocabulary. The researchers reworded the questions accordingly and increased the readability level.

### **5.2.2 Participants**

Participants were recruited in November 2019, from an online consumer panel of Qualtrics XM, an external online survey company. Qualtrics sent the Qualtrics-based survey to participants across the United States. Qualtrics sent invitations via email, or it showed up on the respondents' panel portal. The researcher paid Qualtrics for the access of a sample that was aligned to the specific demographics. Qualtrics XM., partnered with sample providers and had access to a pool of 90 million participants who could respond to the survey. All the participants agreed to be contacted by sample providers in order to respond to the survey. The support team ensured that participants received an incentive to complete the entire survey. Qualtrics worked with Rybbon Inc., a partner that simplifies incentives-management processes.

Participant selection criteria included pet owners who were: (a) dog and/or cat owners; (b) the primary caregivers of the dog and/or cat; and (c) older than 18 years old. In addition, quotas for demographic characteristics were set by the researchers to mirror the U.S. population (United

States Census Bureau, 2010). Two questions were developed to detect participants' level of disengagement. In this article, we referred those questions to instructional manipulation checks (IMC). Previous studies showed that some online survey respondents had disengaged behaviors and did not pay attention when filling out the questions (Oppenheimer et al., 2009). IMC was used as an additional screener to improve the quality of the study. Consumers were required to answer every question before moving to the next question. The survey took approximately 15 minutes to complete.

### **5.2.3 Survey questions**

There were 62 questions included in the survey, starting with seven screening questions: three pet ownership questions and four demographic questions. All of the survey questions can be found in Appendix W.

### **5.2.4 Screening and demographic**

The pet ownership questions included, "Do you have a pet dog or cat living with you?" "Are you the primary caregiver of the pet(s) that live with you?" and "What kind of pet(s) live with you currently?" Depending on the kind of pet(s), either dog and/or cat, the pet owner was directed to questions asking, "How many pets do you have?" and "Where do the pets live?" The four demographic screening questions were used in recruiting to help match participants' characteristics to the general U.S. population. These questions included gender, age, ethnic background, and the state in which the participant lived. Four more demographic questions were asked at the end of the survey, including household income, level of education, community type, and if they had children or grandchildren younger than 5 living with them or visiting frequently.

### **5.2.5 Interaction and practices**

All pet owners were asked questions about their interaction and their children's interaction (if they had children) with their pets, like sleeping and kissing, as well as their risk perception of contracting a foodborne illness from their pets and pet food. Additional questions queried potential food safety implications related to those interactions, like handwashing after playing with pets.

### **5.2.6 Pet food and pet treat selection**

Pet owners were then asked about their pet food or treat selections, including “dry pet-foods,” “canned pet foods,” “raw pet foods (including raw meat and/or raw animal parts),” “table scraps,” “home-prepared foods that are only for pet's consumption,” “dry (vegetable-based) pet treats, like biscuits,” and “dry (animal parts or meat-based) pet treats, like pig ears or jerky.” This is a check-all-that-apply question. Participants had the option of choosing more than one type of food that they feed their pets. If they chose dry pet foods or treats, pet owners were asked where they got it from, how they store it, and how they clean up a food spill. If they selected raw pet foods, owners were asked where they first learned about raw animal food and why they chose that kind of food.

### **5.2.7 Pet food utensils**

Pet owners were asked questions about utensils used to contain food or to feed their pets, including “scoops,” “containers (for storage),” “feeding bowls,” “feeding mats,” “food-stuffed toys, like Kong,” and “treat or training pouches.” “Kong” is a pet toy that can hold pet food as well. Pet owners were then asked how they cleaned each kind of utensil, depending on their previous answers. Cleaning methods included “rinsing with water only,” “washing with soap,” “sanitizing after washing,” and “washing in the dishwasher.”

### **5.2.8 Pet food safety knowledge and perceptions**

Questions assessing pet owners' perceptions and knowledge of pet food safety were asked. These questions measured pet owners' perceptions of food safety risks associated with food products, perceptions of news about pet food outbreaks, knowledge of pet food recalls, and trusted sources of pet food safety information. Pet owners who purchased pet foods or treats from commercial venues were asked to answer questions about their purchase intent of recalled products, their behavior after being notified the products they bought were recalled, and food labels they relied on when making pet food choices. Food labels refers to information on the packaging including "organic" and "natural".

### **5.2.9 Data analysis**

Data were analyzed using Excel 2016 for descriptive analysis, and SPSS version 26 for logistic regression and one-way ANOVA. Statistical significance was determined at a  $p$ -value  $< 0.05$ . Logistic regression was used between different groups in some demographic categories to see the strength in association of interactions, certain practices, and food choices. These demographics included if the pet owner had children living in the home (Yes vs. No), gender (Female vs. Male), and type of pet (Dog vs. Cat). The output of the logistic regression included a change in the odds ratio (OR) or the exponential function of the regression coefficient ( $e^b$ ) for each demographic category. This change is the OR associated with one unit increase of the exposure. The OR is the odds that an outcome will occur given a particular exposure compared to the outcome occurring without the exposure. In this study, the outcome is whether pet owners have a specific interaction, practice, or food choice, and the exposure is the group in each demographic category. If the OR is less than one, then one group is less likely to have an interaction, practice, or particular food choice. If the OR is 1, then the exposure does not affect the odds. If OR is greater

than 1, then one group is more likely to practice the behavior than the other group is (Laerd Statistics, 2017a; Szumilas, 2010). Previous studies have used similar methods to generate OR to analyze consumer survey data (Firestone & Hedberg, 2019; Pollard et al., 2017). One-way ANOVA was used to determine whether or not there was a significant difference between demographic groups when asked about concerns about different news headlines (Laerd Statistics, 2017b). This test generated means with 95% confidence intervals and levels of significance (p-value < 0.05).

## **5.3 Results**

### **5.3.1 Demographics**

A total of 1,507 pet owners answered the survey, 1,178 (78%) met all three criteria listed in the methods section, and 1,040 (88%) passed the IMC. This article only reports results from those pet owners who passed the IMC. Half (50%) were female, 18% were aged 25 to 34, 61% were white, non-Hispanic, 41% had some college or technical school, and 46% lived in suburban communities. Half (51%) had dogs, a quarter (26%) had cats, and another quarter (23%) had both. Nearly one-third (27%) had children or grandchildren younger than five years of age and lived with the participant or frequently visited (Table 5.1).

Table 5.1. Demographic characteristics of survey participants, N = 1040

Characteristics	Response n (%)
<b>Gender</b>	
Male	515(50)
Female	525(50)
<b>Age</b>	
18-24	135(13)
25-34	189(18)
35-44	179(17)
45-54	170(16)
55-64	167(16)
65 and above	200(19)
<b>Ethnicity</b>	
White (non-Hispanic)	636(61)
Hispanic	193(19)
African American	141(14)
Asian	50(5)
American Indians	14(1)
Other	6(1)
<b>Income</b>	
Less than \$10,000	78(8)
\$10,000-\$29,999	216(21)
\$30,000-\$49,999	255(25)
\$50,000-\$79,999	268(26)
\$80,000 and above	200(19)
Prefer not to answer	23(2)
<b>Education</b>	
Not High School graduate	24(2)
High School or GED Degree	246(24)
Some college or technical school	425(41)
Bachelor's Degree	238(23)
Graduate Degree	106(10)
Prefer not to answer	1(<1)
<b>Community</b>	
Urban	301(29)
Suburban	477(46)
Rural	247(24)
Prefer not to answer	15(1)
<b>Pet kind</b>	
Dog	529(51)
Cat	270(26)
Both	241(23)
<b>Children or grandchildren younger than 5 years old live together or visit frequently (such as once a month)</b>	
Yes	
No	280(27)
	760(73)



### 5.3.2 Interactions and practices

Table 5.2 displays the interactions and practices of pet owners and their young children. Almost all pet owners petted or cuddled with their pets. Most pet owners allowed their pets to lick them. More than half of the pet owners slept with and kissed their pets. Overall, only 31% of pet owners reported that they washed their hands with soap after interacting with their pets and 58% after feeding their pets. About half of the owners with young children allowed their pets to lick their children and allowed their children to kiss their pets. Half of owners with young children reported their children washed their hands with soap after interacting with the pets. Consuming pet food or treats was not a common practice among pet owners (8%), nor pet owners with young children (5%).

Table 5.2. Interactions and practices of pet owners and children [Check all that apply]

Interactions and Practices	Pet Owners n (%) (N=1040)	Children n (%) (N=280) <sup>b</sup>
Pet their pets(s)	962(93)	206(74)
Cuddle with pet(s)	860(83)	176(63)
Pet(s) lick them	731(70)	143(51)
Pet(s) sleep with them	655(63)	67(24)
Kiss Pets	635(61)	117(42)
Wash hands with soap after playing with pet(s)	326(31)	139(50)
Wash hands with soap after feeding pet(s)	598(58)	N/A <sup>a</sup>
Eat pet food/treats	83(8)	14(5)

<sup>a</sup> N/A indicates the question was not asked in the survey

<sup>b</sup> N=280 represents the number of pet owners who reported having children or grandchildren younger than 5 years of age living with them or frequently visiting them, such as once a month.

Dog owners and cat owners interacted with their pets differently. It was more common for dog owners to allow their pets to lick them than cat owners. Conversely, dog owners are less likely to sleep with their pets. The odds of dog owners palm-feeding their pets was 2.35 times more likely than cat owners. Female owners were significantly more likely to kiss, cuddle, and sleep with their pets than male pet owners. The odds of female owners washing their hands after feeding their pet was 1.64 times more likely than male owners. The odds of owners with young children allowing their pet to lick the owner was less likely than owners without children. It was also less likely for owners with young children to pet their pet and sleep with their pet than owners who did not have young children. On the other hand, owners with young children were more likely to wash their hands with soap after feeding their pet (Table 5.3).

Table 5.3. Logistic regression model of sociodemographic determinants of pet-interactions and practices among pet owners, N=1040 [Check all that apply]

Interactions and Practices	Having Children vs Not Having Children Odds Ratios (95% CI)	Female vs Male Odds Ratios (95% CI)	Dog vs Cat Odds Ratios (95% CI)
Kiss the pet(s)	0.77 (0.58;1.02)	2.00 (1.55;2.58) <sup>a</sup>	0.95 (0.71;1.28)
Licked by pet(s)	0.71 (0.53;0.96) <sup>a</sup>	0.82 (0.63;1.07)	1.38 (1.01;1.88) <sup>a</sup>
Cuddle with pet(s)	0.98 (0.68;1.41)	2.04 (1.46;2.84) <sup>a</sup>	1.36 (0.93;1.97)
Pet the pet(s)	0.30 (0.19;0.48) <sup>a</sup>	1.02 (0.64;1.62)	0.60 (0.34;1.04)
Sleep with pet(s)	0.60 (0.45;0.79) <sup>a</sup>	1.35 (1.05;1.74) <sup>a</sup>	0.60 (0.44;0.82) <sup>a</sup>
Wash hands with soap after playing with pet(s)	1.32 (0.97;1.78)	1.252 (0.96;1.63)	1.28 (0.94;1.74)
Feed pet(s) food from palm	1.20 (0.91;1.58)	0.97 (0.76;1.25)	2.35 (1.71;3.22) <sup>a</sup>
Eat the pet's food/treats	1.79 (1.13;2.86) <sup>a</sup>	0.73 (0.47;1.15)	1.02 (0.59;1.79)
Wash hands with soap after feeding the pet(s)	1.33 (1.00;1.76) <sup>a</sup>	1.64 (1.28;2.10) <sup>a</sup>	1.29 (0.96;1.73)

<sup>a</sup> value is significant within each demographic ( $p$ -value<0.05).

### 5.3.3 Pet food choices

Dog owners were significantly more likely to feed their pets dry vegetable-based pet treats and dry animal-based pet treats than cat owners. Dog owners were also significantly more likely than cat owners to feed their pets raw pet food, table scraps, and home-prepared food. However, the odds of dog owners feeding their pets canned pet food was significantly less likely than that of cat owners. Male owners were significantly more likely than female owners to feed their pets dry animal-based pet treats, raw pet food, and table scraps (Table 5.4). Most pet owners fed their pets dry pet foods or treats and nearly one quarter (23%) reported using raw pet foods (Appendix X).

Table 5.4. Logistic regression model of sociodemographic determinants of food choices among pet owners, N=1040 [Check all that apply]

Type of Food	Dog vs Cat Odds Ratios (95%CI)	Male vs Female Odds Ratios (95%CI)
Dry vegetable-based treats	4.71 (3.50;6.34) <sup>a</sup>	0.85 (0.65;1.10)
Dry animal-based treats	4.59 (3.33;6.34) <sup>a</sup>	1.69 (1.28;2.23) <sup>a</sup>
Canned pet food	0.40 (0.31;0.53) <sup>a</sup>	1.02 (0.79;1.32)
Raw pet food (raw meat and/or RAP diet)	1.61 (1.09;2.37) <sup>a</sup>	1.87 (1.31;2.65) <sup>a</sup>
Table scraps	2.91 (2.17;3.90) <sup>a</sup>	1.37 (1.05;1.81) <sup>a</sup>
Home-prepared food	3.03 (2.15;4.26) <sup>a</sup>	1.31(0.98;1.76)

<sup>a</sup> value is significant within each demographic ( $p$ -value<0.05).

### 5.3.4 Raw animal product diet

Most pet owners reported they learned about feeding raw meat and RAP to pets through social media, family and friends, veterinarians, YouTube influencers, and pet store employees. When asked why owners chose to feed their pets raw meat or RAP, reasons varied from improving pets' health to avoiding processed foods. About a quarter (25–30%) stated they fed their pets raw meat to prevent food allergies, to improve oral and dental hygiene, to improve the skin and coat of

the pet, to improve the pet's immune system and to give the pet to have a healthier diet. Only 13% stated that pets prefer raw meat or RAP diets (Appendix X). A little over half of pet owners who fed their pets raw meat and RAP diets washed their hands after feeding their pets, while 76% washed their hands after play. Most pet owners who fed raw meat or RAP diets allowed their pet to lick them (Appendix Y).

#### **5.3.5 Recall**

If the pet food or treats owners bought were recalled due to microbial contamination, most pet owners said they would throw it away, and some said they would clean and sanitize all contacting surfaces. Only 4% said they would continue using the recalled product. After the recall, 31% pet owners would never buy related products from the recalled brand and 23% would never buy the recalled product from that brand (Appendix Z).

#### **5.3.6 Risk perception**

Most pet owners perceived that raw meat and animal parts could pose microbial food safety risks. Low-moisture products, like dry pet-food and treats, were perceived to be low risk, with less than a quarter of pet owners choosing those products as items posing food safety risks. Less than a quarter of pet owners had heard of any pet food or treats that were involved in foodborne outbreaks or recalls due to microbial contaminations. Most received their information from TV news and social media, and some from family and friends, veterinarians, and government agencies' websites (Appendix Z).

Pet owners were asked to rate their risk perception of getting sick from pets or pet food, their children getting sick from pets or pet food, and their pets getting sick from pet food. As seen in Table 5.5, dog owners and male pet owners perceived a significantly higher risk of children

getting sick from pets and pet food than cat owners and female pet owners. Dog owners also perceived a significantly higher risk of themselves getting sick from pets and pet food. They also perceived a significantly higher risk of their pets getting sick from pet food than cat owners. Owners who did not wash their hands after play and did not eat pet food had a significantly lower risk perception of getting sick from pets or pet food. Owners who did not eat pet food also perceived significantly less risk of their pets getting sick from pet food when compared to owners who ate eat pet food. Pet owners who did not allow kitchen and dining room access to pets perceived a significantly higher risk of themselves getting sick from pet food (Table 5.5).

Table 5.5. Logistic regression model of sociodemographic determinants of risk perception among pet owners, N=1040

Risk Perception	Dog vs Cat Odds Ratios (95%CI)	Male vs Female Odds Ratios (95%CI)	Did Not Wash Hands after Play vs Washed Hands after Play Odds Ratios (95%CI)	Did not eat Pet Food vs Ate Pet Food Odds Ratios (95%CI)	Did not Allow Kitchen and Dining Room Access vs Allow Kitchen and Dining Room Access Odds Ratios (95%CI)
Children Getting Sick from Pet	3.23 (1.74;6.00) <sup>a</sup>	1.68 (1.01;2.80) <sup>a</sup>	0.66 (0.34;1.08)	1.05 (0.54;2.04)	1.47 (0.61;2.26)
Children Getting Sick from Pet Food	3.83 (2.06;7.15) <sup>a</sup>	2.17 (1.30;3.64) <sup>a</sup>	0.66 (0.34;1.08)	1.05 (0.54;2.04)	1.18 (0.77;1.81)
Owners (themselves) Getting Sick from Pets	1.75 (1.31;2.33) <sup>a</sup>	1.03 (0.79;1.35)	0.58 (0.44;0.77) <sup>a</sup>	0.56 (0.37;0.849) <sup>a</sup>	1.25 (0.98;1.59)
Owners (themselves) Getting Sick from Pet Food	1.44 (1.07;1.92) <sup>a</sup>	0.99 (0.755;1.30)	0.57 (0.42;0.76) <sup>a</sup>	0.57 (0.37;0.86) <sup>a</sup>	1.41 (1.1;1.80) <sup>a</sup>
Pets Getting Sick from Pet Food	1.80 (1.35;2.39) <sup>a</sup>	0.97 (0.75;1.26)	0.77 (0.58;1.02)	0.56 (0.37;0.85) <sup>a</sup>	1.34 (1.06;1.70) <sup>a</sup>

<sup>a</sup> value is significant within each demographic ( $p$ -value<0.05).

### 5.3.7 Perception of news headlines

Pet owners were presented with two different news headlines to assess their risk perception upon seeing the news. The news headline “143 People Got Sick from ABC Brand Dry Pet Treats” is referred to as “people-centric news” while “143 Pets Got Sick from ABC Brand Dry Pet Treats” is referred to as “pet-centric news.” As seen in Table 5.6, in general, pet owners were more

concerned about pet-centric news than people-centric news. Female dog owners who lived in urban communities were significantly more concerned about people-centric news than male dog owners who also lived in urban communities. In general, dog owners who lived in urban communities were significantly more concerned about both people-centric news and pet-centric news than cat owners who lived in rural communities. Owners who were 25 to 34 years old and of Hispanic or African American ethnicity were significantly more concerned about people-centric news than people ages 55 and above and of white (non-Hispanic) ethnicity. People of white (non-Hispanic) ethnicity also reported they were significantly less concerned about pet-centric news than people of Hispanic and African American ethnicities (Table 5.6).

Table 5.6. Mean risk perception of news headlines among pet owners, N=1040 [Very Concerned =1, Somewhat Concerned = 2, Not Concerned at all = 3]

Groups		143 People sick from ABC brand dry pet food Mean $\pm$ SD (95%CI) <sup>a</sup>	143 Pets sick from ABC brand dry pet food Mean $\pm$ SD (95%CI) <sup>a</sup>
Gender			
	Male	1.78 $\pm$ 0.74(1.72;1.85) A	1.65 $\pm$ 0.69 (1.59;1.71) A
	Female	1.61 $\pm$ 0.67 (1.56;1.67) B	1.49 $\pm$ 0.68 (1.44;1.56) B
Dog owner or Cat owner			
	Dog	1.65 $\pm$ 0.70 (1.59;1.71) B	1.55 $\pm$ 0.68 (1.50;1.61) B
	Cat	1.83 $\pm$ 0.75 (1.74;1.92) A	1.66 $\pm$ 0.74 (1.57;1.75) A
Age			
	18-24	1.70 $\pm$ 0.72 (1.58;1.83) AB	1.53 $\pm$ 0.71 (1.41;1.65) A
	25-34	1.53 $\pm$ 0.66 (1.44;1.63) B	1.49 $\pm$ 0.67 (1.39;1.59) A
	35-44	1.68 $\pm$ 0.73 (1.57;1.79) AB	1.57 $\pm$ 0.69 (1.47;1.68) A
	45-54	1.71 $\pm$ 0.71 (1.60;1.81) AB	1.59 $\pm$ 0.68 (1.49;1.69) A
	55-64	1.80 $\pm$ 0.73 (1.69;1.91) A	1.68 $\pm$ 0.72 (1.57;1.79) A
	65+	1.78 $\pm$ 0.69 (1.68;1.74) A	1.58 $\pm$ 0.67 (1.49;1.68) A
Community			
	Urban	1.58 $\pm$ 0.68 (1.50;1.65) B	1.51 $\pm$ 0.67 (1.43;1.58) B
	Suburban	1.71 $\pm$ 0.71 (1.65;1.77) AB	1.57 $\pm$ 0.69 (1.51;1.63) AB
	Rural	1.83 $\pm$ 0.73 (1.74; 1.92) A	1.67 $\pm$ 0.69 (1.58;1.76) A
Ethnicity			
	White (non- Hispanic)	1.80 $\pm$ 0.72 (1.74;1.85) A	1.65 $\pm$ 0.70 (1.60;1.71) A
	Hispanic	1.52 $\pm$ 0.66 (1.42;1.61) B	1.44 $\pm$ 0.67 (1.35;1.54) B
	African American	1.54 $\pm$ 0.67 (1.43;1.66) B	1.43 $\pm$ 0.65 (1.32;1.54) B
	Asian	1.60 $\pm$ 0.70 (1.40;1.80) AB	1.48 $\pm$ 0.68 (1.29;1.67) AB
	American Indians	1.79 $\pm$ 0.70 (1.38;2.19) AB	1.79 $\pm$ 0.70 (1.38;2.19) AB
	Other	1.67 $\pm$ 0.82 (0.81;2.52) AB	1.33 $\pm$ 0.69 (1.53;1.62) AB

<sup>a</sup> Within each group and under the same headline, values with different uppercase letters are significantly different ( $p$ -value  $<0.05$ ).



## **5.4 Discussion**

### **5.4.1 Risks of consumers becoming ill from interactions with their pets**

Some of the most common pathogens can be transmitted between humans and animals (especially pets) that live in close proximity with one another (Lambertini, Buchanan, Narrod, & Pradhan, 2016). Previous studies report foodborne pathogens like *Staphylococcus*, *Salmonella*, and enteropathogenic *Escherichia coli* have been transmitted to humans via direct contact with pets (Davis et al., 2012; Rodrigues et al., 2004; Sato et al., 2000). Almost all the pet owners in the present study had close contact with pets, including sleeping with their pets and allowing their pets to lick them. Similar instances of having close contact with pets were also seen in previous studies (Gurry et al., 2017; Laflamme et al., 2008; Lambertini, Buchanan, Narrod, & Pradhan, 2016). Such close contact, such as sharing food preparation and sleeping environments, may cause exposure and health risks to pet owners (Lambertini, Buchanan, Narrod, & Pradhan, 2016; Stull et al., 2012; Westgarth et al., 2008). Because outbreaks and diseases have been linked to pet food, there may be a possible transmission of disease via direct contact with pets who have been contaminated by pet food (Adley et al., 2011; Behravesh et al., 2010; Smith & Whitfield, 2012).

The present study reports that most pet owners allowed their pets to lick them, and about half of the pet owners palm-fed their pets. This study's findings also concluded that dog owners tended to palm-feed and allow their pets to lick them significantly more than cat owners. This may be due to dogs being more socially involved than cats (Miller & Lago, 1990). There have been health concerns about coming into direct contact with a pet's feces and saliva due to the unknown and potentially high levels of pathogens in the digestive tract of the pet (Lambertini, Buchanan, Narrod, & Pradhan, 2016). Pet owners who allow their pets to lick them or do not wash their hands

after palm-feeding could be at a higher risk of contracting infections from their pet due to contact with saliva. The risk could be higher if the pet consumed contaminated food or treats.

Over half the pet owners in the present study reported they slept with their pets and were more likely to do so if they were cat owners. Sleeping with pets puts owners in closer contact since they are sharing the same bed, sheets, and blankets. Pets may shed harmful bacteria which can get on to the bed or sheets the owner also uses. Dr. Jane Heller from Charles Sturt University notes that since pets are not sterile, there is a risk of transmitting pathogens from pet to owner, especially in sleeping situations (ABC Health and Wellbeing, 2011). Other ways of transmission are indirect through contaminated surfaces, including floors, food contact-surfaces, and aerosols. Allowing pets into the kitchen may have health implications for humans due to cross-contamination with human food (Fischer et al., 2007). Cross-contamination may occur if a pet owner pets their pet and then handles human food or human utensils without washing their hands. Pet owners who did not allow their pets into the kitchen or dining room, where owners cook and eat, perceived a higher risk of themselves becoming ill from pet food. This connection between a perceived higher risk of getting sick from pet food and feeding pets in a location away from human food areas may exist because pet owners are concerned about human food becoming contaminated by pet food. The CDC also recommends storing pet food far away from human food and preparation areas to reduce contamination (Centers for Disease Control and Prevention, 2017).

#### **5.4.2 Risk of consumers becoming ill from handling dry pet food and treats**

Similar to past studies, most of the pet owners reported feeding their pets dry pet food and dry pet treats (Laflamme et al., 2008; Sallander et al., 2010). Very few pet owners reported that low-moisture foods like dry pet foods, treats, and raw nuts pose a microbial food safety risk. This study is consistent with a study by Feng (Feng & Archila, 2020), where consumer handling and

knowledge of flour food safety risks were examined. Several recent outbreaks were associated with low-moisture foods like flour, pistachios, and dry pet food (Behravesch et al., 2010; Centers for Disease Control and Prevention, 2019c; Feng & Archila, 2020). Many consumers are unaware of these cases. From January 2012 to July 2012, 53 cases of *S. enterica* illness were linked to dry dog food (Imanishi et al., 2014). Another recent outbreak occurred in October 2019 when dried pig ear treats caused 154 cases due to *Salmonella* (Centers for Disease Control and Prevention, 2019e).

A previous study reported that an outbreak strain of *Salmonella* had been found in unopened bags of dry dog food from a factory (Behravesch et al., 2010). The researchers in the study indicated their suspicions that the pet food was re-contaminated via cross-contamination after the kill step. Dry pet foods can be a vehicle for pathogens since microorganisms have been found to survive the drying process in dehydrated foods. Although metabolism is greatly reduced in a desiccated state, vegetative cells and spores may be viable for several years. Very few cells are needed to cause disease by foodborne pathogens, such as *Salmonella* and *E. coli* O157:H7 (Beuchat et al., 2013). Pet food can contain foodborne pathogens that are not active in the dehydrated state but may become an issue if in the hydrated state. Bacterial cultures are known to be in a dehydrated state before they are enriched to be used for inoculation in microbiology studies (Beuchat et al., 2013). Hydration can occur through wet utensils, wet hands, saliva from the pet's mouth, or even transfer of water from the pets' water bowl. A previous study where researchers estimated the exposure *Salmonella* from dry pet food to pets and humans, reported that exposure may be the highest when transferred from pet food to human food at favorable conditions (Lambertini, Buchanan, Narrod, Ford, et al., 2016). This can happen from humans touching the contaminated pet food and not washing their hands before handling food. The researchers also

indicated that exposure can decrease if hand washing is done after handling the pet food (Lambertini, Buchanan, Narrod, Ford, et al., 2016).

#### **5.4.3 Risk of consumers becoming ill from raw animal product and raw meat pet food**

About a quarter of pet owners in this study reported they fed their pet raw animal products (RAP) and raw meat. A quarter of the owners claimed the RAP and raw meat diet would prevent food allergies and improve the overall health of the pet. A previous study found similar results where health was an important factor in pet owners' decision to feed their pet RAP diets (Morgan et al., 2017). Conversely, past studies claimed that RAP and raw meat diets are nutritionally inappropriate for pets depending on the species and pet life stage (Freeman et al., 2013; Morgan et al., 2017). It is important to consult veterinarians on topics related to pet nutrition, and while some pet owners do, many rely on sources other than the veterinarians, like the internet and media (Laflamme et al., 2008; Morgan et al., 2017). This study found less than half of pet owners who fed their pets raw meat and RAP diets learned this practice from veterinarians. Most learned from social media outlets. This finding is similar to the findings of a survey conducted by Morgan, Willis, and Shepherd in 2017 (Morgan et al., 2017), which revealed that owners who fed their pet RAP diets trusted their veterinarians less and relied more on online resources. RAP and raw meat diets to pets are actually discouraged by the American Animal Hospital Association (AAHA), the American Veterinary Medical Association (AMVA), and the FDA (American Veterinary Medical Association, 2012; U.S. Food and Drug Administration, 2018b). This is not only due to RAP diets' nutritional deficits but also the fact that pets may contract bacteria and zoonotic parasite diseases from raw meat. RAP diets have been associated with pathogenic foodborne bacteria such as *Salmonella*, *L. monocytogenes*, *Campylobacter* spp., and *E. coli* (Morgan et al., 2017). Humans may contract pathogens from pets even if the pet does not exhibit clinical signs of illness because

pets can carry and shed pathogens in their feces (Leonard et al., 2011). The present study reported that dog owners were more likely than cat owners to feed their pets RAP diets. Lenz et al. (Lenz et al., 2009) reported that dogs who were fed raw meat had a higher risk of shedding *Salmonella* than dogs who were not fed raw meat. For cats, there is the risk of toxoplasmosis if cats are fed raw meat containing *toxoplasma gondii* (Cornell Feline Health Center, 2018). Cats are definitive hosts and can shed this parasite through the feces and owners have the risk of contracting toxoplasmosis when they clean cat litter or come into contact with fecal matter (Cornell Feline Health Center, 2018; Dabritz & Conrad, 2010).

If pet owners decide to feed their pets RAP diets, the FDA advises that owners should wash their hands afterwards, not allow their pets to lick them, disinfect contact surfaces, and store leftovers properly (U.S. Food and Drug Administration, 2018b). These suggestions reinforce the importance of handwashing after handling pets and feeding pets. The current study found that a little over half of the pet owners who fed their pets RAP washed their hands after feeding. However, the majority of pet owners who fed their pets raw meat allowed their pets to lick them. Pet owners may be more aware of pathogens transferred from raw meat to hands than from pets' saliva to humans.

#### **5.4.4 Risk perception between male and female pet owners**

There was a difference in risk perception between male and female pet owners. Male pet owners perceived a significantly higher risk of children getting sick from pets and pet food than female pet owners. These results contradict previous study findings where women tend to have higher risk perceptions than men in non-food related situations (Davidson & Freudenburg, 1996; Hitchcock, 2001). Some researchers explained this phenomenon by saying that men tended to have higher knowledge and self-confidence in controlling risks (Davidson & Freudenburg, 1996; Flynn

et al., 1994; Graham et al., 1999). However, this study reports a shift to women having a lower risk perception than men in some areas of pet food safety. When it comes to food preparation, women tend to have more confidence because they have more knowledge in this situation (Schaeffer, 2019; Taillie, 2018). Having more confidence around food and food preparation may be a reason why women have a lower risk perception connected to pet food.

#### **5.4.5 Consumers' response to food recall news headlines**

This study showed that pet owners perceived stronger sentiment when reading a news headline reporting pets becoming ill from pet food, which implied that the communication strategies for pet food recalls could be different from strategies used for human food recalls. The news headline can influence the way readers perceive the contents of the rest of the article (Ecker et al., 2014). When informing pet owners of pet food recalls, referring to the potential risk for pets can resonate better among pet owners. Pet owners may consider their pets in a humanistic way, thinking of them as their children or close friends. The relationship can be so important that owners consider their pets to be more important than their human friends and family (Blouin, 2013). Sociologist Jennifer Greenebaum (Greenebaum, 2004) reported that people think of their pets as friends, children, and even “fur babies.” Pet owners become responsible for their pets by caring for and protecting them just as they would their own children or family members. Another reason that pet owners were more concerned about pet-centric news may be due to optimism bias among pet owners. Optimism bias is the difference between expectations and the actual outcome of a situation. When expectations are better than the actual outcome, the bias is “optimistic” (Sharot, 2011). Pet owners might assume the people who got sick had eaten the pet food and believe they will not get sick because they do not eat pet food. This may also be an indication that there is less awareness of other ways a person can become sick from pet food.

This study found that many pet owners are not aware of pet food recalls or outbreaks that have been associated with foodborne pathogens. Pet owners may also lack knowledge of safe pet food handling practices. Many of them reported not washing their hands after feeding or playing with their pets. The findings of this study identified the need for consumer education programs concerning pet food handling. The data collected can also assist in developing more accurate risk assessment models related to pet food handling.

Though the researchers carefully developed and conducted the survey, there were several limitations. This study attempted to obtain a sample that mirrored the general population of pet owners in the United States. However, the results of this survey cannot be generalized for all pet owners in the United States. Pet owners who participated were also recruited online via Qualtrics Inc. There might be pet owners with different experiences who did not have access to the online survey. Secondly, the behavior in this study is self-reported rather than observed. Pet owners may choose certain answers because they think it is the correct choice instead of what they actually do (Borrusso et al., 2015). Thirdly, this study only focused on cats and dogs because they were the most popular pet in the United States, but there are pet owners who may have other types of pets as well. Lastly, due to the length of the survey, some food safety questions were not asked. An example of this could be asking about homemade pet food. Food safety concerns can occur from how homemade pet food was prepared, what it consists of, and how pet owners learned about this type of diet for their pet. Although questions about young children were asked, questions related to risks for elderly people can be added since this group tends to be among the immunocompromised. Future studies can be conducted to address these limitations by the addition of more pet owners, expanding to other types of pets, and following up with more targeted questions. Below are some recommendations that were developed based on the results of this study.

- Consumer food safety programs focusing on safe pet food handling should be developed to minimize the risk of foodborne illness from pets and pet food. The programs should enhance pet owners' knowledge and change their behaviors related to safe pet food handling, including handwashing after feeding and interacting with pets, and keeping pet food away from human food.
- Educators who develop pet food safety materials should be aware of current trends in pet food and feeding practices. This is necessary in order to take preventative measures and address possible risks before issues arise. Since most pet owners reported receiving information about pet food from television and social media, those media platforms should be utilized to delivering pet food safety educational programs and informing pet food recalls and outbreaks.
- Effective pet food outbreak and recall communication strategies need to be developed targeting pet owners. Pet owners care about their pets' health. When developing communication strategies, the impact of foodborne pathogens on pet health should be mentioned, in addition to that on human health.

## **5.5 Acknowledgments**

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## **CHAPTER 6. FOOD SAFETY COMMUNICATION #2: AN EYE-TRACKING STUDY OF FLOUR SAFETY MESSAGE EVALUATION**

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### **6.1 Introduction**

Raw flour and other low-moisture foods are not traditionally considered a source of foodborne illness because its water activity ( $A_w$ ) is less than 0.85 and bacteria growth doesn't usually occur below this point (Mermelstein, 2018). However, past outbreaks in these types of foods — such as peanut butter, rice, and wheat cereal — have caused foodborne illness in consumers (Dag et al., 2022). Flour is a food of interest because it is a staple food ingredient in many consumer households and is used in many items, including other baking mixes and cookie doughs (Feng & Archila, 2020). From 2009 to 2019, six foodborne outbreaks in the U.S. and Canada were caused by wheat flour and flour products (Harris & Yada, 2019). In 2019, a multi-state outbreak of *E. coli* in flour caused 21 cases and three hospitalizations (Centers for Disease Control and Prevention, 2019d).

Consumers may not be aware of the repercussions of improper flour handling or even that any recalls have been related to it (Beecher, 2019; Feng & Archila, 2020). In a study by Feng and Archila, 85% of participating consumers reported having never heard of flour recalls or outbreaks (Feng & Archila, 2020). In the same study, while 85% were confident in their flour handling, only 46% of those who cleaned their counters said they included a sanitizing step. If food contact surfaces are not properly cleaned and sanitized, potential pathogens can infect individuals via cross-contamination (Centers for Disease Control and Prevention, 2020d, 2020j). Along with improper handling of raw flour products, many consumers throughout the ages have been eating

or tasting raw doughs or batters (Feng & Archila, 2020; Klontz et al., 1995). It is important to effectively encourage consumers to properly handle flour and to refrain from consuming it raw.

While many flour and baking mix packages contain warnings against consuming raw dough or batter, for various reasons those messages may not as effective as they could be. Only 22% of consumers participating in a previous study even paid attention to flour safety messages on packages (Feng & Archila, 2020). Many factors can deter consumers from noticing or paying attention to these messages. Some of these may include the location on the packaging, the proximity of the message to other content on the package, the size of the message box and text, and color of the box and type. While the first step is to entice consumers to notice the message, the next step is to ensure that they understand the message and that it encourages them to practice proper behaviors. Previous studies indicate that the structure of the content (including stated benefits, reasonings, and other information) can greatly influence the effectiveness of a message (Chapman et al., 2010; Feng et al., 2016). Producers should communicate with consumers and document their comments carefully as part of a careful assessment of which factors can enhance consumer attention and retention of flour safety messages on packages.

Observations are an effective way to assess needs in real-time. One way to track what consumers are looking at and how fast they can find messages is to record consumer eye movements using eye-tracking technology. Eye-tracking most commonly uses a technique that records the corneal reflection of infrared lighting to determine the pupil position. This allows the mapping of a person's gaze and where they are focusing their attention (Chamberlain, 2007; Tien et al., 2014). This also allows researchers to collect metrics like fixation count — how many times a person focuses on an area of interest (AOI) — and time to fixation (TTF) — how long it took to reach the AOI (Pham et al., 2018; Tien et al., 2014). The TTF is useful for eliminating human error

in determining how long a person requires to find the flour safety message on a food package. Eye-tracking also can be used to assess what a person focuses on most often prior to finding the AOI and enables researchers to identify packaging elements that may be distracting consumers from noticing flour safety messages quickly. Distractions can include graphics or extra content, such as recipes and instructions.

The objectives of this study were (1) to utilize eye-tracking technology to accurately assess if consumers were able to find the messages on commercial flour and baking mix packages, and how long it took them to find the messages within a given timeframe; and (2) to assess attitudes and perceptions toward flour safety following the activity, to evaluate whether consumers would have a change in behavior intention.

## **6.2 Materials and methods**

Study protocol was approved by the Institutional Review Board (IRB) at Purdue University IRB-2021-252 and pilot tested to improve techniques for data collection. The form of consent was signed by participants.

### **6.2.1 Participant recruitment and check-in procedure**

The study took place July-September of 2021 and participants were recruited via a qualification survey using convenience sampling and snowball sampling methods. In the early stages of the participant recruitment, the Qualtrics XM consumer panel was used to reach qualifying individuals. However, due to the minimal responses, researchers decided to advertise the survey via flyers and snowball sampling. The qualification survey contained questions that would match the inclusion criteria for participating in the in-person study: primary food preparers or grocery shoppers for the household, use of wheat flour or wheat baking mix at least once a

month, at least 18 years old, and ability to travel to the site of the study. Wheat flour included all-purpose flour, whole wheat flour, bread flour, cake flour, and other similar products. Baking mixes included cake mix, cookie mix, biscuit mix, pancake mix, muffin mix, brownie mix, and other similar products. Following recruitment, each participant was offered their choice of an hour-long time slot during which to complete the study. For completion of the whole study, participants each received an incentive of \$75 USD to compensate them for their time and contributions.

After their arrival at the study site, participants were instructed to check in outside the study room. During check-in, they were given a consent form to sign and a pre-survey to fill out. The pre-survey contained 11 questions and assessed what type of wheat flour or baking mixes they used, if they sneaked a taste of raw flour products (cookie dough, cake batter, or bread mix), years of meal preparation experience, and demographic information (including gender, age, and ethnicity).

### **6.2.2 Eye-tracking**

The current study utilized eye-tracking technology to accurately assess the time to first fixation (TTF) or the time they required to visually find and recognize the area of interest (AOI) (Pham et al., 2018). The AOI for this study was the flour safety message on the packaging. These messages contain warnings against eating or playing with raw dough or batter. The messages may contain other information, such as handling instructions and proper storage tips. Participants were asked to wear Tobii Pro Glasses 3 eye-tracker glasses (by Tobii Pro AB, Stockholm, Sweden). Analysis of eye-tracking data was done using the Tobii Pro Lab software (version 1.171.34906) to find the TTF for all packages and to create gaze plots for further analysis of one package. Gaze plots show spots on the package where the participant had a fixation and allow assessment of points at which they looked at first.

### **6.2.3 Commercially available packages**

This study involved the use of 10 wheat flour and baking mix packages that researchers randomly selected from a chain grocery store (in West Lafayette, IN, USA). Prior to the random selection of packages, researchers had assessed all the flour and baking mix packages in the grocery store for flour safety messages and created a list of packages that contained flour safety information. Flour safety messages included text on the package warning consumers from consuming raw dough or batter and some messages included how to handle the flour (washing hands and cleaning surfaces). The random selection involved five packages with long messages (more than one sentence) and five packages with short messages (only one sentence). Two of the selected “long message” packages contained two separate messages. One of these two packages contained one short and one long message, but the package was still categorized as a “long message” package (Appendix AA).

The 10 packages were placed on the table in random order, and participants were allotted a maximum of 20 seconds to find the flour safety message on each package. Before participants moved on to another package, researchers re-started the timer, and the participants were told to focus on another point in the room during the transition in order to avoid looking at the next package prematurely. The time limit of 20 seconds was chosen based on previous eye-tracking research showing that consumers needed an average of 12.2 seconds to review a package and make a purchasing decision, as well as on another nutrition label eye-tracking study in which participants were given 20 seconds to view a food package (Bix et al., 2015; Leong, 1993). Participants who did find the flour safety message were instructed to place that particular package to the side, and they were later given a set of statements that they had to rate on a Likert scale (1–7) based on their perceptions of each of the flour safety messages they found with 1 being strongly disagree and 7 being strongly agree. The statements from which they had to choose were: (a) This flour safety

message was easy to find, (b) this message was the perfect length for a flour safety message and, (c) in general, I prefer my flour safety message to be like this. To make sure that the participant had found the correct flour safety message, researchers asked participants to read the message aloud.

#### **6.2.4 Interview and post-survey questionnaires**

After the eye-tracking activity, researchers conducted a brief interview containing questions about their experience with flour safety messages and their perceptions of those messages, their baking habits, and their use of ready-to-eat foods. Participants were also asked what other information they would like to see regarding flour safety messages. The interviews were created among researchers and finalized after consensus. The interview contained 13 questions. Following the interview, participants filled out a short post-survey questionnaire to wrap up the study. The post-survey contained six questions that pertained to perceptions about flour safety messages and participants' overall experience completing the study.

Post-survey responses were analyzed for descriptive data using Microsoft Excel (version 16.58). The interviews were mainly analyzed using a deductive coding method for the responses from the questions asked, but also included some inductive coding for some noteworthy answers. The codes were further analyzed using a thematic approach (Fereday & Muir-Cochrane, 2006). The codebook was created by the main researcher's analysis of the first 10 interviews using NVivo software (version 12.6.1) to organize the transcripts and codes. For further development of the codebook, another researcher independently coded three transcripts using the initial codebook and worked with the first researcher to reach consensus on the codebook (Appendix BB). Once the codebook was developed, the main researcher coded the remaining interviews and the same second

researcher checked the contents under each code to make sure that the contents matched the definition of the codes.

### **6.2.5 Measuring type size**

To investigate the influence of type size on accessibility of the flour safety messages on the packages, researchers measured the size of the type in millimeters. The body size is the distance from the tip of the highest ascender (top of the letter) to the lowest descender (bottom of the letter) of the tall letters (Brógáin, 1983). In this study, the first letter was measured for each message. Our measurement excluded headings such as the phrases “Warning” or “Safe Handling Procedures.” One researcher measured the letters while another checked for accuracy. If packages contained more than one message, both messages were measured.

## **6.3 Results**

### **6.3.1 Participant demographics**

Due to COVID restrictions, researchers recruited 47 participants to complete the study, and their demographic information can be found in Table 1. Majority of the participants were non-Hispanic white (53%), and people identifying as Asian/Pacific Islander constituted the second-largest group (36%). Over half of the participants were 25–34 years old, females, or had a graduate degree. Many of the participants (66%) had over five years of meal preparation experience and lived by themselves or with one other person. Most of the participants bought all-purpose flour (94%) followed by baking mixes like cookie mix, cake mix, and brownie mix (64%). Over half had tasted raw cookie dough (70%) and raw cake batter (53%) while baking (Table 6.1).

Table 6.1. Demographic information of participants (N=47)

<b>Question</b>	<b>%(n)</b>
<b>What type of flour or baking mix do you buy?</b>	
All-purpose flour	94(44)
Whole wheat flour	55(26)
Bread flour	40(19)
Baking mix (like cookie mix, cake mix, biscuit mix, pancake mix, muffin mix, brownie mix)	64(30)
Other	11(5)
<b>Do you sneak a taste of the following items?</b>	
Raw cookie dough	70(33)
Raw cake batter	53(25)
Raw bread dough	30(14)
None of the above	23(11)
<b>What is your gender?</b>	
Male	32(15)
Female	68(32)
<b>What is your age?</b>	
18-24	19(9)
25-34	62(29)
35-44	9(4)
45-54	9(4)
55-64	2(1)
65 and above	0(0)
<b>What is your ethnicity? (Select all that apply)</b>	
White (non-Hispanic)	53(25)
Hispanic	2(1)
Black or African American	6(3)
Asian or Pacific Islander	36(17)
Native American	0(0)
Other	6(3)
<b>Would you give us a guess of your total household's income (previous year) before taxes?</b>	
Less than \$10,000	0(0)
\$10,000 - \$29,999	51(24)
\$30,000 - \$49,999	9(4)
\$50,000 - \$79,999	13(6)
\$80,000 and above	21(10)
Prefer not to answer	6(3)



Table 6.1 continued

<b>What is your education level?</b>	
Not high school graduate	0(0)
High school or GED degree	11(5)
Bachelor's degree	28(13)
Graduate degree	62(29)
Prefer not to answer	0(0)
<b>How many years of experience do you have in preparing meals?</b>	
Less than 1 year	2(1)
1-3 years	9(4)
3-5 years	23(11)
Over 5 years	66(31)
<b>How many people (including yourself) live in the household?</b>	
1	34(16)
2	32(15)
3	13(6)
4	13(6)
5	9(4)
More than 5	0(0)
<b>Do you or the people living in the household have the following conditions? (Select all that apply)</b>	
Children younger than age 5	15(7)
People ages 65 and over	2(1)
Diabetes	0(0)
Immunocompromised, including organ transplant patients, HIV/AIDS, and cancer	2(1)
None of the above	83(39)

### 6.3.2 Accessibility of flour safety messages on commercial flour and baking mix packages

Table 6.2 displays the percentage of participants who were able to identify the flour safety message on packages. Corresponding package codes use the letter “S” to indicate packages with short messages and “L” to indicate packages with longer messages. Only two participants (4.3%) found all the messages on the 10 packages (data not shown in table). While most people found the message on S4 (98%), only 15% of the participants preferred that message out of all the messages

they found. S4 also had the lowest TTF of 7.08s (Fig. 6.1). On the other hand, S5 had the highest TTF of 13.04s and the lowest percentage of identification (28%) (Fig. 6.1). Along with that, none of the participants preferred this package. Results correlated with descriptive data for consumer perception using the Likert scale method (Table 6.3). S5 had the lowest average rating on the scale (closer to “Disagree”) for how easy the message was to find and generally how consumers felt about the message (location and content).

Table 6.2. Participants who found the flour safety messages

<b>Package codes</b>	<b>Found flour safety message %(n)</b>	<b>Those who preferred the message %(n)<sup>b</sup></b>
S1	68(32)	3(1)
S2	79(37)	14(5)
S3	72(34)	3(1)
S4	98(46)	15(7)
S5	28(13)	0(0)
L1 <sup>a</sup>	93(44)	34(15)
L2 <sup>a</sup>	87(41)	17(7)
L3	79(37)	16(6)
L4	81(38)	8(3)
L5	34(16)	13(2)

*The letter “S” (S1-S5) signifies that the messages were short and contained only one sentence. The letter “L” (L1-L5) signifies that the messages were long and contained more than one sentence.*

<sup>a</sup> *Package had more than 1 food safety message*

<sup>b</sup> *Only participants who found the flour safety message were asked this question*

Table 6.3 Consumer Perceptions of flour safety messages on packages

Package Code	Average Rating Mean $\pm$ SD <sup>b</sup>		
	This flour safety message was easy to find.	This message was the perfect length for a flour safety message.	In general, I prefer my flour safety message to be like this.
S1 n=32	3.813 $\pm$ 1.693	5.438 $\pm$ 1.564	3.719 $\pm$ 1.988
S2: n=37	4.865 $\pm$ 1.917	5.514 $\pm$ 1.502	5.054 $\pm$ 1.794
S3 n=34	5.147 $\pm$ 1.778	5.735 $\pm$ 1.421	5.147 $\pm$ 1.811
S4 n=46	5.391 $\pm$ 1.468	5.587 $\pm$ 1.529	5.391 $\pm$ 1.693
S5 n=13	3.154 $\pm$ 1.625	4.462 $\pm$ 1.854	3.615 $\pm$ 2.181
L1 <sup>a</sup> n=44	5.636 $\pm$ 1.586	4.364 $\pm$ 2.081	4.477 $\pm$ 2.029
L2 <sup>a</sup> n=41	5.268 $\pm$ 1.379	4.512 $\pm$ 1.886	4.341 $\pm$ 1.970
L3 n=37	5.216 $\pm$ 1.493	6.189 $\pm$ 1.076	5.703 $\pm$ 1.450
L4 n=38	4.789 $\pm$ 1.545	6.000 $\pm$ 1.115	5.316 $\pm$ 1.526
L5: n=16	5.250 $\pm$ 2.049	5.938 $\pm$ 1.289	5.438 $\pm$ 1.965

The letter “S” (S1-S5) signifies that the messages were short and contained only one sentence. The letter “L” (L1-L5) signifies that the messages were long and contained more than one sentence.

Rating Was based on a Likert scale (1-7) with 1 being “Strongly Disagree”, 4 being “Neutral”, and 7 being “Strongly Agree”.

<sup>a</sup> Package had more than 1 food safety message

<sup>b</sup> Only participants who found the flour safety message were asked this question

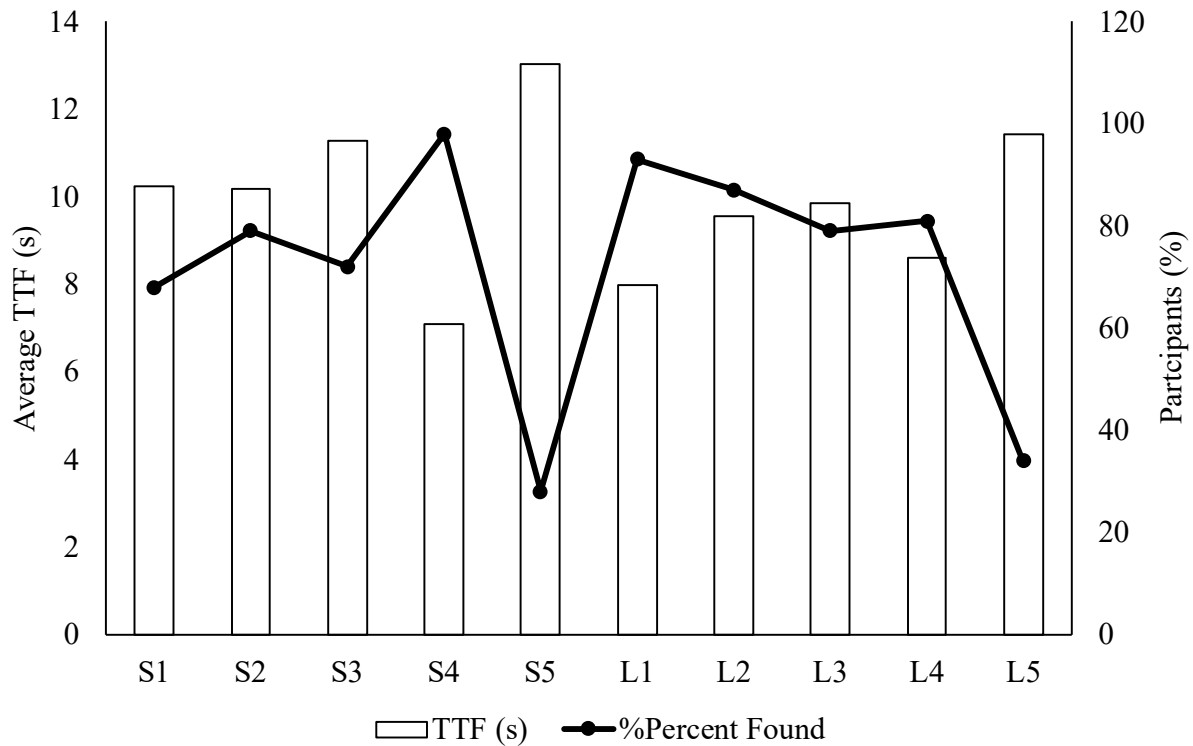


Figure 6.1. Overall average time to first fixation (TTF) for flour safety messages in Activity 1  
*Includes only participants who found the message in 20 seconds or less*  
*The letter “S” (S1-S5) signifies that the messages were short and contained only one sentence.*  
*The letter “L” (L1-L5) signifies that the messages were long and contained more than one sentence.*

For the long messages, 93% of the participants found the message on L1, which attained the highest preference ranking (34%). L1 and L2 both contained two messages but L2 contained one short and one long. Researchers still classified L2 as long but when analyzing L2 separately, more participants (65.9%) found the long message (Appendix CC). Like S5, L5 had the lowest identification among the long packages (34%), and only 13% of those who found it preferred it (Table 6.2). Participants also had the highest average TTF for L5 (11.42s) among all the long packages.

To consider if type size was a predictor of accessibility, researchers measured the first letter of the food safety message text on all the packages (Fig. 6.2). However, the type sizes for most of

the packages were similar (2mm), and the package with the highest TTF (S5) was printed in this size as well. This may mean that other factors on the package, including color, contrast, position, and other distractions, may decrease the accessibility or conspicuousness of the food safety message.

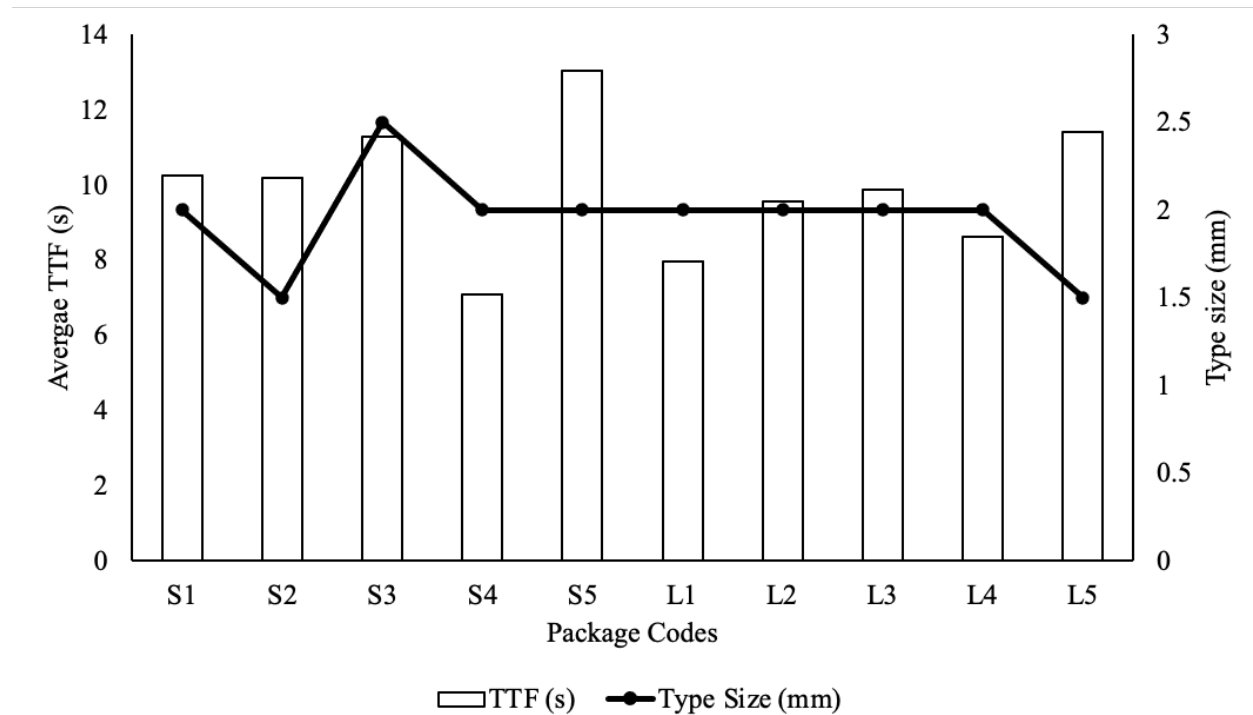


Figure 6.2. Overall TTF's vs type size for flour safety messages in Activity 1

*Type measurements were taken from the top of the letters to the bottom of the letters and include only the message itself without any headings like "Warning" or "Safe Handling Procedures."*

Researchers further analyzed S5 recordings of those who found the food safety message, in order to assess what may have distracted the participant before they found it. Using the eye-tracking software, the researchers created gaze plots of the side of the package on which the message was printed. Table 6.4 displays the fixations of the 13 participants who found the flour safety message on the package. Most participants (5) first fixated on the "extra ingredients" table,

which was located near the top of the package. None of the participants fixated first on the brand logo, the flour safety message, or the website for tips. Right before finding the flour safety message, almost all the participants (10) fixated on the baking instructions near the middle of the package. Lastly, 10 participants had clusters of four or more fixations in some areas of the package. Most of them had clusters on the extra ingredients followed by yield and bake-time table (Table 6.4).

Table 6.4. Gaze plot fixations for S5

<sup>a</sup> Area (from top to bottom of package)	First fixation, n=13	Fixation before flour safety message, n=13	Clusters of 4 fixations, n=10
Brand logo	0	0	0
Extra ingredients table	5	0	5
Baking instructions	3	10	5
Flour safety message	0	1	0
Yield and bake-time table	2	1	6
Extra recipe	3	1	7
Website for tips	0	0	0

*Includes only participants who found the flour safety message on the package S5.*

*<sup>a</sup>Displays the fixations only for the side of the package on which the flour safety message was printed.*

### 6.3.3 Interview and post-survey responses: Capturing participant perceptions

After participants completed the exercise, they were each interviewed briefly and asked to fill out a post-survey instrument to gauge their thoughts and perceptions in response to their exposure to flour safety messages. Interviews were analyzed using a thematic approach; themes and subthemes can be seen in Table 6.5. Four subthemes and two themes emerged from this study.

Table 6.5. Themes from interview codes

Themes	Subthemes	Codes
Perceptions and preferences of flour safety messages	Flour safety messages were necessary	Compared to the grocery store General thoughts on flour safety messages Necessary messages Unnecessary messages
	Preference toward easy-to-find messages with mixed views on length.	Best message Additional information Other platforms for messages
Flour safety awareness increases but behavior may stay the same	Unaware of flour-related foodborne illness and continued consumption of raw batter or dough	Prior belief of flour safety Previous sneaking a taste Future sneaking a taste Future handling of flour Paying extra
	Knowledge and awareness of ready-to-eat products was sufficient among most with some exceptions	Ready-to-eat Ready-to-eat perception Not ready-to-eat perception

All the participants except one thought flour safety messages were necessary for many reasons, including preventing foodborne illness among people who are not familiar with food safety, protection for the flour company, and correcting misinformation in news and social media. One participant commented: “Well, if I buy flour and I eat it not knowing that it could have bacterial contamination in it, and I get sick I could sue the flour company, and then of course, XXX (the company’s name) goes down like a ton of bricks — but they say, ‘sorry, we’ve got a warning on this and you did it anyway,’ then that’s definitely going to protect the company” (female, 55–64). The one person who didn’t think the messages were necessary said it would be difficult for people to eat raw dough (e.g., pizza dough), and this person did not know that raw flour is in baking mixes as well.

Participants tended to prefer easy-to-find messages that were separated from other content and distractions on the package, as one participant indicated: "...the best message for me was one that was separated from too much text. I think it's easier for consumers to find this safety message. ... I saw some black boxes back there that the safety message was confusing to find because it was between too much text, so I think would be better for us to separate it from instructions or from ingredients.... [it's] easier to find them [if] it's clearer" (male, 18–24). Participants expressed divergent views about length preference. Some participants liked messages that were "short and to the point" (female, 45–54) while others liked information in longer messages explaining how and why someone could become ill. One person mentioned that the shorter messages may not contain enough information, thus leading consumers to believe that other factors (such as raw eggs) are the causes for consumers becoming ill. That participant wrote: "I think most of them [warning messages] are insufficient. The ones that we were reading, they were very short. They were hard to find on prepared mixes. I almost never notice it. And when I do, I don't associate it with the mix — I associate it with the other things you're adding to the mix. And so, I think [warning messages are] insufficient if you're trying to really get that message that the flour being raw is what's unsafe. That's being lost" (female, 34–44). Along those lines, researchers noticed that when asked about future flour handling, some people mentioned they would store it in closed containers and in a cool place as some of the messages (L1 and L2) suggested (Appendix BB). They may be thinking that storage can get rid of bacteria. This participant said she wouldn't change any of her flour handling practices because she stores it in cool temperatures: "No, because I always keep [it] in a cool temperature and then, you know, closed and [I] try to get rid of some insects. There's no insects at home, but just in case" (female, 25–34).



Most participants had seen ready-to-eat labels and agreed that these types of foods should have very little to no preparation required. Participants expected that they would have to cook or prepare foods that are not ready-to-eat prior to consumption, in order to avoid becoming ill from bacteria. While this knowledge of not-ready-to-eat food was sufficient, most participants mentioned that they did not think flour posed a microbial threat. Reasons they cited for that belief included flour being made from plant material; its stability in shelf storage; it is considered an ingredient for cooking (not for consuming raw); wheat flour doesn't spoil; flour is a dry product; it's not tasty or good to eat raw; and because they assumed that whenever they were told they should not eat raw batter or dough, it was because of the raw eggs and not the flour. Participants who did know they should not eat unprepared packaged foods mentioned they knew that because their relatives told them that eating raw dough would make them sick, or they had seen messages before, or were aware such food ingredients could cause indigestion, and/or they previously received food safety or agriculture-related education. One person was unsure if a particular ingredient was a source of bacteria but, knew it could cause sickness said it's: "not really a source of harmful bacteria that could make me sick, but I know that raw flour can make me sick ... my grandmother told me" (female, 25–34).

Most participants said they had eaten or sneaked a taste of raw batter or dough before. Participants said they did so because they like to taste foods before baking them, or they had eaten raw eggs before, or they were vegan (and thus don't use eggs). One commented: "It's fine if they don't have eggs cause I'm vegan. I bake without eggs, and I eat raw cookie dough all the time" (female, 55–64). Again, consumers have been associating the harm of raw dough and batter coming from raw eggs rather than from the flour itself. When asked if they would continue to sneak a taste, most of the participants mentioned they would do so for various reasons, including

that tasting the dough or batter hasn't caused illness or death yet, or the amount they taste is small, or everything has a risk, or because they have a strong immune system. One person who admitted tasting said: "Uh, yes, because I have never had any complications from it. I don't tend to eat large amounts.... It's in small quantities ... typically shortly after making it. I guess you could say the freshest, it's not been incubating for super long. Um, if there is that potential, especially 'cause it's usually mixed with egg and there's that *Salmonella* component. Um, so, I mean, I will, but it's usually very infrequent. Um, so I will still probably do it" (male, 25–34). The few who indicated that they won't sneak a taste in the future said they would refrain from doing so because they already avoid eating raw dough or batter and/or they became aware after the study. Even so, some hesitation to refrain from eating raw dough apparently lingers because, as one participant said: "everyone does it [tastes raw batter] to check the batter" (female, 25–34).

Lastly, in response to being asked how they would handle flour in the future and overall, many participants said they would be careful. However, some mentioned they wouldn't change their flour handling habits for the following reasons: they don't eat it anyway, they feel they handle their flour properly, and they have many years of experience. As mentioned earlier, some of the participants said they would just change their storage habits (storing in a cool place). However, some mentioned they will adopt behaviors like wiping down surfaces, washing their hands, and rinsing out their flour cup or other utensils they used. Others asserted that they would follow their same practices but would look for warning labels and indicated they had become more aware of the repercussions, saying: "I'll still be handling the same kind of way and make sure it'd be clean, clean up after myself and so on and so forth. So, I tend to be, and my wife as well, try to be thorough and making sure that everything's baked fully, cooked fully, especially for our kids, to

make sure that they don't get sick. So, I won't be doing anything different, but I probably might be looking out for those labels a little bit more" (male, 25–34).

The post-survey questionnaire responses also showed that most participants thought flour safety messages were important (98%) on food packaging, and one person thought it could "maybe" be important (Table 6.6). None of the participants reported that it would not be important at all. All the participants preferred the messages to be on the packaging itself followed by the address of the company website (30%) and the grocery store website (23%) (Table 6.6).

Table 6.6. Perception and preference of flour safety messages

Question	%(n)
<b>Do you think it is important to have flour safety messages on packaging?</b>	
Yes	98(46)
No	0(0)
Maybe	2(1)
<b>How would you like to receive flour safety messages?</b>	
On the food packaging	100(47)
On the company website	30(14)
On the grocery store website	23(11)
Other	23(11)
None of the above	0(0)

## 6.4 Discussion

### 6.4.1 Accessibility of food safety messages

While having food safety messages on packaging is important, it may not be as effective if consumers are unable to find the messages within a reasonable amount of time. Out of the 47 participants, only two people were able to successfully find the flour safety message in 20 seconds

or less on all 10 packages. In consumers' daily food-related decision-making, 20 seconds can be a long time. A previous study indicates that consumers spend an average of only 12.2 seconds to view products before making a purchasing decision in a store environment (Leong, 1993). Because the past study was 30 years ago, there may differences in consumers' attention spans today as well as differences in food packaging. Worse, consumers are not accustomed to look for safety information during that time, so it is critically important to ensure that food safety information is conspicuous and easily accessible.

While the U.S. FDA has labeling guidelines, requirements pertain to the nutrition label rather than food safety labels which are not required (U.S. Food and Drug Administration, 2013). This can cause companies to have different ways of creating (font, type size, color, etc.) and placing labels (front, back, side, etc.). These multiple factors may determine whether consumers are able to locate food safety messages. During the current study, researchers speculated that type size may influence the conspicuousness of food safety messages. When measuring the type size, however, researchers found no correlation between size and TTF. Conversely, a study done by Bialkova found that nutrition labeling caught consumer attention when the display size was doubled (Bialkova & van Trijp, 2010). This indicates, for the current study, the size of type in safety messages on food packages may need to contrast more from the other text on the package in order to reduce the TTF value. Another proposed factor was color contrast or the color difference between the background and text that is overlaid on the background. Previously, researchers agreed that color contrast and the varied combinations of background colors and typefaces affect legibility (Bix et al., 2003; Bradley et al., 1994). According to the study by Bix et al., in which researchers measured the legibility of messages with differing color contrasts, black text on white background was the most legible combination for all age groups (Bix et al., 2003). However, in

the current study, S5 (the highest TTF) was also black print on a white background. This indicates the need for further investigation about what else could be impeding safety message accessibility and conspicuousness on certain packages.

Lastly, the researchers considered speculation that the placement of the message itself may affect accessibility. Aspects of placement include where a message appears on a package (front, back, top, bottom, side) and how distinct the message is from the text and graphics on the package. Participants in the current study even had mentioned in their interviews that they preferred messages to be in less crowded areas. Further analysis of S5 (the package with the highest TTF and lowest percentage of participants who found the safety message) revealed that consumers focused on many aspects of the package before finding the message. The other distracting elements include baking instructions, extra tables, and extra text. Similarly, a previous consumer eye-tracking study showed that health information was less retained by consumers than brand names and product names on food packages that contained a profuse amount of information (Varela et al., 2014). In a previous analysis of over 100 flour and baking-mix packages, type sizes on most of the packages were similar to the type size used for the preparation instructions and ingredient list (Barrett & Feng, 2020a). The packages selected for the current study were representative.

Another factor outside of the package itself is the health literacy and understanding of what a flour safety message is. Health literacy can be described as skills that allow individuals to obtain, understand, and use information to make decisions that impact health status (Nutbeam & Lloyd, 2020). This can vary from person-to-person and can change over time. A past study found that many American adults had intermediate health literacy and those who were older than 65 years had lower health literacy skills compared to younger adults (25-39 years) (Kutner et al., 2006). With regards to the flour safety message, if consumers don't understand the message or even know

what a flour safety message is, then it may be difficult for consumers to follow the directions and make a health-related decision.

Consumers were challenged to find flour safety messages among all the information on packages. While type size, color contrast, placement, other information on the package, and health literacy individually may not be a factor in determining whether consumers are able to find food safety messages, combinations of those elements may reduce the accessibility and conspicuousness of food safety messages on packaging.

#### **6.4.2 Information and wording of current flour safety messages**

Not only should these food safety messages be accessible, but they should also be easily understood. The book *Thinking Fast and Slow*, by psychology professor Daniel Kahneman, mentions that there are two systems for how a person thinks: system 1 and system 2 (Kahneman, 2011). System 1 is automatic and requires very little effort because it comes naturally — such as understanding simple sentences or driving on an empty road — while system 2 allocates more attention and concentration to certain activities — such as looking for a white-haired woman or every letter *a* on this page (Kahneman, 2011). Ideally, the flour safety messages on food packages should come easily (system 1) so that consumers understand these simple sentences.

Message preference is important to consider when creating food safety messages for consumers and to possibly evoke a system 1 thought process. While consumers may be able to find a message, if they are dissuaded from reading it or have difficulty understanding it, the presentation of the message might not be effective in encouraging proper food safety behaviors. Overall, some consumers expressed no preference between short and long messages. A recent survey study assessing flour safety among consumers found that messages that include recommendations, explanations, and benefits of the recommendations were the most effective for

preventing people from eating or playing with raw flour products (Feng & Archila, 2020). Similarly, another study by Feng et. al discovered that the most effective messages for food irradiation contained information about the benefits of choosing the technology (Feng et al., 2016). While there is evidence to show that explanations and benefits are important aspects of an effective flour safety message, further research needs to be conducted to assess how much of this information is necessary without having “too much information” which can cause consumers to stop reading.

If messages are not clearly worded or optimally placed, consumers may be getting the wrong message or even misinformation. A paper by Swire-Thompson and Lazer define health misinformation as “information that is contrary to the epistemic consensus of the scientific community regarding a phenomenon” (Swire-Thompson & Lazer, 2019). The wording of a message is important when it comes to conveying the proper information without accidental misinformation. For example, “store in a cool dry place” may cause people to equate that to “keep bacteria out” or “kill bacteria” rather than it being a way of quality control. This notion that storage may impact bacterial load was seen throughout the interviews in the current study. During the creation of messages, food safety experts and food companies need to be aware that accidental misinformation can be spread and may cause consumers to equate quality to safety.

#### **6.4.3 Awareness does not directly affect behavior change**

A consumer’s goals should be aligned with the content of the health message in order to influence behavior change. A previous eye-tracking study related to nutritional labels found that consumers who had more nutritional goals spend more time attending to the nutritional information on food packaging (Bialkova et al., 2014). Similarly, a more recent consumer flour study by Feng and Archila found that those who did not eat raw flour products found flour safety messages to be

more effective than those who did consume these products (Feng & Archila, 2020). In this current study, consumers expressed their thoughts through the interview and brief post-survey questionnaire. Overall, it seemed that most respondents were comfortable with their current flour handling and wouldn't make many changes. Many even mentioned they would continue to taste or eat raw batter or dough because they didn't ingest a large amount. This thought may have occurred because of optimism bias; they feel that they are unlikely to become ill because they have not become ill yet from eating raw flour products (Sharot, 2011). Another reason for this behavior may be subjective norms or the ways in which the actions of respondents are influenced by peers or people that they consider "important" (Ajzen, 1985). One participant in the current study even asserted that everyone tastes raw batter to check it.

Another interesting point was that while these messages warned against eating raw dough or batter, a few participants attributed the potential for danger to the eggs rather than to the raw flour (Feng & Archila, 2020). This indicates that consumers may need more education outside of flour safety messages on food packaging or extra information on the packages to clarify that both raw flour *and* eggs present the threat of danger. This is important because one participant mentioned that because she was vegan, she did not use raw eggs, so she recurrently eats raw cookie dough. This may be a common misconception among consumers. While flour safety education contributes to knowledge, the messages on the packages can act like a tool to increase perceived behavior control, since many consumers may use instructions on the package to guide their cooking.

This study has given researchers some insights about the accessibility and perceptions of consumers regarding flour safety messages and overall flour safety. More research needs to be conducted by observation and interviews in order to curate the most effective message content.



Food safety experts and stakeholders must be aware of consumers' perceptions regarding raw flour and must appeal to them with a greater sense of urgency in order to initiate effective behavior change. Awareness and knowledge alone are insufficient unless packaging instructions provide consumers with accurate and complete information.

Although this study was carefully designed, some technical limitations need to be addressed. This study used eye-tracking technology to track consumers' eye movements. Although the eye-tracker glasses and application were calibrated for each participant, some accuracy errors may have been introduced, however, due to technical difficulties involving the position of the glasses on the participant's face, and the participant's vision. In addition, while the selection of the flour and baking mix packages were done in a systematic way, the packages presented to survey participants may not necessarily have been representative of all the commercial packages available to consumers. Further research can be done to explore more packages and gather more data to support claims. Lastly, due to the COVID-19 pandemic and in efforts to keep researchers and participants safe, the study was done in only one community consisting mostly of people who attend or work at Purdue University. While this population provides rich data for this particular community and for further product safety labeling research, the participants may not represent all consumers. Again, additional and expanded research can be done in a way to encompass a wider participant pool and to include different demographics.

#### **6.4.4 Conclusion**

This is the first study to examine the accessibility of flour safety messages on commercially available packages and to identify barriers that impede consumers from reading, comprehending and practicing the recommendations in these messages. Eye-tracking technology enabled measurements on consumers' time to fixation (TTF) on the flour safety messages. The findings

showed that participants encountered difficulty in finding flour safety messages on packages. Highly accessible messages did not result in high preference of presentation among participants. Factors that influence accessibility and conspicuousness need to be further studied. As a result of the limited number of packages used in this study, no clear correlation emerged between accessibility and the factors of font size, color contrast and placement of messages. Many participants who were interviewed said that they preferred messages that identified the reasoning for the warnings, and they favored safety messages that were well separated from other information on the package. This study sheds light on the use of eye-tracking technology to evaluate consumer accessibility and conspicuousness of food safety messages on packages. The findings will help guide the development of more effective flour safety messages for consumers and will support the decision-making process of flour industry stakeholders in consumer risk communication. Along with that, these findings emphasize the need for policy changes with regards to flour safety messages on food packaging. Creating a standard message, similar to how nutrition labels are standardized, may help consumers find and understand the flour safety message.

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## **CHAPTER 7. SUMMARY AND FUTURE RESEARCH DIRECTIONS**

As seen throughout the studies within this dissertation, behavior change is complex and can be a result of multiple factors including knowledge, attitudes, perceptions, trust, tools, and more (Figure 1.1). Chapter 2 explored online content in the form of YouTube videos. These videos feed into all three of the constructs in the TPB. Food safety communications can influence attitudes, trust in sources can influence the subjective norms, and food safety video tutorials can influence perceived behavioral control since these tutorials can act as a tool to help consumers boost their confidence. Chapters 3 and 4 explored longitudinal changes in food safety behaviors and perceptions during COVID-19 using both surveys and focus groups. Both data collection methods helped researchers gather information that evaluate factors that influence attitudes and subjective norms. Attitudes can be influenced by risk perception, prior knowledge, and food safety communications while subjective norms can be influenced by trust in sources and influences from family/friends. Chapter 5 and 6 explored foods that consumers may not categorize as a biological hazard. Chapter 5 assessed the pet owners' awareness of pet food safety through a survey study. Through this study, researchers gathered information attitude and subjective norm similar to the previous chapters. Chapter 6 explored the accessibility of flour safety messages on packaging and consumer perceptions regarding flour safety. While this chapter assessed the attitudes, it also assessed perceived behavioral control since food safety messages on packaging, similar to recipes on packaging, can act as a tool to encourage consumers to follow proper handling. If consumers are not able to access the messages, they may not know how to handle raw flour. The complexity of behavior change goes beyond knowledge and assessing what needs to be addressed can ensure more efficient interventions.

While this dissertation has gathered information regarding the needs of consumers from different angles (pet food safety, COVID-19 and food safety, food safety messaging, etc.), research in this area should continue due to changes in time/people and to gather more information for specific emerging topics and niche behaviors. One future research direction needs to focus on food safety messages on packaging. As discussed in Chapter 6 of this dissertation, more research should be conducted to assess factors that may affect the accessibility of these food safety messages on packaging and how to enhance the messages themselves, so consumers understand them quickly. In the case of COVID-19-related food safety (Chapters 3-5), food safety educators can utilize the information that was found in the needs assessments to create interventions for consumers. After implementing these interventions, more needs assessments can take place to assess how well the interventions in changing behavior. Likewise, the COVID-19 pandemic is surely not be the only major health event and more may occur in the coming years.

Beyond needs assessments, it is important to discuss future directions to help consumers follow proper food safety behaviors and feel more confident in their abilities. Figure 7.1 illustrates the TPB and how future directions can be taken from the angle of evoking behavior change. While constructs like attitude, subjective norm, and perceived behavioral control interact, food safety educators can break them down and tackle it from the different constructs.

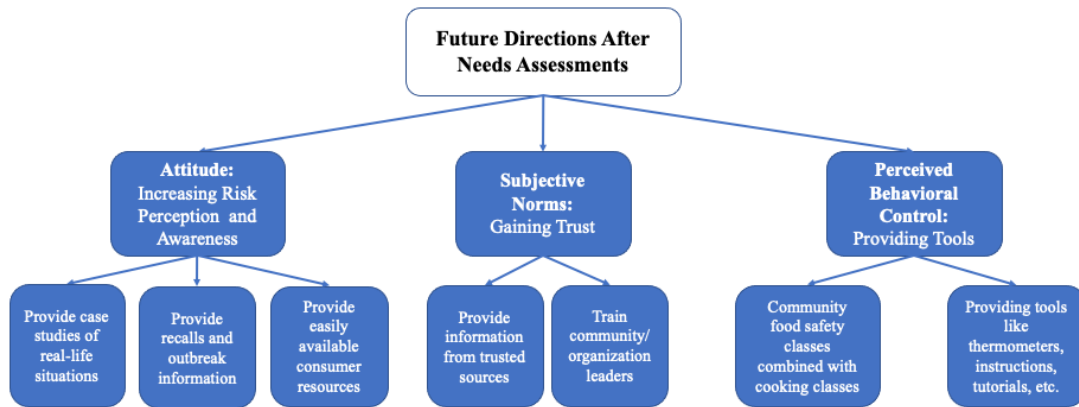


Figure 7.1. Ideas for future directions

Attitude refers to how an individual perceives the behavior change and if they are in favor of it or not. Attitudes can change by increasing risk perceptions as well as awareness. Some ideas for this include providing case studies of real-life situations during. This may help consumers see that food safety is not just an abstract idea but happens to real-world. Subjective norms refer to how an individual attitude toward conforming to social norms. Subjective norms can be addressed by providing information from trusted sources. Some sources may include healthcare workers, scientists, and government agencies. Food safety educators need to make sure these trusted sources are providing proper information if they are not providing such. Another way to address subjective norms is through providing trainings for community leaders that consumers trust. This can be through training programs like a train-the-trainer program. These leaders and people that consumers within the community trust can provide information or trainings sessions through community activities like cooking classes. Perceived behavioral control refers to how confident the individual is in performing the behavior and how much control they feel that they have. We can address perceived behavior control by teaching basic food handling practices during these community events and providing tools like thermometers. Some consumers may not be able to

afford or think about extra tools like food/ appliance thermometers and more than one cutting board so providing these basic materials and instructions for use may increase their confidence in food safety. There may be more future directions and continued needs assessments can ensure proper interventions.

## APPENDIX A. DEFINITION OF CATEGORIES FOR GOVERNMENT CITATIONS

Category	%(n), N=70	Definition
Handwashing	7(5)	The video suggests or describes handwashing including how long, if they recommend soap and how they describe using hand sanitizer.
Survival on surfaces	10(7)	The video suggests how long the virus will survive other surfaces (not food related)
Sanitizing Surfaces	17(12)	The video suggests or describes how to sanitize surfaces including high touch surfaces in the kitchen
Washing fruits and vegetables	14(10)	The video suggests or describes how to wash fruits and vegetables
Hazardous foods/ food packages	37(26)	The video implies certain foods or food packages are hazardous or not hazardous
Grocery store practices	9(6)	The video suggests practices to take at grocery stores
General Practices	6(4)	The video emphasized on general food safety practices and/or the host/guest suggested to visit the official government agencies' website.

## APPENDIX B. GENERAL DESCRIPTIONS OF SELECTED VIDEOS

Video Code	Video title	Date Posted	Location	Keywords			Video author	Current views	Average rating score by viewers	
				Food and COVID-19	Food safety and COVID-19	Groceries and COVID-19			Likes	Dislikes
1	PSA Grocery Shopping Tips in COVID-19 (See Important Notes Below) www.DrJeffVW.com	24-Mar-20	U.S.	Yes	Yes	Yes	Jeffrey VanWingen	26,127,309	249,000	7,100
2	Coronavirus tips: How to grocery shop safely during COVID-19 pandemic	27-Mar-20	U.S.	Yes	Yes	Yes	syracuse.com	845,643	3,900	390
3	How to properly wipe down your groceries and remove gloves	2-Apr-20	U.S.	No	No	Yes	CNN	804,638	6,600	510
4	How to grocery shop during the Coronavirus Pandemic.	4-Apr-20	U.S.	No	No	Yes	FAIR USE FUNNY	510,827	9,400	601
5	Grocery Shopping Tips in COVID-19 Revised (March 31, 2020) www.DrJeffVW.com	1-Apr-20	U.S.	Yes	Yes	Yes	Jeffrey VanWingen	458,654	9,400	270
6	COVID-19: Should I disinfect my fruits and vegetables?	17-Mar-20	Canada	Yes	No	Yes	CBC News: The National	394,728	1,900	286
7	How to wash fruits & vegetables amid coronavirus pandemic	29-Mar-20	U.S.	No	Yes	No	Detroit Free Press	373,298	1,700	1,100
8	Will Buffets Ever Regain Popularity After COVID-19?	1-May-20	U.S.	Yes	No	No	Inside Edition	337,801	5,600	230
9	PSA Package & Delivery Tips for COVID-19   www.DrJeffVW.com	5-Apr-20	U.S.	Yes	Yes	No	Jeffrey VanWingen	237,122	9,500	189
10	How to safely shop for groceries during COVID-19	4-May-20	Canada	No	No	Yes	National Post	228,542	20	21
11	People are more dangerous than food! (COVID-19 food safety tips)	6-Apr-20	U.S.	Yes	Yes	No	Adam Ragusea	212,662	7,500	162
12	How to handle your groceries during the COVID-19 outbreak	28-Mar-20	Canada	No	Yes	Yes	CBC News	179,113	1,000	178
13	How To Unpack And Disinfect Your Groceries	27-Mar-20	U.S.	No	No	Yes	DoctorOz	175,364	2,500	89
14	How to Safely Buy Groceries During Coronavirus Pandemic	27-Mar-20	U.S.	No	No	Yes	Inside Edition	170,356	2,100	122
15	Doctors weigh in on people cleaning groceries	24-Mar-20	U.S.	No	No	Yes	41 Action News	146,660	311	43



16	Grocery Shopping Tips - UPDATE (March 31,2020) www.DrJeffVW.com	31-Mar-20	U.S.	No	Yes	Yes	Jeffrey VanWingen	136,495	3,600	55
17	Can You Get Coronavirus Through Food?	18-Mar-20	U.S.	Yes	Yes	No	Mashed	125,220	1,400	116
18	How to safely grocery shop during the COVID-19 pandemic	8-Apr-20	Canada	No	No	Yes	CBC News	123,947	1,000	235
19	To clean or not to clean your groceries in the age of coronavirus	6-Apr-20	U.S.	No	No	Yes	CNET	120,890	1,700	73
20	COVID-19: Food Safety and Nutrition	10-Mar-20	U.S.	Yes	Yes	No	NYU Langone Health	114,806	415	154
21	Safe Grocery Shopping: U of G Expert Dispels Myths	31-Mar-20	Canada	No	Yes	No	uofguelph	96,337	N.A.	N.A.
22	7 Ways To Keep Your Groceries Clean During Covid-19	21-Apr-20	U.S.	No	No	Yes	Bestie	79,074	1,500	100
23	Top 10 grocery safety tips to avoid coronavirus	11-Apr-20	U.S.	No	Yes	Yes	AJ+	76,092	1,500	145
24	VERIFY: Microwaving your take-out food does not kill coronavirus	24-Mar-20	U.S.	Yes	No	No	KHOU 11	62,284	114	199
25	Safe Use Of Bleach And How To Sanitize Your Groceries During Coronavirus	23-Mar-20	U.S.	No	No	Yes	Wendy Achatz	59,125	576	39
26	7 Tips for Healthy Grocery Shopping during COVID-19	27-Mar-20	U.S.	No	No	Yes	Nourishable	52,151	419	26
27	How to Wash Produce during COVID-19 and Beyond	1-Apr-20	U.S.	No	Yes	No	Nourishable	50,687	557	161
28	Can coronavirus (COVID-19) live on groceries? Are they safe to bring home?	26-Mar-20	U.S.	No	Yes	Yes	Click On Detroit	46,219	257	11
29	Safe grocery shopping in the COVID-19 pandemic	29-Mar-20	Canada	No	No	Yes	Dr. Dina Kulik	46,016	314	77
30	How To Safely Bring Groceries Into Your Home	4-Apr-20	U.S.	No	No	Yes	Kristina Braly	38,870	2,800	69
31	10 Ways the Fast Food Industry is AFFECTED by the Coronavirus	17-Apr-20	U.S.	Yes	No	No	BabbleTop	36,759	652	32
32	COVID-19: Can Food or Water Carry Coronavirus?	16-Mar-20	U.S.	Yes	Yes	No	University Hospitals U.S. Food and	35,829	271	50
33	12 Tips for Grocery Shopping During the Pandemic.	1-May-20	U.S.	No	Yes	Yes	Drug Administration	35,398	N.A.	N.A.
34	DDP talks Food Safety in your home.	29-Mar-20	U.S.	Yes	Yes	No	DDP Yoga	33,038	545	32
35	Food Safety and Coronavirus: A Comprehensive Guide	27-Mar-20	U.S.	No	Yes	No	Serious Eats	30,535	745	19
36	Can an Infected Cook Transmit COVID 19 Through Your Food?	7-Apr-20	U.S.	Yes	No	No	DoctorOz	28,478	399	30
37	COVID-19: Can I safely cook or bake food for friends?	30-Mar-20	Canada	Yes	No	No	CBC News: The National	28,083	187	41
38	PSA Covid19: Safe Grocery Shopping with a Grocery Store CEO	10-Apr-20	U.S.	No	Yes	Yes	Stew Leonard's	25,075	193	10

39	What to eat in isolation   COVID-19 Ask an expert	3-Apr-20	Canada	No	Yes	No	CBC News	20,074	100	40
40	Grocery Shopping and COVID-19	3-Apr-20	U.S.	No	No	Yes	Doctor Stu	23,896	11	0
41	How to safely order takeout and delivery food during coronavirus lockdown   New York Post	24-Mar-20	U.S.	Yes	Yes	No	The New York Post	14,698	106	24
42	Doctor Explains How to Safely Bring Home Groceries During Coronavirus Outbreak   NBC10 Philadelphia	30-Mar-20	U.S.	No	No	Yes	NBC10 Philadelphia	12,691	62	2
43	What You Need to Know: Food and COVID-19	2-Apr-20	U.S.	Yes	Yes	No	U.S. Food and Drug Administration	12,396	N.A.	N.A.
44	The new normal: how keep clean while handling groceries, deliveries and tech	1-Apr-20	U.S.	No	No	Yes	ABC News	10,835	168	14
45	Inside America's Food Supply Chain Under Covid-19   Forbes	22-May-20	U.S.	Yes	No	No	Forbes	10,753	201	14
46	COVID-19 and food safety	1-Apr-20	U.S.	Yes	Yes	No	Mayo Clinic	10,583	69	7
47	Covid-19 Coronavirus   Buying Groceries Safer Way   How-To BBQ Champion Harry Soo SlapYoDaddyBBQ.com	29-Mar-20	U.S.	No	Yes	Yes	Harry Soo	8,772	322	39
48	Is food delivery safe during the COVID-19 pandemic?	16-Apr-20	Canada	Yes	Yes	No	CBC News: The National	7,674	80	27
49	Is it Safe to Order Food Delivery & Takeout During the COVID-19 Pandemic?	27-Mar-20	U.S.	Yes	Yes	No	sciencecomedian	7,213	79	3
50	HOW TO CLEAN YOUR GROCERIES FROM COVID-19   Grocery Shopping Coronavirus Safety    Doctor ER	11-Apr-20	U.S.	No	No	Yes	Doctor ER	7,148	139	5
51	Covid-19 food safety tips   Quarantine Cooking Show	2-Apr-20	U.S.	Yes	Yes	No	Washington Post	6,881	132	12
52	RV LIVING   INSTACART PUBLIX GROCERY   OUR COVID-19 PANDEMIC CLOROX SANITATION PROCEDURE   EP114	19-Apr-20	U.S.	No	No	Yes	Our Journey In Myles	6,499	453	18
53	Coronavirus Update: Latest Grocery Shopping Tips To Stay Safe From COVID-19	30-Mar-20	U.S.	No	No	Yes	CBS New York	5,904	48	3
54	Food safety expert speaks on coronavirus concerns	11-Mar-20	U.S.	No	Yes	No	KTNV Channel 13 Las Vegas	5,716	21	5
55	Is takeout food safe from COVID-19 Coronavirus?	17-Mar-20	U.S.	Yes	Yes	No	WCNC	5,290	23	2
56	Best way to sanitize your groceries during COVID-19!	17-Apr-20	U.S.	No	No	Yes	Nextgen Digital	5,039	111	3
57	Fresh Produce and COVID19	30-Mar-20	U.S.	No	Yes	No	BACFighter	4,592	25	1

58	CDC offers tips to be safe from COVID-19 when you shop for groceries	27-Mar-20	U.S.	No	No	Yes	FOX6 News Milwaukee	4,517	30	2
59	Is it safe to order takeout during COVID-19?	31-Mar-20	U.S.	No	Yes	No	41 Action News	4,347	16	1
60	Disinfect Groceries During COVID-19 Pandemic (How To) #disinfectgroceries	28-Mar-20	U.S.	No	No	Yes	triguytedro	3,926	54	4
61	Is It Safe To Eat Food From A Drive-Thru? Coronavirus Safety Tips (COVID-19) & Cleaning Credit Cards	26-Mar-20	U.S.	No	Yes	No	Stan Cravens	3,442	44	5
62	Food Safety and Coronavirus (COVID-19) Updated 4/14/20	14-Apr-20	U.S.	Yes	Yes	No	Mytonomy	3,551	30	0
63	Coronavirus Tips - How to Safely Grocery Shop During COVID-19 Pandemic	1-Apr-20	U.S.	No	No	Yes	New Parents in Training	3,367	60	5
64	Disinfect Groceries with Hydrogen Peroxide from Coronavirus COVID-19 With Me	7-Apr-20	U.S.	No	No	Yes	QualityDaydreams	3,220	61	6
65	TUBEREATS 🍷 Delivering food to friends during Covid19 quarantine #supportlocal	19-May-20	U.S.	Yes	No	No	Fancy Nancy TV	3,124	212	4
66	Is food delivery safe? Does cooking kill the coronavirus? An expert answers commonly asked questions	13-Apr-20	U.S.	No	Yes	No	ABC7	3,306	31	5
67	Food Safety and Grocery Shopping Tips during COVID-19	6-Apr-20	U.S.	No	Yes	Yes	A Healthier Michigan	2,867	25	2
68	How to Safely Grocery Shop During COVID-19 Outbreak	14-Apr-20	U.S.	No	No	Yes	DrTanya	2,855	62	0
69	COVID-19 impacting food truck business in Baltimore	20-Mar-20	U.S.	Yes	No	No	WMAR-2 News	1,871	21	0
70	Can cooks spread coronavirus (COVID-19) by talking, breathing near prepared food?	10-Apr-20	U.S.	Yes	No	No	Click on Detroit Local 4 WDIV	1,569	19	2
71	Food Security Throughout the COVID-19 Pandemic	24-Mar-20	U.S.	Yes	No	No	Center for Strategic & International Studies	1,514	26	2
72	Does Cooking & Freezing Food Affect the Coronavirus?	1-Apr-20	U.S.	No	Yes	No	sciencecomedian	1,442	17	0
73	How To Clean & Sanitize your groceries properly during the Covid 19 outbreak sanitize groceries	13-Apr-20	U.S.	No	No	Yes	Made By Meenal	1,411	122	1
74	Covid-19   Can Groceries Spread the Virus?	21-Apr-20	U.S.	No	No	Yes	Clean Freak & Germophobe	1,395	41	2
75	Food Safety During the COVID-19 Outbreak	7-Apr-20	U.S.	Yes	Yes	No	Ohio State News	1,366	10	0

76	How to Disinfect Costco Groceries w/ DIY Hydrogen Peroxide Disinfectant Spray to Kill Coronavirus	22-Apr-20	U.S.	No	No	Yes	QualityDaydreams	1,263	25	3
77	Coronavirus: Shoes off when you enter the house? Is takeout food safe? Answering health questions	30-Mar-20	U.S.	No	Yes	No	ABC10	1,262	12	2
78	How to wash fruits & vegetables amid coronavirus pandemic #COVID19#FoodSafety#Awareness	11-Apr-20	U.S.	No	Yes	No	Laxmi Raghunadh	1,122	25	0
79	Is grocery store food, take-out food safe to eat?	9-Apr-20	U.S.	No	Yes	No	KSAT 12	1,066	9	0
80	COVID-19   30 Tips for Grocery Shopping Safely during Coronavirus Pandemic	4-Apr-20	U.S.	No	No	Yes	Alex goes Coconuts	851	31	2
81	Ways to Stay Healthy While at the Grocery Store	18-Mar-20	U.S.	No	Yes	No	MissStateExtension	783	7	0
82	Coronavirus food safety tips for takeout and delivery	26-Mar-20	U.S.	No	Yes	No	KOAT	780	2	3
83	Covid-19 & Food Safety: How to Wash Your Produce	26-Mar-20	U.S.	No	Yes	No	Kaplan Center for Integrative Medicine	758	7	0
84	Coronavirus, Food Packaging, and Ways to Prevent the Spread of COVID-19	27-Mar-20	U.S.	No	Yes	No	FMI	709	4	0
85	More than 800 cases of COVID-19 at 19 NC food and meat processing plants	11-May-20	U.S.	Yes	No	No	WLOS News 13	538	5	2

## APPENDIX C. PROCEDURES AND PRACTICES CONSIDERED FOR TAKE-OUT FOOD AND GROCERY SHOPPING, N=50

Video code	Video Title	Take-out	Grocery stores
1	PSA Grocery Shopping Tips in COVID-19 (See Important Notes Below) <a href="http://www.DrJeffVW.com">www.DrJeffVW.com</a>	(1) Change container (2) Heat the food on the microwave	(1) Wipe down your cart (2) Commit to what you are buying (3) Do not shop if you have respiratory symptoms or have been exposed (4) Do not allow elderly to go grocery shopping (5) Plan what you will buy for 2 weeks (1) Go when it is not crowded (2) Bring sanitizing wipes with you. Use them to wipe your cart and your hands (3) Gloves not needed (4) Use wipes to open freezer doors (5) Keep social distance (6) Wait your turn at the register (7) Try virtual payment (8) Sanitize your hands and your phone as soon as you reach the car
2	Coronavirus tips: How to grocery shop safely during COVID-19 pandemic	N.A. <sup>a</sup>	(1) Limit the number of times going to the grocery store
3	How to properly wipe down your groceries and remove gloves	(1) Ask to leave the take-out outside	(1) Wipe down cart (2) Make a list ahead of time (3) Go alone (4) Do not touch what you do not need (5) Social distance (6) Move safely and briskly through the store (7) Move items so UPC codes face up (quick checkout) (8) Leave receipt behind if you do not need it
4	How to grocery shop during the Coronavirus Pandemic.	N.A.	(1) Use delivery service. (2) Only go when necessary. (3) Send younger family members. (4) Pay with plastic. (5) Get up to 2 weeks of groceries. (6) Make a plan and a list. (7) Commit to buy. (8) Do not go to the store if experiencing respiratory illness symptoms.
5	Grocery Shopping Tips in COVID-19 Revised (March 31, 2020) <a href="http://www.DrJeffVW.com">www.DrJeffVW.com</a>	N.A.	(1) Commit to buy what you touch.
6	COVID-19: Should I disinfect my fruits and vegetables?	(1) Take your food out of the bag and practice hand hygiene	
9	PSA Package & Delivery Tips for COVID-19   <a href="http://www.DrJeffVW.com">www.DrJeffVW.com</a>	(1) Change container	N.A.
10	How to safely shop for groceries during COVID-19	N.A.	(1) Shop once a week (2) Plan ahead (3) Do not linger in the aisles (4) Do not touch groceries you will not buy (5) Stay 6ft away (6) Wear a mask (7) Wipe cart and basket down (1) Do grocery delivery instead of shopping in store
11	People are more dangerous than food! (COVID-19 food safety tips)	(1) Change container (2) Wash hands with soap and water for 20 seconds	
12	How to handle your groceries during the COVID-19 outbreak	N.A.	(2) Stay 2 meters away from others
13	How To Unpack And Disinfect Your Groceries	N.A.	(1) Ask for double bagging
14	How to Safely Buy Groceries During Coronavirus Pandemic	N.A.	(1) Wipe down cart (2) Maintain 6ft away (3) Pay with your phone or use credit card
17	Can You Get Coronavirus Through Food?	N.A.	(1) Social distance (2) Take advantage of wipes and hand sanitizer
18	How to safely grocery shop during the COVID-19 pandemic	N.A.	(1) Make a shopping list (2) Go alone (3) Physical distance - 2 meters (4) Go at off peak hours (5) Wipe down the cart handle (6) Do not touch your face (7) Only touch what you are going to buy (8) Pay with card tap
19	To clean or not to clean your groceries in the age of coronavirus	(1) Stay 6ft away when picking up (2) Pay via app or phone (3) Change containers and dispose it	(1) Minimize time at the store, go shopping every two weeks (2) Wipe down the cart (3) Plan ahead and touch items you intend to buy (4) Consider switching to paper list (5) Self-checkout (6) Contactless payment
21	Safe Grocery Shopping: U of G Expert Dispels Myths	N.A.	(1) Make a list of food items to minimize time in store (2) Go to a store that are following precautions (3) Disinfect handles of shopping carts (4) Practice social distancing (5) Use disinfectant wipe to clean hands after leaving the store

22	7 Ways To Keep Your Groceries Clean During Covid-19	N.A.	(1) Use airtight containers when shopping (2) Wear washable gloves (3) Go cashless and card-less;
23	Top 10 grocery safety tips to avoid coronavirus	N.A.	(1) Do not shop too often (2) Avoid peak hours (3) Wipe down the cart (4) Do not touch your face (5) Social distance (6) No need to bring your own bags
24	VERIFY: Microwaving your take-out food does not kill coronavirus	(1) Microwaving will not kill the virus on take-out food	N.A.
25	Safe Use Of Bleach And How To Sanitize Your Groceries During Coronavirus	N.A.	(1) Sanitize groceries (e.g. canned goods, plastic container) for elderly people after shopping
26	7 Tips for Healthy Grocery Shopping during COVID-19	N.A.	(1) Make a plan - 2 weeks' worth of meals (2) Write list on a paper (3) Use wipes on cart (4) Do not touch the face (5) Social distance - 6ft away (6) Stock, but do not hoard (7) Commit to what you touch
27	How to Wash Produce during COVID-19 and Beyond	N.A.	(1) Go grocery shopping every two weeks (2) Use wipes and hand sanitizer (3) Keep 6ft away from people (4) Be quick and efficient
29	Safe grocery shopping in the COVID-19 pandemic	N.A.	(1) Shop less frequently
31	10 Ways the Fast Food Industry is AFFECTED by the Coronavirus	(1) Heat the food on the microwave	N.A.
33	12 Tips for Grocery Shopping During the Pandemic.	N.A.	(1) Check for shopping hours (2) Make a list (3) Buy one to two weeks of groceries at a time (4) Wear a face mask (5) Social distance (6) Use wipes to wipe down cart or basket (7) Wash reusable bags
34	DDP talks Food Safety in your home.	(1) Get hot food or put it in the microwave	(1) If over 60 years old, should not go to the grocery store
35	Food Safety and Coronavirus: A Comprehensive Guide	(1) Heat food to 149F/ 65C for 3 minutes	(1) Use the self-checkout lane (2) Use cash-free or card-less payment (3) Shop at small grocery stores (4) Go at off peak hours
36	Can an Infected Cook Transmit COVID 19 Through Your Food?	(1) Change container (2) Reheat in the microwave	N.A.
38	PSA Covid19: Safe Grocery Shopping with a Grocery Store CEO	N.A.	(1) Try not to go when it's busy (2) Keep 6 ft away from people (3) Wear gloves and wear a mask (4) Wipe credit card down (5) Use Apple pay (6) Wipe down reusable bags if you used them (7) Do not touch your face;
39	What to eat in isolation   COVID-19 Ask an expert	(1) Change container and dispose it	(1) Use plastic bags, not reusable bags
40	Grocery Shopping and COVID-19	N.A.	(1) Shop for 10 days to 2 weeks
41	How to safely order takeout and delivery food during coronavirus lockdown   New York Post	(1) Wipe the container (2) Wash hands	N.A.
42	Doctor Explains How to Safely Bring Home Groceries During Coronavirus Outbreak   NBC10 Philadelphia	N.A.	(1) Use plastic bags
44	The new normal: how keep clean while handling groceries, deliveries and tech	(1) Change container	(1) Careful to be in contact with people
45	Inside America's Food Supply Chain Under Covid-19   Forbes	N.A.	(1) Social distancing (2) Specific hours for elderly (3) Limit number of shoppers in store
47	Covid-19 Coronavirus   Buying Groceries Safer Way   How-To BBQ Champion Harry Soo SlapYoDaddyBBQ.com	N.A.	(1) Wear mask and gloves (2) Go to the grocery when it is less crowded (3) Use self-checkout (4) Stay at least 10ft away from people (5) Wipe down wallet, credit cards, and phone (6) Going to the store once a week;

48	Is food delivery safe during the COVID-19 pandemic?	(1) Change container (2) Wash hands with soap and water	N.A.
49	Is it Safe to Order Food Delivery & Takeout During the COVID-19 Pandemic?	(1) Wash hands	N.A.
50	HOW TO CLEAN YOUR GROCERIES FROM COVID-19   Grocery Shopping Coronavirus Safety    Doctor ER	N.A.	(1) Plan ahead, get more than you need on a list (2) Sending the healthiest person to the store; one person (3) Do not go if you are sick (4) Wear a mask; optional gloves (5) Pay with a credit card (6) Give as much distance as you can (7) Do not touch items if you are going to put them back
51	Covid-19 food safety tips   Quarantine Cooking Show	(1) Change container (2) Wash hands	(1) Keeping 6 ft away from people (2) Do not touch your face, if gloves help you to remember wear them (3) Go to the store alone (4) Touch only the things you plan to add to your cart (5) Go as infrequently as possible (6) Try to have a couple weeks of food at hand
53	Coronavirus Update: Latest Grocery Shopping Tips To Stay Safe From COVID-19	N.A.	(1) Stay 6 ft away (2) Wipe down the cart (3) Use paper shopping list (4) Avoid touching your face and your phone (5) Avoid paying with cash, use credit card
55	Is takeout food safe from COVID-19 Coronavirus?	(1) Clean containers (2) Wash hands	N.A.
56	Best way to sanitize your groceries during COVID-19!	N.A.	(1) Wear a mask (2) Go to the store alone (3) Sanitize the cart handle (4) Avoid touching your face (5) Wear gloves when going to the store (6) Stay 6ft away (7) Use contactless pay or credit card
58	CDC offers tips to be safe from COVID-19 when you shop for groceries	N.A.	(1) Maintain social distancing (2) Limit time in the store; two trips a week (3) Make a list
59	Is it safe to order takeout during COVID-19?	(1) Wipe down hard containers (2) Change container	N.A.
61	Is It Safe To Eat Food From A Drive-Thru? Coronavirus Safety Tips (COVID-19) & Cleaning Credit Cards	(1) Change container and dispose it	N.A.
62	Food Safety and Coronavirus (COVID-19) Updated 4/14/20	(1) Stick with cooked food and reheat well (2) Change container	1. Buy at least 2 weeks of groceries at a time; 2. Get groceries delivered; 3. Try to go early to avoid crowds; especially if elderly or have high risk condition; 4. Stay 6ft away; two shopping carts away; 5. Don't touch face; wear a mask; 6. Use hand san
63	Coronavirus Tips - How to Safely Grocery Shop During COVID-19 Pandemic	N.A.	(1) Go to the grocery store when it opens (2) Bring wipes to wipe down cart (3) Wear a mask (4) Have a list ready (5) Buy what you grab
66	Is food delivery safe? Does cooking kill the coronavirus? An expert answers commonly asked questions	(1) Wipe container (2) Change container	(1) Go at off peak hours (2) Wipe down the cart (3) Go as fast as you can (4) Pay with a credit card (5) Use the pen to push the buttons (6) Wash cloth reusable bags in hot and soapy water (7) Spray plastic reusable bags with disinfecting spray, let it air dry
67	Food Safety and Grocery Shopping Tips during COVID-19	(1) Change container and dispose it (2) Use own silverware (3) Reheat food	(1) Use a sanitizing wipe to clean your cart handles (2) Commit to buying items before picking them up (3) Pay with a card instead of cash (4) Sanitize after checkout
68	How to Safely Grocery Shop During COVID-19 Outbreak	N.A.	(1) Make a grocery list (2) Go not at a peak time (3) Wear a mask and gloves (4) Keep credit card and phone in a bag (5) Wipe down the cart (6) Only touch what you will buy
71	Food Security Throughout the COVID-19 Pandemic	N.A.	(1) Keep other shoppers in mind (only buy what you need), if item is out try again in few days
74	Covid-19   Can Groceries Spread the Virus?	N.A.	(1) Have no direct handoff (2) Maintain 6ft away (3) Wear a mask (4) Do not bring people, go alone (5) Do not go if you have symptoms (6) Use wipe to clean cart (7) Go shopping when it is not busy (8) Do not touch your face (9) Use credit card or virtual pay
75	Food Safety During the COVID-19 Outbreak	(1) Deliver food	(1) Wash your hands before going grocery shopping (2) Wipe the grocery cart handle; is a high touch surface (3) Separate raw meat from ready to eat foods (4) Keep social

			distancing (5) Go for self-checkout (6) Use credit card instead of card
77	Coronavirus: Shoes off when you enter the house? Is takeout food safe? Answering health questions	(1) Wipe down	N.A.
79	Is grocery store food, take-out food safe to eat?	(1) Change container and dispose it (2) Wipe down package (3) Reheat in the microwave	N.A.
80	COVID-19   30 Tips for Grocery Shopping Safely during Coronavirus Pandemic	N.A.	(1) Write down a list (2) Go to the grocery store that you are familiar (3) Bring your own hand sanitizer (4) Wipe down the handle of cart (5) Bring your own grocery bags (6) Make items accessible (7) Pay with credit card (8) Maintain 6ft away (9) Stick to food that can be cooked, peeled, or washed (10) Pack your own groceries
81	Ways to Stay Healthy While at the Grocery Store	N.A.	(1) Use sanitizing wipe to wipe down all surfaces that can come into contact with food and hands (2) Touch or pick up products you intend to purchase (3) Shop at off peak hours;
82	Coronavirus food safety tips for takeout and delivery	(1) Leave food at doorstep (2) Wash hands (3) Change container	N.A.

<sup>a</sup> Not applicable



## APPENDIX D. PROFESSION OF HOSTS AND GUESTS, N=51

Video code	Video title	Video author	Host		Guest	
			Healthcare Professional <sup>a</sup>	Professor/Expert <sup>b</sup>	Healthcare professional	Professor/Expert
1	PSA Grocery Shopping Tips in COVID-19 (See Important Notes Below) www.DrJeffVW.com	Jeffrey VanWingen	1	NA <sup>c</sup>	NA	N.A.
5	Grocery Shopping Tips in COVID-19 Revised (March 31, 2020) www.DrJeffVW.com	Jeffrey VanWingen	1	NA	NA	1
6	COVID-19: Should I disinfect my fruits and vegetables?	CBC News: The National	NA	NA	2	NA
8	Will Buffets Ever Regain Popularity After COVID-19?	Inside Edition	NA	NA	NA	1
9	PSA Package & Delivery Tips for COVID-19   www.DrJeffVW.com	Jeffrey VanWingen	1	NA	NA	NA
11	People are more dangerous than food! (COVID-19 food safety tips)	Adam Ragusea	NA	NA	NA	2
13	How To Unpack And Disinfect Your Groceries	DoctorOz	1	NA	NA	NA
14	How to Safely Buy Groceries During Coronavirus Pandemic	Inside Edition	NA	NA	NA	1
15	Doctors weigh in on people cleaning groceries	41 Action News	NA	NA	1	NA
16	Grocery Shopping Tips - UPDATE (March 31,2020) www.DrJeffVW.com	Jeffrey VanWingen	1	NA	NA	NA
19	To clean or not to clean your groceries in the age of coronavirus	CNET	NA	NA	1	1
20	COVID-19: Food Safety and Nutrition	NYU Langone Health	1	NA	NA	NA
21	Safe Grocery Shopping: U of G Expert Dispers Myths	uofguelph	NA	1	NA	NA
23	Top 10 grocery safety tips to avoid coronavirus	AJ+	NA	NA	NA	1
26	7 Tips for Healthy Grocery Shopping during COVID-19	Nourishable	NA	1	NA	NA
27	How to Wash Produce during COVID-19 and Beyond	Nourishable	NA	1	NA	NA
28	Can coronavirus (COVID-19) live on groceries? Are they safe to bring home?	Click On Detroit	NA	NA	1	NA
29	Safe grocery shopping in the COVID-19 pandemic	Dr. Dina Kulik	1	NA	NA	NA
30	How To Safely Bring Groceries Into Your Home	Kristina Braly	1	NA	NA	NA
32	COVID-19: Can Food or Water Carry Coronavirus?	University Hospitals	1	NA	NA	NA
35	Food Safety and Coronavirus: A Comprehensive Guide	Serious Eats	NA	NA	NA	1
36	Can an Infected Cook Transmit COVID 19 Through Your Food?	DoctorOz	1	NA	NA	NA
37	COVID-19: Can I safely cook or bake food for friends?	CBC News: The National	NA	NA	NA	1
39	What to eat in isolation   COVID-19 Ask an expert	CBC News	NA	NA	1	NA
40	Grocery Shopping and COVID-19	Doctor Stu	1	NA	NA	NA
41	How to safely order takeout and delivery food during coronavirus lockdown   New York Post	The New York Post	NA	NA	NA	1
42	Doctor Explains How to Safely Bring Home Groceries During Coronavirus Outbreak   NBC10 Philadelphia	NBC10 Philadelphia	NA	NA	1	NA

		U.S. Food and Drug Administration				
43	What You Need to Know: Food and COVID-19		NA	1	NA	NA
44	The new normal: how keep clean while handling groceries, deliveries and tech	ABC News	NA		NA	1
46	COVID-19 and food safety	Mayo Clinic	1	NA	NA	NA
	Covid-19 Coronavirus   Buying Groceries Safer Way   How-To BBQ Champion Harry Soo					
47	SlapYoDaddyBBQ.com	Harry Soo	NA	NA	NA	1
48	Is food delivery safe during the COVID-19 pandemic?	CBC News: The National	NA	NA	NA	2
	Is it Safe to Order Food Delivery & Takeout During the COVID-19 Pandemic?					1
49	HOW TO CLEAN YOUR GROCERIES FROM COVID-19   Grocery Shopping	sciencecomedian	NA	NA	NA	
50	Coronavirus Safety    Doctor ER	Doctor ER	1	NA	NA	NA
	Coronavirus Update: Latest Grocery Shopping Tips To Stay Safe From COVID-19					1
53	Food safety expert speaks on coronavirus concerns	CBS New York KTNV Channel 13 Las Vegas	NA	NA	NA	1
54	Fresh Produce and COVID19	BACFighter	NA	1	NA	NA
57	Is it safe to order takeout during COVID-19?	41 Action News triguytedro	NA	NA	1	NA
59	Disinfect Groceries During COVID-19 Pandemic (How To) #disinfectgroceries		NA	1	NA	NA
60	Is food delivery safe? Does cooking kill the coronavirus? An expert answers commonly asked questions	ABC7	NA	NA	NA	1
66	How to Safely Grocery Shop During COVID-19 Outbreak	Dr. Tanya	1	NA	NA	NA
68	Can cooks spread coronavirus (COVID-19) by talking, breathing near prepared food?	Click on Detroit Local 4 WDIV				
70			NA	NA	1	NA
		Center for Strategic & International Studies				
71	Food Security Throughout the COVID-19 Pandemic		NA	1	NA	NA
72	Does Cooking & Freezing Food Affect the Coronavirus?	sciencecomedian	NA	NA	NA	1
74	Covid-19   Can Groceries Spread the Virus?	Clean Freak & Germophobe	1	NA	NA	NA
75	Food Safety During the COVID-19 Outbreak	Ohio State News	NA	1	NA	NA
	Coronavirus: Shoes off when you enter the house? Is takeout food safe?					
77	Answering health questions	ABC10	NA	NA	1	NA
79	Is grocery store food, take-out food safe to eat?	KSAT 12	NA	NA	NA	1
81	Ways to Stay Healthy While at the Grocery Store	MissStateExtension	NA	1	NA	1
		Kaplan Center for Integrative Medicine				
83	Covid-19 & Food Safety: How to Wash Your Produce		1	NA	NA	NA
84	Coronavirus, Food Packaging, and Ways to Prevent the Spread of COVID-19	FMI	NA	1	NA	NA

<sup>a</sup> Healthcare professional refers to physicians, nurses, dietitians, and those in any related profession.

<sup>b</sup> Professor/Expert refers to a virologist, epidemiologist, microbiologist, or food safety experts.

<sup>c</sup> Not applicable

## APPENDIX E. PROCEDURES AND GOVERNMENT AGENCIES CITATIONS, N=70

Video code	Video Title	Total number of Government Agencies citations	Government Agencies (abbreviate name)	Category	Any Miscitation <sup>a</sup>	Miscitations <sup>b</sup>	Why was this a miscitation?	Interpretation or feedback of the citation
1	PSA Grocery Shopping Tips in COVID-19 (See Important Notes Below) <a href="http://www.DrJeffVW.com">www.DrJeffVW.com</a>	5	NIH	Survival on Surfaces	No	N.A. <sup>c</sup>	N.A.	N.A.
			NIH	Hazardous Food/food packages	Yes	"Following the logic, keep groceries on garage or porch for 3 days."	Although the NIH reported that the virus can live on surfaces for up to 3 days, it was never suggested to leave groceries in the garage or porch for 3 days.	N.A.
			CDC	Survival on Surfaces	No	N.A.	N.A.	N.A.
			CDC	Sanitizing Surfaces	No	N.A.	N.A.	N.A.
			CDC	Handwashing	No	N.A.	N.A.	N.A.
2	Coronavirus tips: How to grocery shop safely during COVID-19 pandemic	1	USDA	Washing fruits and vegetables	No	N.A.	N.A.	N.A.
5	Grocery Shopping Tips in COVID-19 Revised (March 31, 2020) <a href="http://www.DrJeffVW.com">www.DrJeffVW.com</a>	2	NIH	Survival on Surfaces	No	N.A.	N.A.	N.A.
			CDC	Sanitizing Surfaces	No	N.A.	N.A.	N.A.
7	How to wash fruits & vegetables amid coronavirus pandemic	1	FDA	Washing fruits and vegetables	No	N.A.	N.A.	N.A.
9	PSA Package & Delivery Tips for COVID-19	1	NIH	Survival on Surfaces	No	N.A.	N.A.	N.A.

11	People are more dangerous than food! (COVID-19 food safety tips)	2	FDA	Hazardous food/food packages	No	N.A.	N.A.	"It is conceivable, it is possible, but the experts as yet are not terribly worried about it."
			CDC	Hazardous food/food packages	No	N.A.	N.A.	"It is conceivable, it is possible, but the experts as yet are not terribly worried about it."
12	How to handle your groceries during the COVID-19 outbreak	1	USDA	Hazardous food/food packages	No	N.A.	N.A.	"You don't need to wash meat, poultry or eggs."
15	Doctors weigh in on people cleaning groceries	1	CDC	Survival on Surfaces	No	N.A.	N.A.	N.A.
17	Can You Get Coronavirus Through Food?	2	USDA	Hazardous food/food packages	No	N.A.	N.A.	"Corona beer isn't the only food or beverage item which poses zero risk of spreading this dreaded virus."
			CDC	Hazardous food/food packages	No	N.A.	N.A.	"There just isn't any risk to us from the animal products we purchase and consume." (about COVID-19)
19	To clean or not to clean your groceries in the age of coronavirus	5	FDA	Hazardous food/food packages	No	N.A.	N.A.	"It is very difficult to prove a negative." (referring to the expression "There is no evidence...")
			CDC	Hazardous food/food packages	No	N.A.	N.A.	"It is very difficult to prove a negative." (referring to the expression "There is no evidence...")
			EPA	Sanitizing Surfaces	No	N.A.	N.A.	N.A.
			USDA	Washing fruits and vegetables	No	N.A.	N.A.	N.A.

			USDA	Hazardous food/food packages	No	N.A.	N.A.	"Normal cooking should kill the coronavirus." "This are the people that will give you the information that you need to be safe..."
20	COVID-19: Food Safety and Nutrition	2	CDC	General Practices	N.A.	N.A.	N.A.	Don't listen to actors, polititians, your neighbor, or read something from a crazy headline." This are the people that will give you the information that you need to be safe...
			NIH	(Practices in general)	N.A.	N.A.	N.A.	Don't listen to actors, polititians, your neighbor, or read something from a crazy headline."
21	Safe Grocery Shopping: U of G Expert Dispels Myths	2	Government of Canada	Washing fruits and vegetables	No	N.A.	N.A.	"The soap that you could use could actually cause vomiting and diarrhoea."
			FDA	Washing fruits and vegetables	No	N.A.	N.A.	"The soap that you could use could actually cause vomiting and diarrhoea."
25	Safe Use Of Bleach And How To Sanitize Your Groceries During Coronavirus	2	CDC	Sanitizing Surfaces	No	N.A.	N.A.	N.A.
			CDC	Sanitizing Surfaces	No	N.A.	N.A.	N.A.
27	How to Wash Produce during COVID-19 and Beyond	6	CDC	Survival on Surfaces	No	N.A.	N.A.	"But that apple, don't know. So out of an abundance of caution let's consider our produce contaminated with coronavirus."

			CDC	Survival on Surfaces	No	N.A.	N.A.	N.A.
								"So it looks pretty unlikely that you could get COVID-19 from eating coronavirus laced food. And just for the record, the whole story about Americans thinking that they can get coronavirus from drinking a Corona beer, not true; just some survey questions taken out of context."
			FDA	Hazardous food/food packages	No	N.A.	N.A.	"Pandemic or not, you should always wash your produce before eating it."
			FDA	Washing fruits and vegetables	No	N.A.	N.A.	"Pandemic or not, you should always wash your produce before eating it."
			USDA	Washing fruits and vegetables	No	N.A.	N.A.	"Pandemic or not, you should always wash your produce before eating it."
			NSF	Washing fruits and vegetables	No	N.A.	N.A.	"Pandemic or not, you should always wash your produce before eating it."
28	Can coronavirus (COVID-19) live on groceries? Are they safe to bring home?	2	FDA	Grocery store practices	Yes	"There is no clear guidance from either the CDC or the FDA." (groceries handling)	The FDA, in its official website, posted an article named "Shopping for Food During the COVID-19 Pandemic - Information for Consumers."	"So I'm just gonna give you my personal practical opinion. When you are in public assume that every surface you touch, is potentially contaminated."

								The CDC, in its official website, has information related to COVID-19 and Food Safety. They also refer to the FDA official website for more information.	"So I'm just gonna give you my personal practical opinion. When you are in public assume that every surface you touch, is potentially contaminated."
31	10 Ways the Fast Food Industry is AFFECTED by the Coronavirus	2	CDC	Grocery store practices	Yes	"There is no clear guidance from either the CDC or the FDA." (groceries handling)			
			CDC	Handwashing	No	N.A.	N.A.		"Thankfully COVID-19 is nothing like the plague, but it still requires us to be vigilant about hygiene."
			FDA	Hazardous food/food packages	No	N.A.	N.A.		N.A.
33	12 Tips for Grocery Shopping During the Pandemic.	1	FDA	Grocery store practices	No	N.A.	N.A.		Video from the FDA.
34	DDP talks Food Safety in your home.	1	CDC	Handwashing	No	N.A.	N.A.		N.A.
38	PSA Covid19: Safe Grocery Shopping with a Grocery Store CEO	1	CDC	Sanitizing Surfaces	No	N.A.	N.A.		N.A.
39	What to eat in isolation   COVID-19 Ask an expert	6							
			Government of Canada	Handwashing	No	N.A.	N.A.		N.A.
			Government of Canada	Sanitizing Surfaces	No	N.A.	N.A.		N.A.
			Government of Canada	Sanitizing Surfaces	No	N.A.	N.A.		N.A.
			Government of Canada	Sanitizing Surfaces	No	N.A.	N.A.		N.A.
			Government of Canada	Grocery store practices	No	N.A.	N.A.		N.A.
			Government of Canada	Washing fruits and vegetables	No	N.A.	N.A.		N.A.
43	What You Need to Know: Food and COVID-19	1	FDA	Hazardous food/food packages	No	N.A.	N.A.		Video from the FDA.
45	Inside America's Food Supply Chain Under Covid-19   Forbes	1	USDA	Hazardous food/food packages	No	N.A.	N.A.		"The chain is at risk, because its workers are at risk."

	HOW TO CLEAN YOUR GROCERIES FROM COVID-19   Grocery Shopping Coronavirus Safety    Doctor ER Covid-19 food safety tips   Quarantine Cooking Show							
50		1	CDC	Sanitizing Surfaces	No	N.A.	N.A.	N.A.
51		2	FDA	Hazardous food/food packages	No	N.A.	N.A.	N.A.
			FDA	Washing fruits and vegetables	No	N.A.	N.A.	"If you want to do more than that, you can rinse or spray your fresh produce with a solution that is three parts water and one part vinegar. If you're really concerned about fresh produce, only buy kind that you would peel or cook."
58	CDC offers tips to be safe from COVID-19 when you shop for groceries	4	CDC	Handwash ing	No	N.A.	N.A.	N.A.
			CDC	Sanitizing Surfaces	No	N.A.	N.A.	N.A.
			CDC	Grocery store practices	No	N.A.	N.A.	N.A.
			CDC	Grocery store practices	Yes	Safety tips for shopping: Throw out plastic bags, cardboard.	Although the CDC posted to discard packaged food after a disaster (like containers that have touched flood waters), it was not suggested as a tip to reduce the incidence of COVID-19.	N.A.
66	Is food delivery safe? Does cooking kill the coronavirus? An expert answers	4	CDC	Hazardous food/food packages	No	N.A.	N.A.	N.A.



commonly asked questions								
			FDA	Hazardous food/food packages	No	N.A.	N.A.	N.A.
			FDA	General Practices	No	N.A.	N.A.	"I strongly urge consumers to use good food safety practices at this time."
			USDA	General Practices				"I strongly urge consumers to use good food safety practices at this time."
72	Does Cooking & Freezing Food Affect the Coronavirus?	1	EPA	Sanitizing Surfaces	No	N.A.	N.A.	N.A.
			CDC					
75	Food Safety During the COVID-19 Outbreak	3	USDA	Hazardous food/food packages	No	N.A.	N.A.	"It's not a gastrointestinal disease, so a person cannot get sick by ingesting food that may be contaminated with COVID-19."
			FDA					
79	Is grocery store food, take-out food safe to eat?	1	CDC	Hazardous food/food packages	No	N.A.	N.A.	N.A.
82	Coronavirus food safety tips for takeout and delivery	2	FDA	Hazardous food/food packages	No	N.A.	N.A.	"That's great news for New Mexicans who want to keep our local restaurants in business."
			FDA	Hazardous food/food packages	No	N.A.	N.A.	N.A.
84	Coronavirus, Food Packaging, and Ways to Prevent the Spread of COVID-19	2	CDC	Hazardous food/food packages	No	N.A.	N.A.	N.A.
			USDA					
85	More than 800 cases of COVID-19 at 19 NC food and meat processing plants	2	CDC	Hazardous food/food packages	No	N.A.	N.A.	N.A.
			USDA					

<sup>a</sup> The criteria for miscitation information are based on current available information from Government Agencies and was checked by the reviewers.

<sup>b</sup> This section is filled if there was a miscitation in the video. It describes the miscitation in the video.

<sup>c</sup> Not applicable

## **APPENDIX F: COVID-19 AND FOOD SAFETY SURVEY QUESTIONS**

### **Study Screening Questions:**

1. Are you the primary food preparer in the household?
  - ☐ Yes
  - ☐ No
2. Are you the primary grocery shopper in the household?
  - ☐ Yes
  - ☐ No

### **Demographic screening questions:**

3. What is your gender?
  - ☐ Male
  - ☐ Female
4. What is your age?
  - ☐ 18-24
  - ☐ 25-34
  - ☐ 35-44
  - ☐ 45-54
  - ☐ 55-64
  - ☐ 65 and above
5. In which state do you reside
  - ☐ All states in the United States listed in alphabetical order starting with Alabama
  - ☐ I do not reside in the United States
6. What is your ethnicity?
  - ☐ White (non-Hispanic)
  - ☐ Hispanic
  - ☐ Black or African American
  - ☐ Asian or Pacific Islander
  - ☐ Native American
  - ☐ Other
7. Would you give us a guess of your total household's income (previous year) before taxes?
  - ☐ Less than \$10,000

- \$10,000 - \$29,999
  - \$30,000 - \$49,999
  - \$50,000 - \$79,999
  - \$80,000 and above
  - Prefer not to answer
8. What is your education level?
- Not High School Graduate
  - High School or GED Degree
  - Bachelor's Degree
  - Graduate Degree
  - Prefer not to answer
9. How many years of experience do you have in preparing meals?
- Less than 1 year
  - 1-3 years
  - 3-5 years
  - Over 5 years
10. How many people (including yourself) live in the household?
- 1
  - 2
  - 3
  - 4
  - 5
  - More than 5
11. Do you or the people living in the household have the following conditions? (Select all that apply)
- Children younger than age 5
  - People ages 65 and over
  - Diabetes
  - Lung conditions
  - Liver or kidney diseases
  - HIV/AIDS
  - Cancer
  - Immunocompromised, including organ transplant patients
  - If you are paying attention, please select this option
  - None of the above

*End survey if respondent doesn't select "If you are paying attention, please select this option"*

12. During the COVID-19 pandemic, does anyone (including yourself) in the household still go out to work?
- Yes
  - No

13. Has anyone in your household ( including yourself) been tested to see whether or not they have COVID-19?

- ☐ Yes
- ☐ No

*Display question 14 if respondent selected “Yes” to question 13*

14. Did the test for COVID-19 come out **positive** for COVID-19?

- ☐ Yes
- ☐ No

**Questions 15-18 contain a scale (0-100) where respondents can slide a bar to choose a number.**

15. How concerned are you about food safety? Slide the bar with 0 being not concerned at all and 100 being very concerned.

16. How much confidence do you have in your food safety measures? Slide the bar with 0 being not confident at all and 100 being very confident.

17. How much risk do you perceive yourself getting COVID-19 from **other people**? Slide the bar with 0 being no risk and 100 being extremely risky.

18. How much risk do you perceive of yourself getting COVID-19 **from food**? Slide the bar with 0 being no risk and 100 being extremely risky.

19. What food products do you buy **before COVID-19** and **right now**? (Select all that apply)

Fresh Fruits (Eaten **with** the peel like apples and berries)

- ☐ Before COVID-19
- ☐ Right Now

Fresh Fruits (Eaten **without** the peel like bananas)

- ☐ Before COVID-19
- ☐ Right Now

Fresh Vegetables (Eaten **raw** like leafy greens and salads)

- ☐ Before COVID-19
- ☐ Right Now

Fresh Produce ( Eaten **cooked** like eggplant)

- ☐ Before COVID-19
- ☐ Right Now

Raw Meat

- ☐ Before COVID-19
- ☐ Right Now

Raw Poultry

- ☐ Before COVID-19
- ☐ Right Now

Raw Fish

- ☐ Before COVID-19
- ☐ Right Now

Deli Meat (Sliced ham, sliced turkey etc.)

- ☐ Before COVID-19
- ☐ Right Now

20. During the COVID-19 pandemic, do you order take-out food from restaurants?

- ☐ Yes
- ☐ No

*Display question 21 if respondent selected “Yes” to question 20*

21. What kind of service do you use for getting take-out food from restaurants during COVID-19 pandemic? (Select all that apply)

- ☐ Food Delivery app/ website
- ☐ Pick up food from inside the restaurants
- ☐ Pick up from curbside (outside) of restaurants
- ☐ If you are paying attention, please select this option
- ☐ Other (Please specify)

*End survey if respondent doesn't select “ If you are paying attention, please select this option ”*

*Display question 22- 25 if respondent selected “Yes” to question 20*

**Questions 22-27 contain a scale (0-100) where respondents can slide a bar to choose a number.**

22. How much risk do you perceive of yourself getting COVID-19 from take-out **FOOD** that you get from restaurants? Slide the bar with 0 being no risk and 100 being extremely risky.
23. How much risk do you perceive of yourself getting COVID-19 from take-out **FOOD THAT IS HOT (from a grill or fryer)** that you get from restaurants? Slide the bar with 0 being no risk and 100 being extremely risky.
24. How much risk do you perceive of yourself getting COVID-19 from take-out **FOOD THAT IS COLD (salads, sushi, fresh fruits and vegetables)** that you get from restaurants? Slide the bar with 0 being no risk and 100 being extremely risky.
25. How much risk do you perceive of yourself getting COVID-19 from the **food package** that you get from restaurants? Slide the bar with 0 being no risk and 100 being extremely risky.
26. How much do you believe hand washing can protect you from **COVID-19**? Slide the bar with 0 being you do not believe and 100 being you believe completely.
27. How much do you believe hand washing can protect you from **Foodborne illness**? Slide the bar with 0 being you do not believe and 100 being you believe completely.

28. Have you received any food safety information during COVID-19?

- ☐ Yes
- ☐ No
- ☐ I don't know

29. Who do you **trust** to get information on food safety and COVID-19? (Select all that apply)

Food and Drug Administration (FDA)

- ☐ Food Safety
- ☐ COVID-19

Centers for Disease Control and Prevention (CDC)

- ☐ Food Safety
- ☐ COVID-19

World Health Organization (WHO)

- ☐ Food Safety
- ☐ COVID-19

Social media Influencers (YouTubers you subscribe to, bloggers you follow)

- ☐ Food Safety
- ☐ COVID-19

TV Show hosts (Dr. Oz, Ellen etc.)

- ☐ Food Safety
- ☐ COVID-19

Family or friends

- ☐ Food Safety
- ☐ COVID-19

Health professionals (doctors, nurse, physician assistant, nutritionists, dietitians etc.)

- ☐ Food Safety
- ☐ COVID-19

Other (Specify)

- ☐ Food Safety
- ☐ COVID-19



30. Where do you **get** information on food safety and COVID-19? (Select all that apply)

Online Websites

- ☐ Food Safety
- ☐ COVID-19

Social Media (Twitter, Facebook etc.)

- ☐ Food Safety
- ☐ COVID-19

YouTube

- ☐ Food Safety
- ☐ COVID-19

Print Material (booklets, pamphlets, brochures, papers etc.)

- ☐ Food Safety
- ☐ COVID-19

Email Listservs (an email subscription program that sends emails to those who sign up)

- ☐ Food Safety
- ☐ COVID-19

TV News

- ☐ Food Safety
- ☐ COVID-19

Newspapers

- ☐ Food Safety
- ☐ COVID-19

Magazines

- ☐ Food Safety
- ☐ COVID-19

Word of mouth

- ☐ Food Safety
- ☐ COVID-19

Healthcare provider messaging system (automatic phone calls, emails)

- ☐ Food Safety
- ☐ COVID-19

Other (Specify)

- ☐ Food Safety
- ☐ COVID-19

**Questions 31-40 contain a scale (0-100) where respondents can slide a bar to choose a number with 0 being never, 50 being sometimes, and 100 being always.**

31. How does COVID-19 affect your **personal hygiene** practices? Drag the scale to indicate how much you are practicing the following behavior: **I wash my hands with water.**
- Before COVID-19 Pandemic
  - During COVID-19 Pandemic
  - After COVID-19, how much do you anticipate that you will practice this behavior?
32. How does COVID-19 affect your **personal hygiene** practices? Drag the scale to indicate how much you are practicing the following behavior: **I wash my hands with soap.**
- Before COVID-19 Pandemic
  - During COVID-19 Pandemic
  - After COVID-19, how much do you anticipate that you will practice this behavior?
33. How does COVID-19 affect your **personal hygiene** practices? Drag the scale to indicate how much you are practicing the following behavior: **I use hand sanitizer.**
- Before COVID-19 Pandemic
  - During COVID-19 Pandemic
  - After COVID-19, how much do you anticipate that you will practice this behavior?
34. How does COVID-19 affect your **personal hygiene** practices? Drag the scale to indicate how much you are practicing the following behavior: **I wear face masks.**
- Before COVID-19 Pandemic
  - During COVID-19 Pandemic
  - After COVID-19, how much do you anticipate that you will practice this behavior?
35. How does COVID-19 affect your **food handling** practices? Drag the scale to indicate how much you are practicing the following behavior: **I wash fruits and vegetables with water.**
- Before COVID-19 Pandemic
  - During COVID-19 Pandemic
  - After COVID-19, how much do you anticipate that you will practice this behavior?
36. How does COVID-19 affect your **food handling** practices? Drag the scale to indicate how much you are practicing the following behavior: **I wash fruits and vegetables with soap.**
- Before COVID-19 Pandemic
  - During COVID-19 Pandemic
  - After COVID-19, how much do you anticipate that you will practice this behavior?

37. How does COVID-19 affect your **food handling** practices? Drag the scale to indicate how much you are practicing the following behavior: **I use a food thermometer to ensure meat is fully cooked.**
- ☐ Before COVID-19 Pandemic
  - ☐ During COVID-19 Pandemic
  - ☐ After COVID-19, how much do you anticipate that you will practice this behavior?
38. How does COVID-19 affect your **food handling** practices? Drag the scale to indicate how much you are practicing the following behavior: **I use a refrigerator thermometer to monitor my refrigerator temperature.**
- ☐ Before COVID-19 Pandemic
  - ☐ During COVID-19 Pandemic
  - ☐ After COVID-19, how much do you anticipate that you will practice this behavior?
39. How does COVID-19 affect your **Kitchen cleanliness**? Drag the scale to indicate how much you are practicing the following behavior: **How much are you washing, with soap and water, high-touch surfaces in your kitchen?**
- ☐ Before COVID-19 Pandemic
  - ☐ During COVID-19 Pandemic
  - ☐ After COVID-19, how much do you anticipate that you will practice this behavior?
40. How does COVID-19 affect your **Kitchen cleanliness**? Drag the scale to indicate how much you are practicing the following behavior: **How much are you sanitizing high-touch surfaces in your kitchen.**
- ☐ Before COVID-19 Pandemic
  - ☐ During COVID-19 Pandemic
  - ☐ After COVID-19, how much do you anticipate that you will practice this behavior?
41. Which of the following preventative measures are you taking to protect yourself and others from COVID-19? (Select all that apply)
- ☐ Avoid social gatherings of people
  - ☐ Wearing a face mask when I leave the house and I see other people
  - ☐ Practicing social distancing
  - ☐ Avoiding public transportation
  - ☐ Staying home if you are sick
  - ☐ If you are paying attention, please do not select this option
  - ☐ None of the above

*End survey if respondent does select “ If you are paying attention, please do not select this option”*

42. During the COVID-19 pandemic, when do you wash your hands with soap and water?  
(Select all that apply)

- ☐ After coming back from grocery shopping
- ☐ After receiving delivered food packages
- ☐ After picking up food from restaurants
- ☐ After arriving home from outside
- ☐ Before cooking or handling food
- ☐ Before eating food
- ☐ After coughing or sneezing
- ☐ After blowing nose
- ☐ After touching garbage
- ☐ After pumping gas at the gas station
- ☐ None of the above

**A video clip was shown to the respondents for question 43**

43. Please review the following video clip and answer the following questions.

Do you trust the information presented in the video?

- ☐ Yes
- ☐ No

Do you believe washing fruits and vegetables with soap and water can protect you from COVID-19?

- ☐ Yes
- ☐ No

Do you believe washing fruits and vegetables with soap and water can protect you from **foodborne illness**?

- ☐ Yes
- ☐ No

Will you practice washing fruits and vegetables with soap and water?

- ☐ Yes
- ☐ No

## APPENDIX G: COVID -19 CASES IN THE US BY APRIL 27, 2020

Group	State	Cases	Participants %(n) <sup>b</sup>
High (H) <sup>a</sup>	New York	288,045	77(33)
	New Jersey	109,038	
	Massachusetts	54,938	
	Illinois	43,903	
	California	43,720	
	Pennsylvania	42,616	
	Michigan	37,778	
	Florida	31,532	
	Louisiana	26,773	
	Connecticut	25,269	
	Texas	24,968	
	Georgia	23,481	
	Maryland	19,487	
	Ohio	15,972	
	Indiana	15,012	
	Virginia	13,538	
	Washington	13,521	
	Colorado	13,441	
Low- Medium (LM)	Tennessee	9,667	10(23)
	North Carolina	9,002	
	Rhode Island	7,439	
	Missouri	7,201	
	Arizona	6,534	
	Alabama	6,429	
	Mississippi	5,911	
	Wisconsin	5,911	
	South Carolina	5,498	
	Iowa	5,476	
	Nevada	4,734	
	Utah	4,123	
	Kentucky	4,078	
	Delaware	4,034	
	District of Columbia	3,892	
	Minnesota	3,602	
	Kansas	3,292	
	Oklahoma	3,254	
	Nebraska	3,028	
	Arkansas	3,001	
	New Mexico	2,726	
	Oregon	2,311	
	South Dakota	2,212	

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Idaho	1,897
New Hampshire	1,864
Puerto Rico	1,389
West Virginia	1,055
Maine	1,015
North Dakota	867
Vermont	851
Hawaii	606
Wyoming	502
Montana	448
Alaska	340

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<sup>a</sup> High Groups consisted of states which had higher than 10,000 cases by April 27, 2020

<sup>b</sup> These are the total participants at the beginning of the study. This does not count those who dropped out.

## APPENDIX H: FOCUS GROUP CODE BOOK

Code <sup>a</sup>	Definition	Type of code	Example
1. At High Risk	If the participants mention that they or family members that live with them are immunocompromised or consider themselves to be at a higher risk for infection.	Attribute	“I have an autoimmune disease, so I have to be extra careful and make sure that I’m protecting myself 100%.”
2. Healthcare worker	If the participants mention that they work in healthcare or hospital setting.	Attribute	“I’m currently an essential worker with a hospital so I have to go out to work so luckily, I haven’t been furloughed but I make do with what I can for the moment.”
3. Living with Children	If the participants mention living with children who are young (infant to 5 years old)	Attribute	“My wife and I both work for home as there is no childcare for the last 7 weeks for our young child so we’re working on being as efficient as we can without kind of boiling over at each other, so, it’s been a bit of a challenge for sure.”
4. Frustrations toward others	The participants express their frustrations or experiences of some people are taking the pandemic it seriously while some are not. They also mention some wear masks, and some do not.	Emotion	“it seems to be about 50/50, people who are taking this very seriously and others who just aren’t. I think we’re really kind of rushing back into reopening everything without having adequate testing or contact tracing.”
5. Questioning truth about Pandemic	If the participant expresses that they don’t believe the pandemic is real or they don’t know for sure.	Emotion	yeah but you don't really know if they're dying or not. You don't really know who's dying.
6. Job Changes	When participants talk about changes with their job status, where they work or how they work (remote).	Descriptive	“I was a substitute teacher and also a ticker broker for concert tickets across the U.S. So, essentially, I’ve lost both of those jobs and collecting unemployment and also getting the CARES Act.”

7. Restricted visiting during Pandemic	When the participants mention not being able to visit people, restrictions for hospital visitors and not allowing people into their home.	Descriptive	“Not having anybody come in the house at all. We had no visitors, it’s just me and my roommate. Just been kind of holed up in here and you know we’re even keeping our distant from each other so.”
8. Fear of spreading COVID	If the participants show a concern or fear of spreading COVID-19 to other people or other people spreading it.	Emotion	“I’m more so concerned about, if I were to get exposed, spreading it to other people than getting sick myself.”
9. Practices	If the participants mention any practices that they are taking to reduce the risk of getting COVID-19 (not from food). These include masks, gloves, hand sanitizer, washing hands, social distancing, following guidelines and more.	Descriptive	“I keep a mask with me at everywhere I usually take one, but I also keep on in the car and in my purse and I keep my gardening gloves too, so I make sure that when I’m in a store I’m wearing my gloves. When I get back in my car, I take off the gloves and do the hand sanitize thing.”
10. Sanitizing	When the participants mention sanitizing other surfaces that are not food or food related.	Process	“I was sanitizing my countertop in my kitchen with the bleach and water combination.”
11. Confidence in Effectiveness	When participants mention if the practices that they are effective, if one practice is more effective or if the practices are not effective (not food practices).	Emotion	“I think that if people follow the guidelines at least well until the scientists have figured this out and come out with either a cure or a vaccine that we’re all going to be safer.”
12. Avoiding Grocery Stores	When a participant mentions they limit the number of times they go to the grocery store, that they try to avoid is by ordering online, or doing something else to avoid going to the grocery store	Process	“my family they have been going around our community and finding people that grow fresh fruits and fresh veggies in their community and they've been buying their tomatoes and stuff that way and some of the veggies from other people around the neighborhood gardens so that's what they've been doing instead of even going to the store and risking it”



13. Not concerned about Food	When participants mention they are not concerned about food safety during this pandemic. They could be more concerned about other people or leaving the house to get food.	Descriptive	“The food is probably honestly my least concern with corona. I’m more about like not getting close to people wearing a mask, using disinfectant, hand sanitizer and just kind of isolating in my house and having. I’ve hanged out with probably two friends, limited contact.”
14. Exposure to Food	When a participant mentions they are concerned about food safety because of other people breathing, exposed to or touching food or food packages from grocery stores or online grocery orders.	Descriptive	“It’s like when you go to the grocery store, you don’t know how long fresh food has been sitting there so you’re wondering how long people have been exposed to it. I do wish some grocery stores would just put everything in some kind of container or just cover it more so it’s not just sitting out so someone who doesn’t happen to be wearing a mask just breathes on it or something like that.”
15. Cleaning groceries	A participant talks about how they clean their groceries including packages, bags, produce, canned goods, freezing and other practices they use to avoid getting COVID-19 from food. This doesn’t include cooking the food.	Process	“Yes, ahh well I did mention before that I do sanitize my fruits and vegetables because I just have nightmares of people going into stores touching everything and leaving it behind for someone else. I don’t know what they’re leaving behind. So, for me personally I’m not abdicating for everyone but for me personally I’m better making sure that I take care of any fruit or vegetables. Even my bananas before I eat them.”
16. Not Cleaning Groceries	Participants mention that they don’t clean their groceries (wash, wipe etc.)	Process	“I’ve been a lot less the food safety hasn’t bother me so much more the fact that I would have to leave the house

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			to get food I saw the video of the guy washing down his grocery and all of that to be honest I haven't done that, and we seem to be fine. We do get fresh fruits and vegetables but for the most part things are cooked anyways I mean I suppose I'm touching them, but we wash our hands a lot, so I haven't gone overboard with any of that stuff."
17. Cooking to Kill the Virus	When the participants mention that cooking the food kills the virus or that hot foods kill the virus. If they mention temperature or checking if meat is done, it was coded here as well.	Process	"I'll just say that most likely if the food has been already cooked and its hot, you know for 5 or 10 minutes whether you get that food delivered to you cold or hot it really doesn't matter. As long as the food was cooked for 5 to 10 minutes at basically 185-degree Fahrenheit you should be okay people as far as handling the packages of food that's something separate."
18. Helping Local Restaurants	When Participants mention helping or supporting restaurants (takeout and ordering food from them).	Process	"my family and I have tried to help out a lot of local and small businesses and you know we've increased our takeout and we're getting food from different restaurants."
19. Confidence in Other People Cooking	When participants mention not trusting other people (restaurants for example) cooking their food for them during the pandemic. These could also be experiences they shared.	Emotion	"I've been very conflicted about ordering takeout just because I want to support local businesses that are struggling right now especially in New York City and what not, but at the same time you don't know who's touching your food. Umm, I'm a little bit hesitant to order takeout."

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20. Diet Changes	When participants mention foods that they avoid (because of COVID-19), foods that they eat, and when they still eat the same foods as before. Not Food shortage.	Descriptive	“We’ve have always bought apples, oranges, bananas but typically we also bought berries and greens so the only thing we quit buying were the berries and greens. We still continue with apples, oranges, and bananas and that’s because of the skin.”
21. Food Shortages	When participants mention foods, they can’t eat or buy due to availability or if they mention that there is no food shortage or that foods have become available.	Descriptive	“I was able to go to the grocery store Saturday my son took me and there was no beef so I’m fortunate I had already had my freezer stocked most of my pantry and everything is stocked, um we can’t buy meat.”
22. Expensive Meat	When a participant mentions that the price of meat has gone up during the COVID-19 pandemic.	Descriptive	This example comes up in the July sessions
23. Ordering Takeout	When participants mention how many times or how frequently they order takeout or food from restaurants (including drive-thru). This could also be none.	Descriptive	“I think I’ve done one drive thru a week and one takeout, no delivery”
24. Food Delivery and Takeout Practices	When participants mention the practices or measures that they take when they takeout food or have it delivered from restaurants (wiping down packages, sanitizing, moving food to another container, choosing to pick up to avoid others handling food, choosing contactless delivery etc.)	Descriptive	“Usually, we’ll use the wipes in our car to wipe down the outside of whatever container the food’s coming in.”
25. Plant Shutdown	When participants mention the recent plant shutdowns (especially the meat plants) and their concerns or lack of concern about it.	Emotion	Well because of the meat packing plant that have had high level of COVID 19 cases and is that something one needs to be concerned about. I

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26. Hand Cleaning Beyond COVID	When participants mention if they will wash hands or use sanitizer after the pandemic and why. Some people just say No.	Process	just don't know. It's just struggling. "Definitely I'm a freak with washing my hands I do it like a bazillion times a day. It just freaks me out knowing you touch so much stuff."
27. Wearing Masks Beyond COVID	When participants mention if they will wear masks after the pandemic and why.	Process	"when I think about wearing the mask I think about my travels to Asia. Asian especially Chinese and Japanese people wear mask all the time seemingly especially when there in mass transit situations and I see no reason why I shouldn't continue to wear mask even after COVID 19. Especially if I go on the train system or I find myself in a large crowd or go to a ball game why wouldn't I wear a mask from now on."
28. Produce cleaning beyond COVID	When participants mention how they will wash their produce or if they will wash their produce after the pandemic. This can include peeling as well.	Process	"I am but I'm saying a year from now or something I think I'll probably go back to water like you know. Washing it with water as long as we are in a better state. Um, but yea right now I am doing this soap and water."
29. Wiping down Groceries beyond COVID	When participants mention how they will wipe down their groceries or if they will wipe down their groceries after the pandemic.	Process	"Yeah, I don't do that I don't expect that I will do that."
30. Mask Frustrations	When participants express their concerns or frustrations about wearing masks	Emotion	"I can't breathe with them on like claustrophobic something I have a lot of trouble breathing with these masks and even when I was in China and Japan and I saw people wearing them years and years ago I tried a few times and I

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31. Hand Sanitizer Woes	When participants express their concern about or question the use of hand sanitizers	Emotion	just can't get comfortable wearing a mask." "Like I've always done that a little less with the hand sanitizer because it's you know so drying for my hand and I have I have like eczema and very sensitive to it so um I think that it definitely I wish I could use that less"
32. Unknown Future	When participants express their feelings about the future with the pandemic. How the world will change or questions on how things will be.	Emotion	"It's just going to be crazy on how things are going to change because you can't share anything anymore just to give someone even a free piece of candy I mean think of Halloween what is that going to look like this year."
33. Food Safety Information	When participants mention that they have not or have received or seen food safety information. They can also mention where they got it from.	Descriptive	"it's pretty much just on the news or you hear about it as far as getting emails from vendors or businesses, I don't really get anything about food safety but it's on the news. I get it on the news or from word-of-mouth or from friends or people sharing YouTube videos on food safety."
34. Trusting Healthcare and experts	When a participant expresses their reasons for trust/ mistrust of healthcare professionals and experts in regard to getting food safety information during the pandemic.	Emotion	"I trust the more because they have the expertise and the knowledge, and they do research and all that. So, they seem more trustworthy than other sources."
35. Trusting Family and Friends	When a participant expresses their reasons for trust/ mistrust of family and friends in regard to getting food safety information during the pandemic.	Emotion	"Family and friends, out of my family and friends I'm probably the most informed on the information so they would probably be looking to me for it."
36. Trusting the Government	When a participant expresses their reasons for trust/ mistrust of the government in regard to getting food safety	Emotion	"I think we've got some of the smartest people in the world on this, not just in our government but in various world-wide governments and

	information during the pandemic.		some of them thoughts are less bias because their fund doesn't come from a certain organization so sites like the FDA and the CDC are really what I trust the most."
37. Trusting TV News	When a participant expresses their reasons for trust/ mistrust of the TV News in regard to getting food safety information during the pandemic.	Emotion	"Yeah sometimes T.V. depending on what station and what I'm watching local news I would trust more than I would trust any of the cable news station because I believe cable news station are slanted in either one way or the other."
38. Trusting Social Media and online websites	When participants express their reasons for trust/ mistrust of social media or online websites for food safety information during the pandemic.	Emotion	"I worry about what's on social media because so much mis information and you never know if it's coming from a legit source or not."
39. Hard to trust anyone	When participants express that they don't trust anyone or don't know who to trust for their food safety information during the pandemic.	Emotion	"it's hard to know who to trust because our government gives us information, but they could give us more, I feel like some doctors argue with each other than work together to figure things out."
40. Information Overload	When participants express their feelings about the large amount of information that they get regarding covid-19	Emotion	"I guess I don't really have a definitive answer, but we've been bombarded with it daily from every angle so it's hard to pinpoint one origin"
41. Lack of information	When participants express their thoughts or concerns about the lack of information that they have gotten in regard to food safety and COVID-19.	Emotion	"And I'm not sure why it hasn't been a priority. All of us haven't really seen a lot of food safety. It's all washing our hands and covering our face and social distancing. There's not a lot. Does that mean it's not really a big deal, you know?"
42. Food Safety Information needed	When participants mention what food safety information they would like to receive during the pandemic.	Descriptive	"I think just the basic facts would be nice. Wash your vegetables don't worry about meat if you cook them properly. Just the basics would

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43. Food Safety Platform	When participants mention how they want to see their food safety information during the pandemic (platform, what they want to see, postcard etc.)	Descriptive	be nice. It's funny now that everybody talking about it how little we've actually heard about in general." "I think point of sale notices would be great like in grocery stores because that's where you're initially dealing with it. I think that would be very helpful."
44. A Little Too Late	When participants mention that they should have gotten food safety information at the very beginning.	Descriptive	I think they should have done information in the very beginning when we wanted it. But now if they come out with something too little too late who cares.
45. Losing Interest	When participant expresses how they are losing interest in the pandemic or frustration about the pandemic not being over.	emotion	You know it's reading those news story on those free newspapers that are coming out even at that I'm kind of losing interest now and I'm just like ugh let's be done with it.
46. Food safety Practices Pre-COVID	When a participant mentions they have been doing some food safety practice (washing vegetables for example) before COVID-19.	Descriptive	"I've always kind of washed fresh produce you know if it's going to be eaten raw and most of the time I'll wash it to even if it's going to be cooked because you're still touching it and stuff like that."
47. Awareness of Foodborne illness	When participants mention if they were or were not aware or cautious of Foodborne illness before COVID-19 pandemic and how. This could be from previous experience cooking or taking courses.	Descriptive	"I worked at um residential house with people with severe pregenital illness and drugs and alcohol and you know we did a lot of food prep, so we had to be really up on our food safety and management of keeping meat separate from other foods and cross contamination and stuff like that, so I've always been kind of mindful of that, so I don't think I really stepped it up anymore except for what I said just been receiving outside

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			packages and washing the fruits. Washing.”
48. Person to Person Influence	When a participant mentions that they will do a practice or are doing a practice if other people do it. This could be for future practices or if one person from the group influenced another to do some practice. Food or non-food related.	Descriptive	“I think that definitely going to be seems as a more acceptable because I know when we were at work before everything started when we first start talking about this we were saying well should we wear mask because that gives them the impression that people are sick not that they are trying to protect people versus we should have people wear mask. I don’t think that’s a discussion people are going to have anymore. People have kind of accepted that as a good thing to do to help keep people healthy.”
49. Dining out	When a participant mentions that they are dining out now.	Descriptive	“I did go out to a restaurant over the weekend but other than that still not really going out or getting together with people.”
50. Hitting Close to Home	When participants mention they know someone who has COVID-19, has suffered from it or has passed away from it.	Descriptive	“I have a friend who's 30 and no underlying issues who died and a friend whose dad does have underlying conditions and survived”

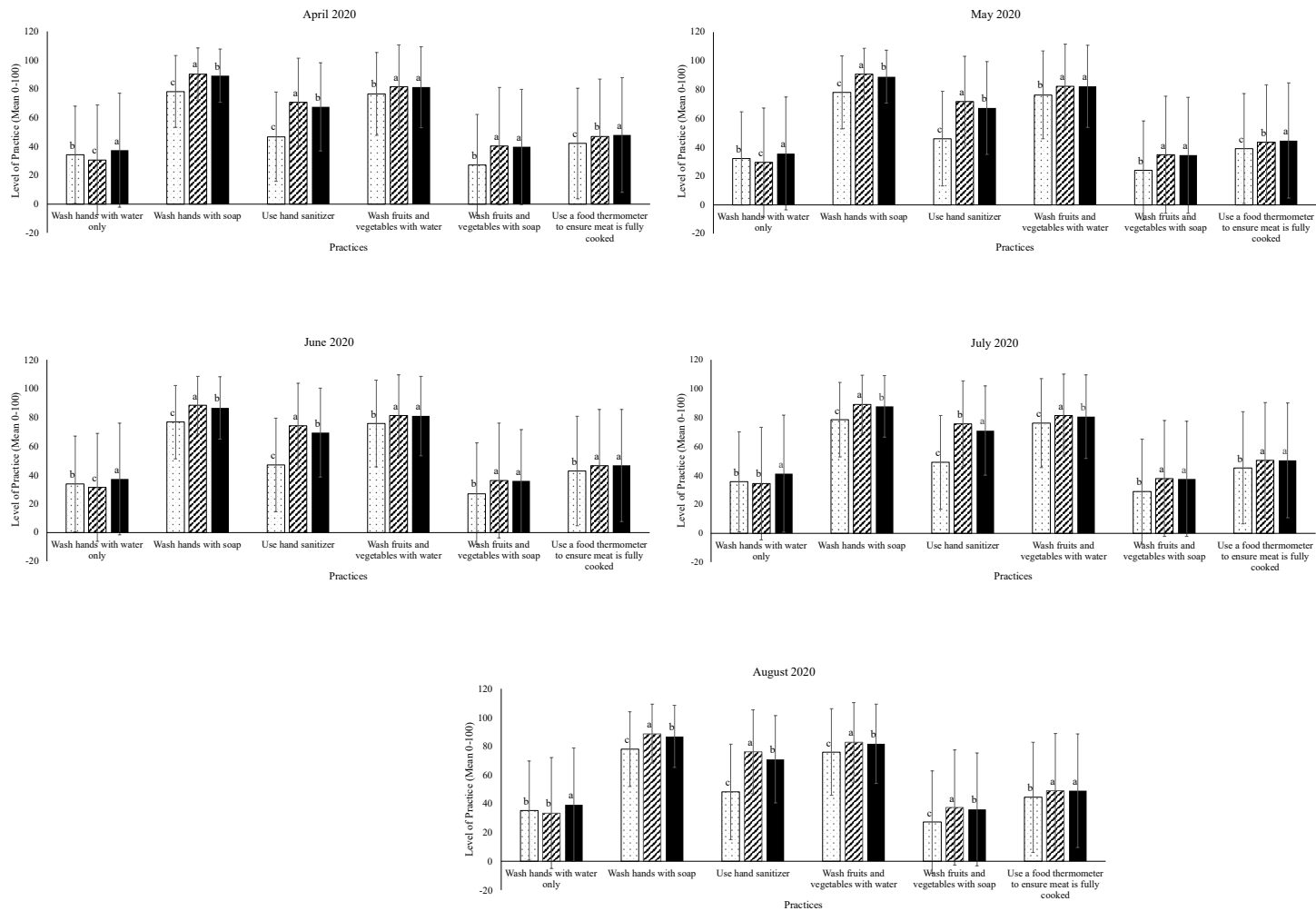
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<sup>a</sup> This list contains all codes. However, only select code were included in the final data analysis and report



APPENDIX I: LEVEL OF PRACTICES BEFORE, DURING, AND ANTICIPATED AFTER COVID-19

[Before (□) ) During (▨) ) and Anticipated After COVID-19 (■)]



## APPENDIX J: DIFFERENCES IN BEHAVIORAL CHANGE (DELTA) BASED OFF SOCIAL DETERMINANTS

April, N= 703

Social Determinates		Handwashing: Water		Handwashing: Soap		Hand Sanitizer		Produce Washing: Water		Produce Washing: Soap		Food Thermometer	
		Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)
Gender	Male	4.22	6.31	-15.66 <sup>a</sup>	-2.44 <sup>a</sup>	-23.64	-4.39	-5.47	-0.70	-12.77	-1.24	-4.72	0.712
	Female	2.72	7.11	-8.50	.05	-24.32	-1.96	-4.27	0.08	-13.51	0.29	-4.95	1.30
Income (USD)	Under 50,000	1.72	6.88	-10.70	-1.09	-21.75	-2.45	-4.97	-0.24	-11.22	0.37	-4.44	1.75
	50,000+	5.57	6.64	-13.80	-1.31	-26.13 <sup>a</sup>	-3.89	-5.54	-0.42	-14.43	-1.22	-5.32	0.44
Ethnicity	White (non-Hispanic)	4.10	6.36	-12.70	-1.54	-24.11	-3.10	-5.43	-0.78 <sup>a</sup>	-13.33	-0.20	-5.27	0.67
	Other Ethnicities	0.84	8.21	-9.80	0.21	-23.39	-3.61	-2.48	1.71	-12.27	-1.75	-2.92	2.43
Age (years)	Under 55	3.50	5.20 <sup>a</sup>	-12.96	-1.00	-24.43	-3.89	-4.36	0.52 <sup>a</sup>	-14.16	-0.55	-5.45	0.79
	55+	3.46	9.32	-10.73	-1.59	-23.18	-2.04	-5.79	-1.77	-11.35	-0.39	-3.75	1.35
Education	Under Bachelor's Degree	0.03 <sup>a</sup>	6.21	-9.98 <sup>a</sup>	-0.39	-21.21 <sup>a</sup>	-3.48	-5.30	-0.56	-10.62 <sup>a</sup>	0.66	-3.32 <sup>a</sup>	1.20
	Bachelor's Degree +	6.01	6.90	-13.79	-1.76	-25.96	-3.23	-4.53	-0.06	-15.19	-1.32	-5.97	0.83

Health conditions in household	Non-risk	2.78	5.52	-12.49	-1.00	-23.60	-3.45	-4.86	-0.02	-11.59	-0.36	-4.89	1.22
	At- risk	4.66	8.68	-11.56	-1.58	-24.59	-2.78	-4.91	-0.81	-15.71	-0.71	-4.74	0.63

May, N= 732

Social Determinates		Handwashing: Water		Handwashing: Soap		Hand Sanitizer		Produce Washing: Water		Produce Washing: Soap		Food Thermometer	
		Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)
Gender	Male	2.37	7.71	-14.08 <sup>a</sup>	-1.84	-25.49	-4.65	-7.26	0.22	-10.73	-0.69	-5.07	0.98
	Female	3.15	4.83	-11.16	-1.56	-25.97	-4.11	-4.82	-0.45	-10.76	0.23	-3.68	1.47
Income (USD)	Under 50,000	0.77 <sup>a</sup>	7.59	-10.37	-1.01	-21.98	-3.94	-5.74	0.36	-10.45	0.30	-3.81	1.29
	50,000+	4.72	5.52	-14.63 <sup>a</sup>	-2.35	-28.60 <sup>a</sup>	-4.66	-6.33	-0.39	-11.00	-0.77	-5.03	1.15
Ethnicity	White (non-Hispanic)	3.72	6.37	-12.99	-1.82	-26.92 <sup>a</sup>	-5.33 <sup>a</sup>	-6.76	-0.21	-10.60	-0.05	-4.06	1.24
	Other Ethnicities	-0.33	6.11	-11.60	-1.34	-21.94	-1.40	-3.89	0.22	-11.20	-0.84	-5.43	1.15
Age (years)	Under 55	3.22	5.60	-12.66	-1.82	-25.32	-4.99	-6.22	0.09	-10.98	-1.20 <sup>a</sup>	-4.65	1.07
	55+	1.88	7.60	-12.65	-1.47	-26.47	-3.28	-5.78	-0.47	-10.31	1.53	-3.91	1.50
Education	Under Bachelor's Degree	2.16	8.01	-11.16	-1.08	-25.91	-3.82	-6.15	0.44	-12.72	0.22	-4.19	1.36
	Bachelor's Degree +	3.58	5.31	-13.89	-2.03	-25.67	-4.54	-6.38	-0.49	-9.51	-0.58	-4.64	1.03
Health conditions in household	Non-risk	3.17	6.85	-12.06	-1.37	-25.04	-4.11	-5.92	0.12	-9.44	0.02	-4.35	1.36
	At- risk	2.06	5.41	-13.62	-2.23	-26.84	-4.85	-6.30	-0.47	-12.87	-0.66	-4.47	0.98

June, N= 707

Social Determinates		Handwashing: Water		Handwashing: Soap		Hand Sanitizer		Produce Washing: Water		Produce Washing: Soap		Food Thermometer	
		Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)
Gender	Male	2.82	4.37	-13.44 <sup>a</sup>	-1.84	-26.10	-4.97	-6.62	-0.80	-8.32	-1.16	-4.72	0.38
	Female	1.78	7.25	-9.66	-1.82	-28.30	-4.68	-4.58	0.17	-9.84	0.75	-2.48	-0.02
Income (USD)	Under 50,000	0.96	8.12 <sup>a</sup>	-11.24	-1.80	-27.25	-4.48	-5.96	0.28	-8.44	0.66	-3.10	0.21
	50,000+	3.19	3.43	-12.30	-1.95	-26.90	-4.80	-5.73	-1.08	-9.85	-1.03	-3.90	0.16
Ethnicity	White (non-Hispanic)	2.91	6.37	-11.62	-1.68	-27.71	-4.76	-5.84	-0.43	-9.44	-0.61	-3.50	0.25
	Other Ethnicities	0.48	3.64	-11.83	-2.32	-25.29	-5.07	-5.07	-0.07	-7.75	0.86	-4.20	-0.00
Age (years)	Under 55	3.33	5.32	-12.03	-1.57	-25.82	-4.21	-5.44	-0.10	-9.74	-0.29	-4.76 <sup>a</sup>	0.17
	55+	0.53	6.46	-11.01	-2.31	-29.51	-5.96	-6.06	-0.80	-7.76	-0.21	-1.69	0.22
Education	Under Bachelor's Degree	0.49	8.26 <sup>a</sup>	-10.11	-1.86	-26.06	-4.89	-4.77	0.14	-9.16	-0.69	-3.09	0.18
	Bachelor's Degree +	3.67	4.00	-12.82	-1.68	-28.17 <sup>a</sup>	-5.01	-6.43	-0.80	-8.75	-0.26	-4.11	0.11
Health conditions in household	Non-risk	2.74	4.98	-11.53	-1.64	-24.56 <sup>a</sup>	-4.51	-6.40	-0.90	-8.30	-0.44	-4.48	0.18
	At- risk	1.67	6.94	-11.89	-2.15	-31.35	-5.35	-4.46	0.56	-10.24	0.03	-2.35	0.20

July, N= 716

Social Determinates		Handwashing: Water		Handwashing: Soap		Hand Sanitizer		Produce Washing: Water		Produce Washing: Soap		Food Thermometer	
		Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)
Gender	Male	0.99	4.46 <sup>a</sup>	-11.77	-1.62	-26.12	-4.95	-6.14	-1.22	-6.96 <sup>a</sup>	-0.12	-5.44	-0.40
	Female	1.36	9.32	-9.15	-1.00	-27.25	-4.53	-4.62	-0.40	-11.25	-0.41	-4.99	0.46
Income (USD)	Under 50,000	-0.02	7.30	-8.15 <sup>a</sup>	-0.69	-22.80 <sup>a</sup>	-3.45	-6.27	-1.34	-9.49	-0.27	-4.40	0.27
	50,000+	2.63	6.59	-12.67	-1.95	-29.85	-5.70	-4.76	-0.45	-8.15	-0.06	-5.73	-0.11
Ethnicity	White (non-Hispanic)	1.15	6.67	-10.78	-1.09	-27.85 <sup>a</sup>	-5.25	-5.77	-1.19 <sup>a</sup>	-8.95	-0.25	-4.82	-0.22
	Other Ethnicities	1.22	7.25	-9.42	-2.33	-21.52	-2.60	-3.91	0.75	-9.22	-0.30	-6.98	0.97
Age (years)	Under 55	0.99	5.27 <sup>a</sup>	-10.55	-1.30	-24.90 <sup>a</sup>	-4.97	-5.01	-0.60	-8.75	-0.38	-5.89	0.46
	55+	1.48	9.42	-10.47	-1.37	-29.74	-4.37	-6.13	-1.23	-9.44	-0.04	-4.06	-0.78
Education	Under Bachelor's Degree	0.01	7.33	-9.27	-0.62	-24.25	-2.92 <sup>a</sup>	-6.45	-0.48	-9.77	0.10	-5.17	-0.37
	Bachelor's Degree +	2.27	6.23	-11.76	-1.92	-28.62	-6.06	-4.55	-1.11	-8.07	-0.39	-5.39	0.09
Health conditions in household	Non-risk	1.52	5.85	-11.04	-0.98	-25.71	-5.37	-5.06	-1.19	-8.22	-0.40	-5.89	-0.62
	At- risk	0.65	8.16	-9.75	-1.84	-28.07	-3.84	-5.95	-0.28	-10.18	-0.05	-4.24	0.95

August, N= 726

Social Determinates		Handwashing: Water		Handwashing: Soap		Hand Sanitizer		Produce Washing: Water		Produce Washing: Soap		Food Thermometer	
		Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)	Before – During (Δ)	After – During (Δ)
Gender	Male	2.17	6.15	-13.41 <sup>a</sup>	-2.83 <sup>a</sup>	-29.41	-5.92	-6.92	-0.23	-9.75	-0.87	-5.21	0.22
	Female	1.27	5.46	-8.02	-0.95	-26.51	-4.58	-6.50	-1.52	-10.71	-1.80	-3.88	-0.30
Income (USD)	Under 50,000	2.09	6.84	-8.86 <sup>a</sup>	-0.87 <sup>a</sup>	-25.54 <sup>a</sup>	-3.20 <sup>a</sup>	-6.65	-0.98	-9.93	-0.94	-3.35 <sup>a</sup>	0.28
	50,000+	1.30	4.98	-12.74	-2.78	-30.85	-7.12	-6.97	-0.72	-10.55	-1.73	-5.94	-0.37
Ethnicity	White (non-Hispanic)	1.85	5.52	-11.23	-2.29	-29.70 <sup>a</sup>	-5.80	-6.78	-0.76	-9.73	-1.69	-4.62	-0.21
	Other Ethnicities	1.29	6.81	-8.96	-0.49	-21.83	-3.34	-6.47	-1.28	-11.99	-0.06	-4.31	0.59
Age (years)	Under 55	0.18 <sup>a</sup>	4.83	-10.38	-1.06 <sup>a</sup>	-25.59 <sup>a</sup>	-4.57	-6.21	-0.68	-10.86	-1.86	-5.71 <sup>a</sup>	0.07
	55+	4.48	7.55	-11.35	-3.40	-32.22	-6.49	-7.61	-1.21	-9.11	-0.38	-2.47	-0.22
Education	Under Bachelor's Degree	1.49	6.12	-8.56 <sup>a</sup>	-1.15	-26.07	-4.43	-6.11	-1.05	-9.89	-1.06	-4.43	0.04
	Bachelor's Degree +	1.58	5.29	-12.94	-2.48	-29.83	-6.12	-6.83	-0.67	-10.49	-1.70	-4.67	-0.33
Health conditions in household	Non-risk	1.77	6.00	-11.66	-2.00	-27.84	-5.22	-7.22	-1.22	-11.25	-1.69	-4.91	0.44
	At- risk	1.65	5.49	-9.21	-1.72	-28.18	-5.31	-5.88	-0.31	-8.57	-0.75	-3.97	-0.82

For supplemental tables 3A, 3B, 3C, 3D, and 3E

<sup>a</sup> Indicate significant differences within social determinate

Negative deltas for “before-during” indicate respondents had an increased a behavior in response to the pandemic

Negative values for “after-during” indicate respondents anticipated a decrease in a behavior after the pandemic

## APPENDIX K. PERCEPTIONS DURING COVID-19

	April, N=703 Mean± SD	May, N=732 Mean± SD	June, N=707 Mean± SD	July, N=716 Mean± SD	August, N=726 Mean± SD
Concern about food safety [0=Not concerned at all, 50=Somewhat concerned,100=Very concerned]	60.71 ±29.73	58.71± 30.98	61.35± 30.48	63.02± 29.38	62.79± 30.54
Confidence in food safety measures [0=Not confident at all, 50=Somewhat confident, 100= Very confident]	74.75 ±21.34	76.43± 21.21	75.97± 21.66	75.87± 21.23	77.47± 21.35
Perceived risk of getting COVID-19 from other people [0=No risk, 50=Medium risk,100=Extremely risky]	53.68 ±28.17	51.11± 28.78	54.68± 29.87	54.15± 28.88	53.21± 29.31
Perceived risk of getting COVID-19 from food [0=No risk, 50=Medium risk, 100=Extremely risky]	31.38 ±27.27	27.56± 25.97	29.14± 26.79	29.47± 27.35	28.75± 27.50
Significance was not found for longitudinal data but there was significant difference between perceived risk of getting COVID-19 from people and perceived risk of getting COVID-19 from food (p <0.05).					



## APPENDIX L. PERCEIVED RISK OF GETTING COVID-19 FROM TAKEOUT FOOD

	April, N=462 Mean $\pm$ SD	May, N=520 Mean $\pm$ SD	June, N=495 Mean $\pm$ SD	July, N=547 Mean $\pm$ SD	August, N=588 Mean $\pm$ SD
From take-out food	35.44 $\pm$ 26.33	29.10 $\pm$ 23.43	34.43 $\pm$ 26.70	32.71 $\pm$ 25.74	32.12 $\pm$ 26.88
From take-out hot food (griller or fryer)	29.31 $\pm$ 25.59	24.00 $\pm$ 22.83	29.47 $\pm$ 26.78	27.90 $\pm$ 25.73	26.54 $\pm$ 26.01
From take-out cold food (salads, sushi, fresh fruits and vegetables)	39.40 $\pm$ 28.37	34.44 $\pm$ 27.41	38.78 $\pm$ 29.55	37.64 $\pm$ 28.15	35.85 $\pm$ 29.01
Food package	36.21 $\pm$ 26.42	30.92 $\pm$ 25.79	34.34 $\pm$ 27.24	34.11 $\pm$ 26.61	31.55 $\pm$ 26.37

[0=No risk, 50= Medium risk,100= Extremely risky]

## APPENDIX M. RISK PERCEPTION AND HANDWASHING BELIEFS

April, N=703

Social Determinant		<sup>b</sup> Perceived risk of getting COVID-19 from other people Mean (SD)	<sup>b</sup> Perceived risk of getting COVID-19 from food Mean (SD)	<sup>c</sup> Belief that hand washing can protect you from COVID-19 Mean (SD)	<sup>c</sup> Belief that hand washing can protect you from Foodborne illness Mean (SD)
Gender	Male	53.56 (28.14)	33.35 (28.18)	77.87 (21.24)	70.47 (26.93)
	Female	53.80 (28.23)	29.33 (26.19)	82.67 (19.44) <sup>a</sup>	70.53 (27.36)
Income (USD)	Under 50,000	53.38 (29.29)	33.65 (27.95)	79.68 (22.00)	69.92 (27.62)
	50,000+	53.89 (27.16)	29.22 (26.79) <sup>a</sup>	80.58 (19.39)	71.28 (26.62)
Ethnicity	White (non-Hispanic)	53.81 (28.60)	29.81 (26.84) <sup>a</sup>	80.28 (20.14)	70.23 (26.87)
	Other Ethnicities	53.10 (28.17)	38.16 (28.16)	80.01 (22.07)	71.64 (28.26)
Age (years)	Under 55	55.16 (27.82)	35.50 (27.97)	77.97 (21.07)	70.52 (25.98)
	55+	51.11 (28.64)	24.22 (24.47) <sup>a</sup>	84.15 (18.88) <sup>a</sup>	70.47 (29.04)
Education	Under Bachelor's Degree	51.00 (28.74) <sup>a</sup>	31.46 (27.17)	78.23 (22.93)	70.80 (27.77)
	Bachelor's Degree +	56.20 (27.46)	31.55 (27.44)	81.67 (18.41) <sup>a</sup>	70.04 (26.90)
Health conditions in the household	Non-risk	52.54 (28.03)	33.29 (27.34)	79.08 (20.96)	70.52 (26.85)
	At-risk	55.58 (28.35)	28.17 (26.91) <sup>a</sup>	82.16 (19.59)	70.46 (27.63)

May, N=732

Social Determinant		<sup>b</sup> Perceived risk of getting COVID-19 from other people Mean (SD)	<sup>b</sup> Perceived risk of getting COVID-19 from food Mean (SD)	<sup>c</sup> Belief that hand washing can protect you from COVID-19 Mean (SD)	<sup>c</sup> Belief that hand washing can protect you from Foodborne illness Mean (SD)
Gender	Male	51.70 (29.75)	30.58 (27.32)	78.09 (22.98)	69.19 (28.77)
	Female	50.48 (27.76)	24.39 (24.11) <sup>a</sup>	80.70 (21.40)	68.28 (29.38)
Income (USD)	Under 50,000	47.09 (29.57) <sup>a</sup>	26.73 (26.15)	77.91 (24.44)	68.05 (30.10)
	50,000+	54.64 (27.63)	28.55 (26.17)	80.63 (20.08)	68.85 (28.40)
Ethnicity	White (non-Hispanic)	49.57 (29.08) <sup>a</sup>	24.75 (24.86) <sup>a</sup>	78.44 (22.24)	67.90 (28.89)
	Other Ethnicities	55.97 (27.35)	36.45 (27.44)	82.26 (22.10) <sup>a</sup>	71.43 (29.47)
Age (years)	Under 55	52.25 (28.65)	31.35 (27.12)	78.26 (22.50)	69.59 (29.24)
	55+	49.00 (28.97)	20.61 (22.13) <sup>a</sup>	81.39 (21.68)	67.18 (28.69)
Education	Under Bachelor's Degree	49.70 (30.37)	26.05 (25.48)	78.44 (24.35)	69.07 (29.18)
	Bachelor's Degree +	52.92 (27.25)	29.03 (26.44)	79.80 (20.62)	68.68 (28.64)
Health conditions in the household	Non-risk	50.42 (29.09)	27.95 (26.45)	79.48 (21.82)	69.30 (28.83)
	At-risk	52.22 (28.78)	26.94 (25.21)	79.17 (22.95)	67.85 (29.42)

June, N=707

Social Determinant		<sup>b</sup> Perceived risk of getting COVID-19 from other people Mean (SD)	<sup>b</sup> Perceived risk of getting COVID-19 from food Mean (SD)	<sup>c</sup> Belief that hand washing can protect you from COVID-19 Mean (SD)	<sup>c</sup> Belief that hand washing can protect you from Foodborne illness Mean (SD)
Gender	Male	54.19 (29.75)	29.88 (27.48)	77.46 (22.28)	69.25 (27.08)
	Female	55.24 (30.05)	28.30 (25.99)	80.74 (20.32) <sup>a</sup>	70.33 (27.97)
Income (USD)	Under 50,000	52.78 (30.49)	29.42 (27.00)	78.39 (22.27)	69.04 (27.49)
	50,000+	57.06 (29.04)	29.31 (26.85)	79.50 (20.53)	70.72 (27.10)
Ethnicity	White (non-Hispanic)	54.42 (29.91)	26.93 (25.84) <sup>a</sup>	79.45 (21.15)	69.43 (27.91)
	Other Ethnicities	55.52 (29.83)	36.20 (28.55)	77.56 (22.30)	70.80 (26.12)
Age (years)	Under 55	57.51 (29.14)	34.03 (28.20)	77.67 (22.66)	70.30 (27.02)
	55+	49.54 (30.56) <sup>a</sup>	20.25 (21.35) <sup>a</sup>	81.43 (18.80) <sup>a</sup>	68.77 (28.34)
Education	Under Bachelor's Degree	52.64 (29.28)	26.31 (24.65) <sup>a</sup>	78.21 (23.04)	67.64 (28.06)
	Bachelor's Degree +	56.31 (30.14)	30.73 (27.93)	79.40 (20.37)	71.50 (26.64)
Health conditions in the household	Non-risk	51.41 (28.87) <sup>a</sup>	29.28 (25.77)	77.47 (22.21)	68.59 (27.83)
	At-risk	60.05 (30.75)	28.90 (28.42)	81.52 (19.88) <sup>a</sup>	71.66 (26.85)

July, N=716

Social Determinant		<sup>b</sup> Perceived risk of getting COVID-19 from other people Mean (SD)	<sup>b</sup> Perceived risk of getting COVID-19 from food Mean (SD)	<sup>c</sup> Belief that hand washing can protect you from COVID-19 Mean (SD)	<sup>c</sup> Belief that hand washing can protect you from Foodborne illness Mean (SD)
Gender	Male	53.55 (30.01)	31.40 (29.06)	78.39 (24.05)	70.67 (28.52)
	Female	54.82 (27.61)	27.35 (25.21) <sup>a</sup>	79.24 (21.84)	68.94 (29.58)
Income (USD)	Under 50,000	51.53 (29.13) <sup>a</sup>	27.65 (26.11)	76.63 (23.42)	72.02 (28.81)
	50,000+	56.63 (29.13)	31.24 (28.43)	78.19 (22.53)	68.50 (28.71)
Ethnicity	White (non-Hispanic)	54.20 (28.94)	28.22 (27.02) <sup>a</sup>	78.92 (23.16)	69.86 (29.13)
	Other Ethnicities	53.96 (28.71)	34.85 (28.18)	78.25 (22.46)	69.79 (28.66)
Age (years)	Under 55	54.74 (29.33)	34.05 (28.76)	75.73 (24.74)	69.00 (28.89)
	55+	53.13 (28.10)	21.44 (22.59) <sup>a</sup>	84.17 (18.48) <sup>a</sup>	71.31 (29.26)
Education	Under Bachelor's Degree	52.66 (29.84)	27.94 (25.25)	79.97 (22.64)	72.92 (27.87) <sup>a</sup>
	Bachelor's Degree +	55.65 (28.16)	30.86 (29.00)	78.19 (23.06)	67.75 (29.69)
Health conditions in the household	Non-risk	53.65 (29.43)	30.36 (27.05)	78.91 (23.96)	69.86 (29.31)
	At-risk	54.91 (28.06)	28.15 (27.93)	78.62 (21.57)	69.82 (28.64)

August, N=726

Social Determinant		<sup>b</sup> Perceived risk of getting COVID-19 from other people Mean (SD)	<sup>b</sup> Perceived risk of getting COVID-19 from food Mean (SD)	<sup>c</sup> Belief that hand washing can protect you from COVID-19 Mean (SD)	<sup>c</sup> Belief that hand washing can protect you from Foodborne illness Mean (SD)
Gender	Male	52.70 (29.65)	30.78 (29.61)	77.91 (23.54)	71.23 (28.11)
	Female	53.73 (28.97)	26.71 (25.06) <sup>a</sup>	77.45 (23.76)	68.61 (28.49)
Income (USD)	Under 50,000	52.68 (30.81)	26.72 (26.18)	78.52 (24.40)	68.39 (30.34)
	50,000+	53.76 (27.93)	30.44 (28.77)	77.11 (23.04)	71.44 (26.67)
Ethnicity	White (non-Hispanic)	52.91 (29.68)	26.59 (27.13) <sup>a</sup>	78.28 (23.33)	69.40 (28.85)
	Other Ethnicities	54.27 (28.00)	36.43 (27.52)	75.58 (24.66)	71.78 (26.34)
Age (years)	Under 55	53.31 (29.29)	33.53 (29.62)	75.45 (24.77)	70.42 (27.73)
	55+	53.04 (29.39)	20.20 (20.68) <sup>a</sup>	81.69 (20.92) <sup>a</sup>	69.04 (29.35)
Education	Under Bachelor's Degree	50.73 (30.02) <sup>a</sup>	25.83 (25.85) <sup>a</sup>	76.96 (26.11)	67.35 (31.46)
	Bachelor's Degree +	55.80 (28.28)	31.69 (28.83)	78.27 (21.07)	72.23 (25.05) <sup>a</sup>
Health conditions in the household	Non-risk	52.32 (29.72)	30.58 (28.49)	76.74 (24.23)	69.52 (28.26)
	At-risk	54.67 (28.62)	25.77 (25.57) <sup>a</sup>	79.23 (22.60)	70.58 (28.43)

<sup>a</sup> Significant difference within social determinant

<sup>b</sup> Mean of perceived risk (0-100) where 0=not concerned at all, 50=somewhat concerned, and 100=very concerned

<sup>c</sup> Mean of belief (0-100) where 0= do not believe, 50= believe moderately, and 100= believe completely

## APPENDIX N. PERCEPTION OF HANDWASHING: COVID-19 VS. FOODBORNE ILLNESS

[0-100 with 0= Do not believe, 50= Believe moderately, 100= Believe completely]

	April, N=703 Mean±SD	May, N=732 Mean±SD	June, N=707 Mean±SD	July, N=716 Mean±SD	August, N=726 Mean±SD
Hand washing can protect you from COVID- 19	80.23 ±20.50	79.36±22.25	79.00±21.43	78.79±23.02	77.68±23.64
Hand washing can protect you from Foodborne illness	70.50 ±27.12	68.75±29.05	69.76±27.48	69.84±29.02	69.92±28.31

Significance was not found for longitudinal data but there was significant difference between both categories under each month (p <0.05)

## APPENDIX O. CODEBOOK USED FOR 2020 AND 2021 FOCUS GROUP SESSIONS

Code	Definition	Type of code	Example
1. At High Risk	If the participants mention that they or family members that live with them are immunocompromised or consider themselves to be at a higher risk for infection.	Attribute	"I have an autoimmune disease, so I have to be extra careful and make sure that I'm protecting myself 100%."
2. Healthcare Worker	If the participants mention they work in healthcare or hospital setting.	Attribute	"I'm currently an essential worker with a hospital so I have to go out to work so luckily, I haven't been furloughed but I make do with what I can for the moment."
3. Living with Children	If the participants mention living with children who are young (infant to 5 years old)	Attribute	"My wife and I both work for home as there is no childcare for the last 7 weeks for our young child so we're working on being as efficient as we can without kind of boiling over at each other, so, it's been a bit of a challenge for sure."
4. Frustrations toward Others	The participants express their frustrations or experiences of some people are taking the pandemic it seriously while some are not. They also mention some wear masks, and some do not.	Emotion	"It seems to be about 50/50, people who are taking this very seriously and others who just aren't. I think we're really kind of rushing back into reopening everything without having adequate testing or contact tracing."
5. Questioning truth about Pandemic	If the participant expresses that they don't believe the pandemic is real or they don't know for sure.	Emotion	yeah, but you don't really know if they're dying or not. You don't really know who's dying.
6. Job Changes	When participants talk about changes with their job status, where they	Descriptive	"I was a substitute teacher and also a ticker broker for concert tickets across the U.S. So,



	work or how they work (remote).		essentially, I've lost both of those jobs and collecting unemployment and also getting the CARES Act."
7. Restricted visiting during Pandemic	When the participants mention not being able to visit people, restrictions for hospital visitors and not allowing people into their home.	Descriptive	"Not having anybody come in the house at all. We had no visitors, it's just me and my roommate. Just been kind of holed up in here and you know we're even keeping our distant from each other so."
8. Fear of spreading COVID	If the participants show a concern or fear of spreading COVID-19 to other people or other people spreading it.	Emotion	"I'm more so concerned about, if I were to get exposed, spreading it to other people than getting sick myself."
9. Practices	If the participants mention any practices they are taking to reduce the risk of getting COVID-19 (not from food). These include masks, gloves, hand sanitizer, washing hands, social distancing, following guidelines and more.	Descriptive	"I keep a mask with me at everywhere I usually take one, but I also keep on in the car and in my purse and I keep my gardening gloves too, so I make sure that when I'm in a store I'm wearing my gloves. When I get back in my car, I take off the gloves and do the hand sanitize thing."
10. Sanitizing	When the participants mention sanitizing other surfaces that are not food or food related.	Process	"I was sanitizing my countertop in my kitchen with the bleach and water combination."
11. Confidence in Effectiveness	When participants mention if the practices they are effective, if one practice is more effective or if the practices are not effective (not food practices).	Emotion	"I think that if people follow the guidelines at least well until the scientists have figured this out and come out with either a cure or a vaccine that we're all going to be safer."
12. Avoiding Grocery Stores	When a participant mentions they limit the amount of times they go to the grocery store, that they try to avoid is by ordering online, or doing something else to avoid going to the grocery store	Process	"My family they have been going around our community and finding people that grow fresh fruits and fresh veggies in their community and they've been buying their tomatoes and stuff that way and some of the veggies from other people

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			around the neighborhood gardens so that's what they've been doing instead of even going to the store and risking it”
13. Not concerned about Food	When participants mention they are not concerned about food safety during this pandemic. They could be more concerned about other people or leaving the house to get food.	Descriptive	“The food is probably honestly my least concern with corona. I’m more about like not getting close to people wearing a mask, using disinfectant, hand sanitizer and just kind of isolating in my house and having. I’ve hanged out with probably two friends, limited contact.”
14. Exposure to Food	When a participant mentions they are concerned about food safety because of other people breathing, exposed to or touching food or food packages from grocery stores or online grocery orders.	Descriptive	“It’s like when you go to the grocery store, you don’t know how long fresh food has been sitting there so you’re wondering how long people have been exposed to it. I do wish some grocery stores would just put everything in some kind of container or just cover it more so it’s not just sitting out so someone who doesn’t happen to be wearing a mask just breathes on it or something like that.”
15. Cleaning groceries	A participant talks about how they clean their groceries including packages, bags, produce, canned goods, freezing and other practices they use to avoid getting COVID-19 from food. This doesn’t include cooking the food.	Process	“Yes, ahh well I did mention before that I do sanitize my fruits and vegetables because I just have nightmares of people going into stores touching everything and leaving it behind for someone else. I don’t know what they’re leaving behind. So, for me personally I’m not abdicating for everyone but for me personally I’m better making sure that I take care of any fruit or vegetables. Even my bananas before I eat them.”

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16. Not Cleaning Groceries	Participants mention that they don't clean their groceries (wash, wipe etc.)	Process	"I've been a lot less the food safety hasn't bother me so much more the fact that I would have to leave the house to get food I saw the video of the guy washing down his grocery and all of that to be honest I haven't done that, and we seem to be fine. We do get fresh fruits and vegetables but for the most part things are cooked anyways I mean I suppose I'm touching them, but we wash our hands a lot, so I haven't gone overboard with any of that stuff."
17. Cooking to Kill the Virus	When the participants mention that cooking the food kills the virus or that hot foods kill the virus. If they mention temperature or checking if meat is done, it was coded here as well.	Process	"I'll just say that most likely if the food has been already cooked and its hot, you know for 5 or 10 minutes whether you get that food delivered to you cold or hot it really doesn't matter. As long as the food was cooked for 5 to 10 minutes at basically 185-degree Fahrenheit you should be okay people as far as handling the packages of food that's something separate."
18. Helping Local Restaurants	When Participants mention helping or supporting restaurants (takeout and ordering food from them).	Process	"My family and I have tried to help out a lot of local and small businesses and you know we've increased our takeout and we're getting food from different restaurants."
19. Confidence in Other People Cooking	When participants mention not trusting other people (restaurants for example) cooking their food for them during the pandemic.	Emotion	"I've been very conflicted about ordering takeout just because I want to support local businesses that are struggling right now especially in New York City and what not, but at the same time you don't know

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	These could also be experiences they shared.		who's touching your food. Umm, I'm a little bit hesitant to order takeout."
20. Diet Changes	When participants mention foods that they avoid (because of COVID-19), foods that they eat, and when they still eat the same foods as before. Not Food shortage.	Descriptive	"We've have always bought apples, oranges, bananas but typically we also bought berries and greens so the only thing we quit buying were the berries and greens. We still continue with apples, oranges, and bananas and that's because of the skin."
21. Food Shortages	When participants mention foods, they can't eat or buy due to availability or if they mention that there is no food shortage or that foods have become available.	Descriptive	"I was able to go to the grocery store Saturday my son took me and there was no beef so I'm fortunate I had already had my freezer stocked most of my pantry and everything is stocked, um we can't buy meat."
22. Expensive Meat	When a participant mentions that the price of meat has gone up during the COVID-19 pandemic.	Descriptive	This example comes up in the July sessions
23. Ordering Takeout	When participants mention how many times or how frequently they order takeout or food from restaurants (including drive-thru). This could also be none.	Descriptive	"I think I've done one drive thru a week and one takeout, no delivery"
24. Food Delivery and Takeout Practices	When participants mention the practices or measures they take when they takeout food or have it delivered from restaurants (wiping down packages, sanitizing, moving food to another container, choosing to pick up to avoid others handling food, choosing contactless delivery etc.)	Descriptive	"Usually, we'll use the wipes in our car to wipe down the outside of whatever container the food's coming in."

25. Plant Shutdown	When participants mention the recent plant shutdowns (especially the meat plants) and their concerns or lack of concern about it.	Emotion	Well because of the meat packing plant that have had high level of COVID 19 cases and is that something one needs to be concerned about. I just don't know. It's just struggling.
26. Hand Cleaning Beyond COVID	When participants mention if they will wash hands or use sanitizer after the pandemic and why. Some people just say No.	Process	"Definitely I'm a freak with washing my hands I do it like a bazillion times a day. It just freaks me out knowing you touch so much stuff."
27. Wearing Masks Beyond COVID	When participants mention if they will wear masks after the pandemic and why.	Process	"When I think about wearing the mask I think about my travels to Asia. Asian especially Chinese and Japanese people wear mask all the time seemly especially when there in mass transit situations and I see no reason why I shouldn't continue to wear mask even after COVID 19. Especially if I go on the train system or I find myself in a large crowd or go to a ball game why wouldn't I wear a mask from now on."
28. Produce cleaning beyond COVID	When participants mention how they will wash their produce or if they will wash their produce after the pandemic. This can include peeling as well.	Process	"I am but I'm saying a year from now or something I think I'll probably go back to water like you know. Washing it with water as long as we are in a better state. Um, but yea right now I am doing this soap and water."
29. Wiping down Groceries beyond COVID	When participants mention how they will wipe down their groceries or if they will wipe down their groceries after the pandemic.	Process	"Yeah, I don't do that I don't expect that I will do that."
30. Mask Frustrations	When participants express their concerns or	Emotion	"I can't breathe with them on like claustrophobic something I have a lot of trouble

	frustrations about wearing masks		breathing with these mask and even when I was in China and Japan and I saw people wearing them years and years ago I tried a few times and I just can't get comfortable wearing a mask."
31. Hand Sanitizer Woes	When participants express their concern about or question the use of hand sanitizers	Emotion	"Like I've always done that a little less with the hand sanitizer because it's you know so drying for my hand and I have I have like eczema and very sensitive to it so um I think that it definitely I wish I could use that less"
32. Unknown Future	When participants express their feelings about the future with the pandemic. How the world will change or questions on how things will be.	Emotion	"It's just going to be crazy on how things are going to change because you can't share anything anymore just to give someone even a free piece of candy, I mean think of Halloween what is that going to look like this year."
33. Food Safety Information	When participants mention that they have not or have received or seen food safety information. They can also mention where they got it from.	Descriptive	"it's pretty much just on the news or you hear about it as far as getting emails from vendors or businesses, I don't really get anything about food safety but it's on the news. I get it on the news or from word-of-mouth or from friends or people sharing YouTube videos on food safety."
34. Trusting Healthcare and experts	When a participant expresses their reasons for trust/ mistrust of healthcare professionals and experts regarding getting food safety information during the pandemic.	Emotion	"I trust the more because they have the expertise and the knowledge, and they do research and all that. So, they seem more trustworthy than other sources."
35. Trusting Family and Friends	When a participant expresses their reasons for trust/ mistrust of family and friends regarding getting food	Emotion	"Family and friends, out of my family and friends I'm probably the most informed on the information so they would

36. Trusting the Government	safety information during the pandemic. When a participant expresses their reasons for trust/ mistrust of the government regarding getting food safety information during the pandemic.	Emotion	probably be looking to me for it.” “I think we’ve got some of the smartest people in the world on this, not just in our government but in various world-wide governments and some of them thoughts are less bias because there fund doesn’t come from a certain organization so sites like the FDA and the CDC are really what I trust the most.”
37. Trusting TV News	When a participant expresses their reasons for trust/ mistrust of the TV News regarding getting food safety information during the pandemic.	Emotion	“Yeah sometimes T.V. depending on what station and what I’m watching local news I would trust more than I would trust any of the cable news station because I believe cable news station are slanted in either one way or the other.”
38. Trusting Social Media and online websites	When participants express their reasons for trust/ mistrust of social media or online websites for food safety information during the pandemic.	Emotion	“I worry about what’s on social media because so much mis information and you never know if it’s coming from a legit source or not.”
39. Hard to Trust Anyone	When participants express that they don’t trust anyone or don’t know who to trust for their food safety information during the pandemic.	Emotion	“it’s hard to know who to trust because our government gives us information, but they could give us more, I feel like some doctors argue with each other than work together to figure things out.”
40. Information Overload	When participants express their feelings about the large amount of information they get regarding covid-19	Emotion	“I guess I don’t really have a definitive answer, but we’ve been bombarded with it daily from every angle so it’s hard to pinpoint one origin”
41. Lack of Information	When participants express their thoughts or concerns about the lack of information they have gotten in regard to food safety and COVID-19.	Emotion	“And I’m not sure why it hasn’t been a priority. All of us haven’t really seen a lot of food safety. It’s all washing our hands and covering our face and social distancing.

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42. Food Safety Information Needed	When participants mention what food safety information they would like to receive during the pandemic.	Descriptive	There's not a lot. Does that mean it's not really a big deal, you know?" "I think just the basic facts would be nice. Wash your vegetables don't worry about meat if you cook them properly. Just the basics would be nice. It's funny now that everybody talking about it how little we've actually heard about in general."
43. Food Safety Platform	When participants mention how they want to see their food safety information during the pandemic (platform, what they want to see, postcard etc.)	Descriptive	"I think point of sale notices would be great like in grocery stores because that's where you're initially dealing with it. I think that would be very helpful."
44. A Little Too Late	When participants mention that they should have gotten food safety information at the very beginning.	Descriptive	I think they should have done information in the very beginning when we wanted it. But now if they come out with something too little too late who cares.
45. Losing Interest	When participant expresses how they are losing interest in the pandemic or frustration about the pandemic not being over.	emotion	You know it's reading those news story on those free newspapers that are coming out even at that I'm kind of losing interest now and I'm just like ugh let's be done with it.
46. Food safety Practices Pre-COVID	When a participant mentions they have been doing some food safety practice (washing vegetables for example) before COVID-19.	Descriptive	"I've always kind of washed fresh produce you know if it's going to be eaten raw and most of the time I'll wash it to even if it's going to be cooked because you're still touching it and stuff like that."
47. Awareness of Foodborne Illness	When participants mention if they were or were not aware or cautious of Foodborne illness before COVID-19 pandemic and how. This	Descriptive	"I worked at um residential house with people with severe pregenital illness and drugs and alcohol and you know we did a lot of food prep so we had to be really up on our food

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	could be from previous experience cooking or taking courses.		safety and management of keeping meat separate from other foods and cross contamination and stuff like that so I've always been kind of mindful of that so I don't think I really stepped it up anymore except for what I said just been receiving outside packages and washing the fruits. Washing."
48. Person to Person Influence	When a participant mentions that they will do a practice or are doing a practice if other people do it. This could be for future practices or if one person from the group influenced another to do some practice. Food or non-food related.	Descriptive	"I think that definitely going to be seems as a more acceptable because I know when we were at work before everything started when we first start talking about this we were saying well should we wear mask because that gives them the impression that people are sick not that they are trying to protect people versus we should have people wear mask. I don't think that's a discussion people are going to have anymore. People have kind of accepted that as a good thing to do to help keep people healthy."
49. Dining out	When a participant mentions that they are dining out now.	Descriptive	"I did go out to a restaurant over the weekend but other than that still not really going out or getting together with people."
50. Hitting Close to Home	When participants mention they know someone who has COVID-19, has suffered from it or has passed away from it.	Descriptive	"I have a friend who's 30 and no underlying issues who died and a friend whose dad does have underlying conditions and survived"
51. Fully Vaccinated	When participants mention that they are fully vaccinated	Descriptive	"...one thing that has changed since Covid is that I am addicted to the mask even

52. Confidence in Restaurants	When participants mention their level of confidence when it comes to food safety procedures at a restaurant that they are dining at or ordering food from.	Emotion	though I am fully vaccinated, I still wear my mask...” “...I guess, and now I'm pretty comfortable as long as I know the restaurant is following the safety guidelines. I could really buy anything off the menu as long as I know they are being careful.”
53. Vaccination for Foodborne Illness	When participants express how they feel about the COVID-19 vaccine and its relation to foodborne illness.	Emotion	“Well if the workers are getting vaccinated then that can protect us. But I don't know how us being vaccinated will help us with foodborne illnesses, but it will help us when the food workers the waitresses and chefs get it.”
54. Grocery Store Trust	When a participant expresses that they trust the grocery store because of the practices put into place.	Emotion	“I think everything that was put into place especially at the [Giant Eagle Market] that I go to they still wear a mask, they wore masks, they wear gloves. I felt very safe purchasing from them.”
55. Heightening Awareness of Foodborne Illness	When a participant mentions that the pandemic made them more aware of foodborne illness or food safety.	Process	“I think for us it did make us more aware because neither of us have backgrounds in food or anything like that, so it did make us aware.”
56. Back to Normal	When a participant mentions that things related to COVID-19 have been going back to what they were before the pandemic. This can include the practices they are doing (food or non-food related).	Descriptive	“I feel like other than working from home, my life is pretty much close to normal in terms of just my everyday activities and being able to go places, um, you know, fly on planes. I feel comfortable. I just got back from Florida and I was, you know, perfectly, we had to wear a mask on the plane, but I was like perfectly comfortable with that eating in restaurants and things like that. I really don't have, you know, the nervousness that I used to have.”

A select number of codes from this original codebook were presented in the present study

**APPENDIX P. DEMOGRAPHIC INFORMATION OF RESPONDENTS FROM 9 WAVES OF SURVEYS  
(APRIL 2020 TO MAY 2021)**

	April 2020, N=703	May 2020, N=732	June 2020, N=707	July 2020, N=716	August 2020, N=726	October 2020, N = 726	January 2021, N=728	March 2021, N=735	May 2021 N= 723
Characteristics	%(n)	%(n)	%(n)	%(n)	%(n)	%(n)	%(n)	%(n)	%(n)
Gender									
Male	51(358)	51(375)	53(375)	52(375)	50(365)	51(372)	51(369)	51(375)	52(374)
Female	49(345)	49(357)	47(332)	48(341)	50(361)	49(354)	49(359)	49(360)	48(349)
Age									
18-24	12(86)	13(94)	13(95)	13(95)	13(92)	13(91)	13(95)	12(91)	13(95)
25-34	18(127)	18(131)	19(131)	18(131)	18(129)	18(129)	18(130)	18(131)	18(130)
35-44	15(102)	17(123)	17(123)	17(123)	17(123)	17(122)	16(120)	17(123)	17(123)
45-54	19(131)	17(126)	15(107)	15(107)	17(122)	17(125)	17(123)	18(130)	16(115)
55-64	17(119)	16(119)	16(112)	17(121)	17(121)	17(120)	17(121)	17(121)	17(121)
65 and above	20(138)	19(139)	20(139)	19(139)	19(139)	19(139)	19(139)	19(139)	19(139)
Ethnic									
White(non-Hispanic)	81(571)	76(556)	76(539)	81(581)	78(566)	82(593)	82(594)	79(577)	73(525)
Hispanic	6(41)	10(73)	6(39)	5(38)	7(53)	4(31)	5(35)	6(47)	9(62)
Black or African American	8(53)	8(60)	9(65)	8(55)	8(59)	7(53)	8(55)	8(55)	10(72)
Asian or Pacific Islander	5(32)	5(35)	7(46)	3(25)	4(29)	4(29)	3(25)	35(37)	6(44)
Other	1(4)	1(7)	2(15)	1(10)	2(11)	2(13)	2(13)	2(12)	2(16)
Native American	0(2)	0(1)	0(3)	1(7)	1(8)	1(7)	1(6)	1(7)	1(4)

Income									
Less than \$10,000	6(42)	6(47)	6(43)	5(36)	8(56)	6(43)	7(48)	7(49)	8(56)
\$10,000-\$29,999	22(156)	19(138)	21(146)	22(156)	21(153)	20(145)	19(135)	22(163)	24(175)
\$30,000-\$49,999	19(130)	19(141)	19(133)	19(139)	18(129)	16(119)	18(134)	21(152)	20(143)
\$50,000-\$79,999	23(159)	24(176)	24(168)	24(169)	23(165)	21(149)	20(144)	22(162)	26(187)
\$80,000 and above	28(197)	28(208)	27(192)	28(199)	27(195)	34(250)	33(237)	25(183)	21(150)
Prefer not to answer	3(19)	3(22)	4(25)	2(17)	4(28)	3(20)	4(30)	4(26)	12(2)
Education									
Not High School Graduate	2(14)	2(13)	1(10)	3(24)	3(22)	2(13)	1(9)	5(26)	4(32)
High School or GED Degree	38(269)	41(298)	40(281)	41(290)	44(316)	35(255)	38(277)	45(327)	48(350)
Bachelor's Degree	39(277)	39(282)	38(266)	33(238)	32(233)	35(253)	34(249)	31(229)	32(230)
Graduate Degree	19(132)	17(123)	18(130)	21(149)	19(139)	26(190)	25(180)	19(136)	13(92)
Prefer not to answer	2(11)	2(16)	3(20)	2(15)	2(16)	2(15)	2(13)	2(17)	3(19)
Experience in preparing meals									
Less than 1 year	1(8)	2(13)	1(9)	2(13)	2(16)	2(14)	2(15)	3(20)	3(21)
1-3 years	8(57)	7(50)	9(61)	9(68)	8(59)	10(74)	12(85)	11(82)	9(66)
3-5 years	9(60)	8(56)	8(60)	7(53)	8(55)	10(71)	9(69)	9(65)	9(63)
Over 5 years	82(578)	84(613)	82(577)	81(582)	82(596)	78(567)	77(559)	77(568)	79(573)
Total people in the household									
1	28(198)	30(216)	27(193)	26(186)	24(175)	24(177)	24(178)	26(193)	24(170)
2	33(229)	30(221)	33(232)	33(239)	32(232)	28(203)	30(222)	30(217)	35(256)
3	18(123)	18(128)	18(124)	16(111)	18(130)	16(113)	15(110)	17(127)	19(135)
4	15(105)	15(107)	15(109)	15(104)	15(110)	22(158)	20(143)	15(113)	12(90)

5	5(32)	5(37)	4(31)	8(56)	8(57)	8(56)	6(45)	8(56)	7(48)
More than 5	2(16)	3(23)	3(18)	3(20)	3(22)	3(19)	4(30)	4(29)	3(24)
Conditions of people living in the household									
Children younger than age 5	5(36)	9(66)	8(58)	10(69)	11(79)	11(77)	11(79)	10(72)	11(77)
People age 65 and over	21(145)	19(138)	18(130)	19(136)	18(134)	18(130)	21(151)	19(142)	21(151)
Diabetes	15(105)	13(93)	14(102)	14(102)	14(99)	16(114)	15(110)	16(114)	15(106)
Lung conditions	7(48)	6(43)	7(48)	8(59)	6(45)	7(53)	7(48)	8(57)	8(60)
Liver or kidney diseases	3(18)	2(12)	3(18)	3(23)	2(14)	2(16)	3(24)	3(25)	3(20)
HIV/AID	0(2)	0(2)	1(4)	0(2)	1(6)	0(1)	1(7)	1(7)	1(10)
Cancer	3(22)	3(19)	3(23)	2(17)	3(25)	3(20)	2(14)	4(29)	4(30)
Immunocompromised, including organ transplant patients	3(22)	2(18)	4(26)	4(27)	1(10)	2(18)	2(16)	3(20)	3(22)
At least 1 person in the household is at - risk	37(263)	38 (279)	38 (268)	40 (287)	38 (276)	42 (307)	41 (322)	42 (304)	45 (322)

## APPENDIX Q. FOOD SAFETY PERCEPTIONS DURING COVID-19 (APRIL 2020-MAY 2021)

	April 2020 N= 703	May 2020 N=732	June 2020 N=707	July 2020 N=716	August 2020 N= 726	October 2020 N=726	January 2021 N=728	March 2021 N=735	May 2021 N= 723
Concern about food safety	60.71 ± 29.73 <sup>ab</sup>	58.71± 30.98 <sup>b</sup>	61.35 ± 30.48 <sup>ab</sup>	63.02 ± 29.38 <sup>ab</sup>	62.79 ± 30.54 <sup>ab</sup>	63.89 ± 30.66 <sup>a</sup>	62.10 ± 30.52 <sup>ab</sup>	63.41± 30.68 <sup>ab</sup>	58.74 ± 32.73 <sup>ab</sup>
Confidence in food safety measures	74.75 ± 21.34 <sup>b</sup>	76.43± 21.21 <sup>ab</sup>	75.97 ± 21.66 <sup>ab</sup>	75.87± 21.23 <sup>ab</sup>	77.47 ± 21.35 <sup>ab</sup>	78.58 ± 21.83 <sup>a</sup>	77.28 ± 21.08 <sup>ab</sup>	77.42 ± 21.99 <sup>ab</sup>	76.02 ± 23.43 <sup>ab</sup>
Perceived risk of getting COVID-19 from other people	53.68 ± 28.17 <sup>ac</sup>	51.11 ± 28.78 <sup>c</sup>	54.68 ± 29.87 <sup>ac</sup>	54.15 ± 28.88 <sup>ac</sup>	53.21 ± 29.31 <sup>ac</sup>	57.79 ± 29.53 <sup>a</sup>	55.79 ± 28.85 <sup>a</sup>	51.67 ± 29.78 <sup>b</sup>	43.31 ± 30.77 <sup>d</sup>
Perceived risk of getting COVID-19 from food	31.38 ± 27.27 <sup>a</sup>	27.56 ± 25.97 <sup>ab</sup>	29.14 ± 26.79 <sup>ab</sup>	29.47 ± 27.35 <sup>ab</sup>	28.75 ± 27.5 <sup>ab</sup>	30.98 ± 29.74 <sup>a</sup>	30.51 ± 29.43 <sup>a</sup>	27.54 ± 27.88 <sup>ab</sup>	25.39 ± 27.42 <sup>b</sup>

[0=Not concerned at all, 50=Somewhat concerned,100=Very concerned]

Different superscripts indicate significant differences between months

## APPENDIX R. BELIEF ON PROTECTIVE EFFECT OF HANDWASHING (APRIL 2020- MAY 2021)

	April 2020 N= 703	May 2020 N=732	June 2020 N=707	July 2020 N=716	August 2020 N= 726	October 2020 N=726	January 2021 N=728	March 2021 N=735	May 2021 N= 723
Handwashing can protect you from COVID-19	80.23 ± 20.50 <sup>a</sup>	79.36 ± 22.25 <sup>a</sup>	79.00 ± 21.43	78.79 ± 23.02 <sup>a</sup>	77.68 ± 23.64 <sup>a</sup>	79.59 ± 22.43 <sup>a</sup>	77.64 ± 23.31 <sup>a</sup>	77.43 ± 23.98 <sup>ab</sup>	73.34 ± 26.84 <sup>b</sup>
Handwashing can protect you from foodborne illness	70.50 ± 27.12 <sup>abc</sup>	68.75 ± 29.05 <sup>b</sup>	69.76 ± 27.48 <sup>abc</sup>	69.84 ± 29.02 <sup>abc</sup>	69.92 ± 28.31 <sup>abc</sup>	70.95 ± 28.29 <sup>abc</sup>	71.63 ± 27.60 <sup>abc</sup>	73.65 ± 26.24 <sup>a</sup>	68.16 ± 29.61 <sup>bc</sup>

Different superscripts indicate significant differences between months  
[0= Do not believe, 50= Believe moderately, 100= Believe completely]

## APPENDIX S. LEVELS OF HAND HYGIENE DURING COVID-19

	April 2020 N= 703	May 2020 N=732	June 2020 N=707	July 2020 N=716	August 2020 N= 726	October 2020 N=726	January 2021 N=728	March 2021 N=735	May 2021 N= 723
Wash hands with water only	30.73±38.09 <sub>b</sub>	29.36±37.82 <sub>bc</sub>	31.43±37.48 <sub>b</sub>	34.34±39.03 <sup>a</sup> <sub>bc</sub>	33.55±38.60 <sup>abc</sup>	36.79±39.68 <sub>ab</sub>	37.58±39.03 <sup>a</sup>	35.48±38.87 <sub>abc</sub>	35.50±38.24 <sub>abc</sub>
Wash hands with soap	90.39±18.22 <sub>ab</sub>	90.65±18.06 <sub>a</sub>	88.44±20.13 <sub>abc</sub>	89.06±20.15 <sub>abc</sub>	88.67±20.55 <sup>abc</sup>	88.92±19.81 <sub>abc</sub>	86.38±22.33 <sup>cd</sup>	87.21±21.28 <sup>bc</sup> <sub>d</sub>	83.94±26.44 <sub>d</sub>
Use hand sanitizer	70.80±30.70 <sub>c</sub>	71.64±31.55 <sub>abc</sub>	74.18±29.69 <sub>abc</sub>	75.72±29.49 <sub>abc</sub>	76.17±29.20 <sup>a</sup>	75.78±28.56 <sub>ab</sub>	74.44±29.69 <sup>abc</sup>	75.40±29.57 <sub>abc</sub>	70.91±32.38 <sub>b</sub>

Different superscripts indicate significant differences between months  
[0= Never, 50= Sometimes, 100 = Always]

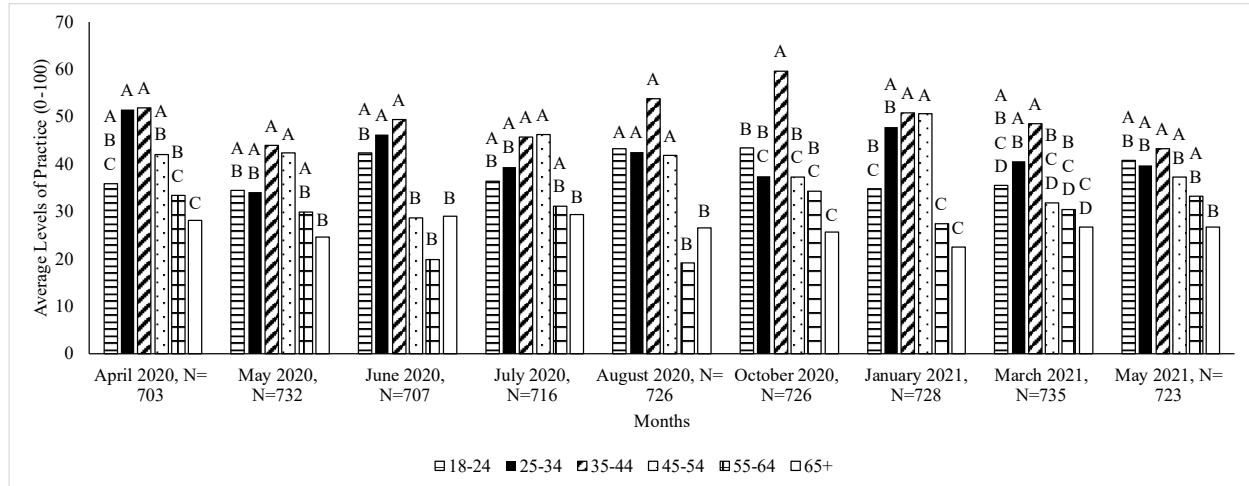


## APPENDIX T. LEVELS OF PRODUCE WASHING, AND THERMOMETER USE DURING THE COVID-19 PANDEMIC (APRIL 2020-MAY 2021)

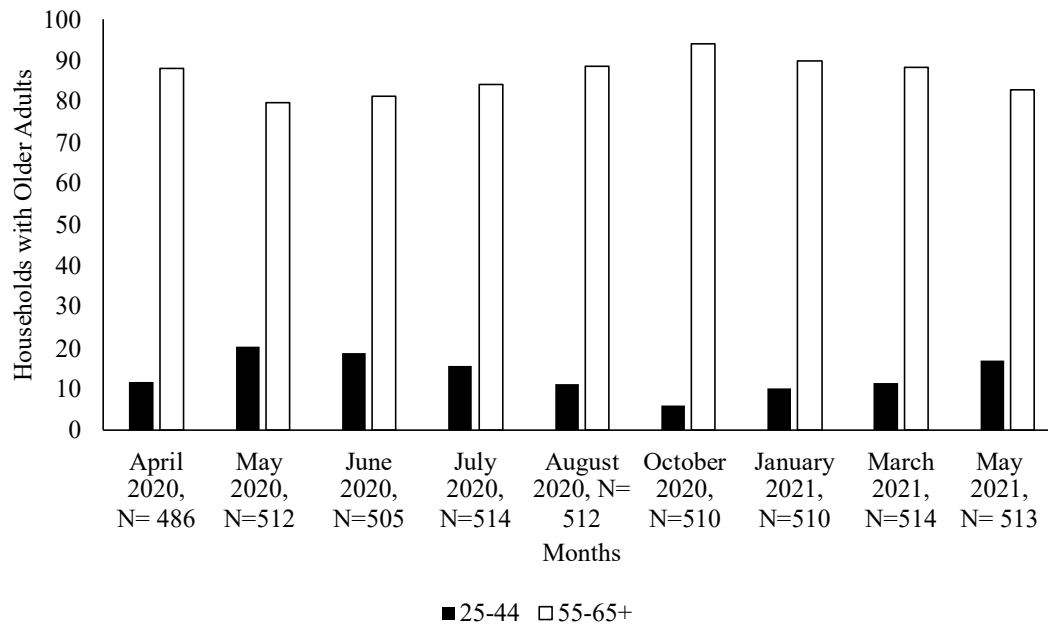
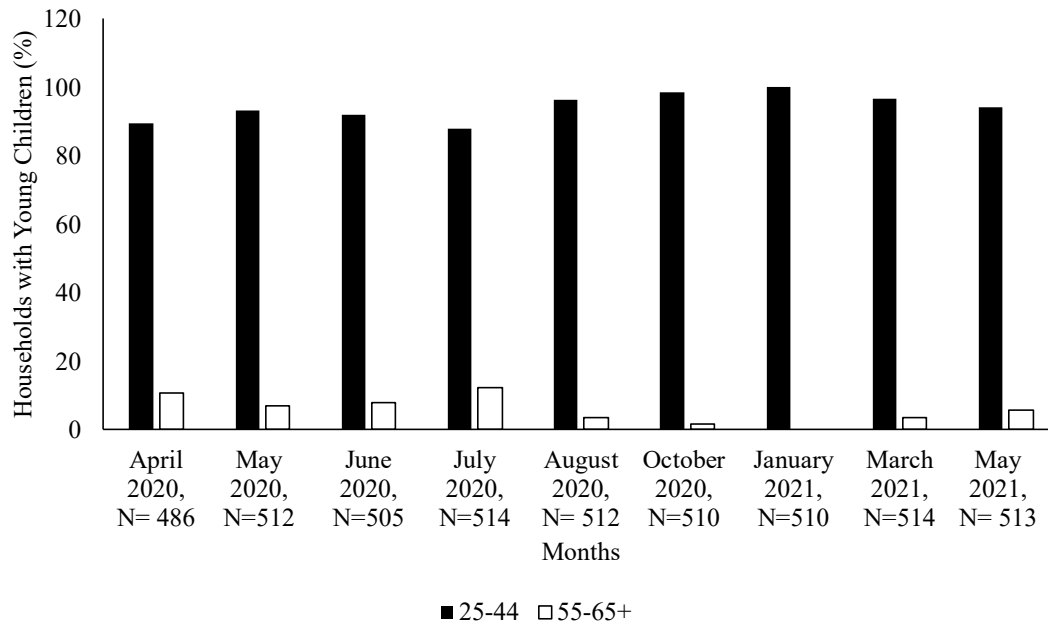
	April 2020 N= 703	May 2020 N=732	June 2020 N=707	July 2020 N=716	August 2020 N= 726	October 2020 N=726	January 2021 N=728	March 2021 N=735	May 2021 N= 723
Wash fruits and vegetables with water	81.56±28.94 <sup>a</sup>	82.37±29.24 <sup>a</sup>	81.36±28.08 <sup>a</sup>	81.45±28.54 <sup>a</sup>	82.61±27.62 <sup>a</sup>	81.18±28.02 <sup>a</sup>	79.74±28.70 <sup>ab</sup>	81.02±28.22 <sup>a</sup>	76.00±32.12 <sup>b</sup>
Wash fruits and vegetables with soap	40.26±40.88 <sup>a</sup>	34.70±40.60 <sup>a</sup>	36.09±39.90 <sup>a</sup>	37.81±40.08 <sup>a</sup>	37.44±40.03 <sup>a</sup>	39.14±40.25 <sup>a</sup>	38.83±39.74 <sup>a</sup>	35.45±39.79 <sup>a</sup>	36.49±39.40 <sup>a</sup>
Use a food thermometer to ensure meat is fully cooked	46.99±39.83 <sup>ab</sup> <sub>cd</sub>	43.41±39.9 <sup>d</sup>	46.44±39.17 <sub>cd</sub>	50.38±40.01 <sub>bc</sub>	49.01±39.82 <sup>ab</sup> <sub>cd</sub>	52.94±39.66 <sub>ab</sub>	51.34±38.92 <sup>bc</sup>	49.62±39.77 <sup>a</sup> <sub>bcd</sub>	52.57±39.62 <sup>bc</sup>

Different superscripts indicate significant differences between months  
[0= Never, 50= Sometimes, 100 = Always]

## APPENDIX U. LEVELS OF WASHING PRODUCE WITH SOAP FOR DIFFERENT AGE GROUPS (APRIL 2020-MAY 2021)



## APPENDIX V. HOUSEHOLDS WITH YOUNG CHILDREN AND OLDER ADULTS SEPARATED INTO AGE GROUPS (25-44 YEARS VS 55-65+ YEARS)



## **APPENDIX W. PET FOOD SAFETY SURVEY**

### **Study Screening Questions:**

1. Do you have a pet dog or cat living with you?
  - ☐ Yes
  - ☐ No
2. Are you the primary caregiver of the pet(s) that live with you?
  - ☐ Yes
  - ☐ No
3. What kind of pet(s) that live with you currently?
  - ☐ Dog
  - ☐ Cat
  - ☐ Both
  - ☐ None of the above

### **Demographic Screening Questions:**

4. What is your gender?
  - ☐ Male
  - ☐ Female
  - ☐ Prefer not to answer
5. What is your age?
  - ☐ 18-24
  - ☐ 25-34
  - ☐ 35-44
  - ☐ 45-54
  - ☐ 55-64
  - ☐ 65 and above
  - ☐ Prefer not to answer
6. With which ethnic group do you identify your ethnic background
  - ☐ White (non-Hispanic)
  - ☐ Hispanic

- ☐ African American
- ☐ Asian
- ☐ American Indians
- ☐ Other
- ☐ Prefer not to answer

7. In which state do you currently reside?

- ☐ All states in the United States listed in alphabetical order starting with Alabama
- ☐ I do not reside in the United States

### **Dog questions**

*Display questions 8 and 9 if question 3 answered “Dog” or “Both”*

8. How many dogs do you have now?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ More than 3

9. Where do the dog(s) live?

- ☐ Inside the house.
- ☐ Outside the house.
- ☐ Both inside and outside, depending on the dog(s).
- ☐ None of above

### **Cats Questions**

*Display questions 10 and 11 if question 3 answered “Cat” or “Both”*

10. How many cats do you have now?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ More than 3

11. Where do the cat(s) live?

- ☐ Inside the house.
- ☐ Outside the house.
- ☐ Both inside and outside, depending on the dog(s).
- ☐ None of above

### **Interactions and Practices Questions**

12. Read the following statements and select the option if you interact with the pet(s) as stated.

(Check all that apply)

- ☐ I kiss my pet(s).
- ☐ My pet(s) lick me.
- ☐ I cuddle with my pet(s).
- ☐ I pet my pet(s).
- ☐ My pet(s) sleep with me.
- ☐ None of above

13. Read the following statements and select the option if you practice as stated. (Check all that apply)

- ☐ Wash hands with soap after play with my pet(s).
- ☐ I feed my pet(s) food from my palm.
- ☐ I eat my pet's food/treats.
- ☐ Wash hands with soap after feed my pet(s).
- ☐ If you are paying attention, please DO NOT SELECT
- ☐ None of above

14. Read the following statements and select the option if your pet(s) practice as stated. (Check all that apply)

- ☐ My pet(s) clean my dishes by licking before the dishes go into the dishwasher.
- ☐ My pet(s) get on the kitchen countertop.
- ☐ My pet(s) put their paws on the kitchen counter or dining table.
- ☐ My pet(s) can access the kitchen or dining room while I eat or cook.
- ☐ None of above

### Children Questions

15. Are there children or grandchildren younger than 5 years old live with you or visit frequently, such as once a month?

- ☐ Yes
- ☐ No

*Display questions 16-18 if question 15 answered "Yes"*

16. Read the following statements and select the option if the children interact with the pet(s) as stated. (Check all that apply)

- ☐ The children kiss the pet(s).
- ☐ The pet(s) lick the children.
- ☐ The children cuddle with the pet(s).
- ☐ The children pet the pet(s).
- ☐ The children sleep with the pet(s).
- ☐ The children wash hands with soap after they play with the pet(s).
- ☐ The children eat the pet's food/treat.
- ☐ None of above

17. Read the following statements and answer if you have heard or believe the statement.

"Young children (younger than 5 years old) are at risk for foodborne illness."

- ☐ I have heard of it
- ☐ Yes
- ☐ No
- ☐ Not sure
- ☐ I believe it
- ☐ Yes
- ☐ No
- ☐ Not sure

18. Read the following statements and answer how much do you agree with those statements.

“The risk of my pet(s) transmitting foodborne pathogens to the children is...”

- ☐ Low
- ☐ Somewhat Low
- ☐ Neutral
- ☐ Somewhat High
- ☐ High

“The risk of the children getting sick from pet foods/treats is...”

- ☐ Low
- ☐ Somewhat Low
- ☐ Neutral
- ☐ Somewhat High
- ☐ High

### **Safety Questions**

19. Read the following statements and answer how much risk associates with each statement.

“The risk of my pet(s) transmitting foodborne pathogens to me is...”

- ☐ Low
- ☐ Somewhat Low
- ☐ Neutral
- ☐ Somewhat High
- ☐ High

“The risk to me getting sick from pet foods/treats is...”

- ☐ Low
- ☐ Somewhat Low
- ☐ Neutral
- ☐ Somewhat High
- ☐ High



“The risk of my pet getting sick from pet foods/treats is...”

- ☐ Low
- ☐ Somewhat Low
- ☐ Neutral
- ☐ Somewhat High
- ☐ High

### **Pet Food Questions**

20. What kind of pet foods/treats do you feed your pet(s)?

Dry pet foods

- ☐ Never
- ☐ Sometimes
- ☐ Always

Dry (vegetable-based) pet treats, like biscuits

- ☐ Never
- ☐ Sometimes
- ☐ Always

Dry (animal parts or meat-based) pet treats, like pig ears and hard or soft jerky

- ☐ Never
- ☐ Sometimes
- ☐ Always

Canned pet foods

- ☐ Never
- ☐ Sometimes
- ☐ Always

Raw pet foods (including raw meat and/or raw animal parts)

- ☐ Never
- ☐ Sometimes
- ☐ Always

Table Scraps

- ☐ Never
- ☐ Sometimes
- ☐ Always

Home-prepared foods that are only for pet's consumption

- ☐ Never
- ☐ Sometimes
- ☐ Always

If you are paying attention, please select "Always."

- ☐ Never
- ☐ Sometimes
- ☐ Always

We understand that pet(s) may not finish the whole can or pack of pet foods. Answer the following questions and tell us how you store the leftovers of CANNED, RAW, or HOME-MADE pet foods. *Display questions 21 and 22 if question 20 answered "sometimes" or "always" for canned, raw and home-prepared.*

21. Where do you store the leftovers? (Check all that apply)

- ☐ In the refrigerator that stores human foods.
- ☐ In the refrigerator that only stores pet foods.
- ☐ In the freezer that stores human foods.
- ☐ In the freezer that stores pet foods.
- ☐ In the room temperature.
- ☐ In the garage temperature.
- ☐ None of above.

22. When you store the pet food leftovers in the refrigerator or freezer, how do you store them?

(Check all that apply)

- ☐ On the top shelves or drawers, with extra containers or bags to prevent juice run-off.
- ☐ On the top shelves or drawers, without extra containers or bags to prevent juice run-off.
- ☐ On the bottom shelves or drawers.
- ☐ On the refrigerator door shelves.
- ☐ Wherever there is enough space for the size of the leftovers.
- ☐ None of above

### **Dry Pet Foods Questions**

*Display questions 23-28 if question 20 answered “Sometimes” and “Always” for “Dry pet foods”.*

23. Where do you get dry pet foods? (Check all that apply)

- ☐ Pet stores
- ☐ Supermarkets
- ☐ Online stores, like Chewy, Amazon
- ☐ Family and friends
- ☐ I make them myself.
- ☐ None of above

24. Where do you store the dry pet foods?

- ☐ Sealed container (discard the original package without keeping information on the package)
- ☐ Sealed container (keep record of information on the package)
- ☐ In the original package
- ☐ None of above

25. When there is a pet foods spill, what do you do? (Check all that apply)

- ☐ I vacuum it.
- ☐ I scoop up the larger amount/pieces.
- ☐ I put them back to the package or container.
- ☐ I throw them away.
- ☐ Leave for the pet(s) to eat.
- ☐ I sanitize the spill area after cleanup.
- ☐ I never had a spill.
- ☐ None of above

26. In which of the following conditions do you store the dry pet foods? (Check all that apply)

- ☐ Refrigerator
- ☐ Freezer
- ☐ Room temperature
- ☐ Garage temperature
- ☐ None of above

27. How long does it take your pet(s) to finish one package of dry pet foods that you often buy?

- ☐ Less than 2 weeks
- ☐ 2 weeks to 1 month
- ☐ 1 to 3 months
- ☐ 3 to 6 months
- ☐ 6 months to a year
- ☐ More than a year

28. How many packages of dry pet foods do you often buy at one time?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ More than 5

### **Dry Vegetable-based Treats Questions**

*Display questions 29-34 if question 20 answered “Sometimes” and “Always” for “Dry vegetable-based pet treats”.*

29. Where do you get vegetable-based treats? (Check all that apply)

- ☐ Pet stores
- ☐ Supermarkets
- ☐ Online, like Chewy, Amazon
- ☐ Family and friends
- ☐ I make them myself.
- ☐ None of above

30. Why do you choose vegetable-based treats for your pet(s)? (Check all that apply)

- ☐ It balanced their diet. They eat meat-based foods, so they need more vegetables.
- ☐ It is healthier for them.
- ☐ They liked the treats.
- ☐ None of above

31. Where do you store the dry (vegetable-based) treats?

- ☐ Sealed container and discard the original package without keeping information on the original package
- ☐ Sealed container and keep record of information on the original package
- ☐ In the original package
- ☐ None of above

32. In which of the following condition do you store the dry (vegetable-based) treats? (Check all that apply)

- ☐ Refrigerator
- ☐ Freezer
- ☐ Room temperature
- ☐ Garage temperature
- ☐ None of above

33. How long does it take your pet(s) to finish one package of dry (vegetable-based) treats that you often buy?

- ☐ Less than 2 weeks
- ☐ 2 weeks to 1 month
- ☐ 1 to 3 months
- ☐ 3 to 6 months
- ☐ 6 months to a year
- ☐ More than a year

34. How many packages of dry (vegetable-based) pet treats do you often buy at one time?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ More than 5

### **Animal Part and Meat Based Pet Treats Questions**

*Display questions 35-39 if question 20 answered “Sometimes” and “Always” for “Dry (animal part or meat-based) pet treats”.*

35. Where do you get dry (animal parts or meat based) treats? (Check all that apply)

- ☐ Pet stores
- ☐ Supermarkets
- ☐ Online, like Chewy, Amazon
- ☐ Family and friends
- ☐ I make them myself.
- ☐ None of above

36. Where do you store the dry (animal parts or meat-based) treats?
- ☐ Sealed container and discard the original package without keeping information on the original package
  - ☐ Sealed container and keep record of information on the original package
  - ☐ In the original package
  - ☐ None of above
37. In which of the following condition do you store the dry (animal parts or meat-based) treats?  
(Check all that apply)
- ☐ Refrigerator
  - ☐ Freezer
  - ☐ Room temperature
  - ☐ Garage temperature
  - ☐ None of above
38. How long does it take your pet(s) to finish one package of dry (animal parts or meat-based) treats that you often buy?
- ☐ Less than 2 weeks
  - ☐ 2 weeks to 1 month
  - ☐ 1 to 3 months
  - ☐ 3 to 6 months
  - ☐ 6 months to a year
  - ☐ More than a year
39. How many packages of dry (animal parts or meat-based) pet treats do you often buy at one time?
- ☐ 1
  - ☐ 2
  - ☐ 3
  - ☐ 4
  - ☐ 5
  - ☐ More than 5

## Raw Pet Foods Questions

*Display questions 40 and 41 if question 20 answered “Sometimes” and “Always” for “Raw pet foods (including raw meat and/or raw animal parts)”.*

40. Where did you first learn about feeding raw meat or raw animal parts for pets? (Check all that apply)

- ☐ Social media, like Facebook and Twitter
- ☐ Bloggers
- ☐ YouTube Influencers
- ☐ Pet owner listserv, for example, an email group that provides news about pet foods or pet disease control.
- ☐ Pet store employees
- ☐ Family or friends
- ☐ Veterinarian
- ☐ Book, magazine, or other printed sources
- ☐ Breeder instructions or advice
- ☐ None of above

41. Why do you feed pet raw meat or raw animal parts? (Check all that apply)

- ☐ Concern about safety/quality control/nutritional value of commercial foods.
- ☐ I try not to eat processed foods and do not want my pet to eat them either.
- ☐ To prevent food allergies.
- ☐ To improve dental or oral hygiene.
- ☐ To improve the skin or coat.
- ☐ To improve my pet's immune system.
- ☐ Feeding a raw animal product diet is healthier.
- ☐ Feeding a raw animal product diet is more natural.
- ☐ My pet prefers a raw animal product diet.
- ☐ None of above.



## Utensils Questions

42. As pet owners, you may buy utensils or toys for your pet(s). What are the utensils or toys that you have for them? (Check all that apply)

- ☐ Scoops that I use for pet foods/treats
- ☐ Containers that I use to store pet foods/treats
- ☐ Feeding bowls
- ☐ Feeding mats
- ☐ Food-stuffed toys, like Kong
- ☐ Treat or training pouches
- ☐ None of above

43. How do you clean the SCOOPS that you use for pet foods/treats?

*Display question 43 if question 42 answered "Scoops that I use for pet foods/treats".*

I rinse them with water only

- ☐ Never
- ☐ Sometimes
- ☐ Always

I wash them with soap

- ☐ Never
- ☐ Sometimes
- ☐ Always

I sanitize them after wash

- ☐ Never
- ☐ Sometimes
- ☐ Always

I wash them in the dishwasher

- ☐ Never
- ☐ Sometimes
- ☐ Always

44. How do you clean the CONTAINERS that you use for pet foods/treats?

*Display question 44 if question 42 answered “containers that I use to store pet foods/treats”.*

I rinse them with water only

- ☐ Never
- ☐ Sometimes
- ☐ Always

I wash them with soap

- ☐ Never
- ☐ Sometimes
- ☐ Always

I sanitize them after wash

- ☐ Never
- ☐ Sometimes
- ☐ Always

I wash them in the dishwasher

- ☐ Never
- ☐ Sometimes
- ☐ Always

45. How do you clean the FEEDING BOWLS that you use for pet foods/treats?

*Display question 45 if question 42 answered “Feeding bowls”.*

I rinse them with water only

- ☐ Never
- ☐ Sometimes
- ☐ Always

I wash them with soap

- ☐ Never
- ☐ Sometimes
- ☐ Always

I sanitize them after wash

- ☐ Never
- ☐ Sometimes
- ☐ Always

I wash them in the dishwasher

- ☐ Never
- ☐ Sometimes
- ☐ Always

46. How do you clean the FEEDING MATS that you use for pet foods/treats?

*Display question 46 if question 42 answered "Feeding mats".*

I rinse them with water only

- ☐ Never
- ☐ Sometimes
- ☐ Always

I wash them with soap

- ☐ Never
- ☐ Sometimes
- ☐ Always

I sanitize them after wash

- ☐ Never
- ☐ Sometimes
- ☐ Always

I wash them in the dishwasher

- ☐ Never
- ☐ Sometimes
- ☐ Always

47. How do you clean the FOOD-STUFFED TOYS (like Kong) that you use for pet foods/treats?

*Display question 47 if question 42 answered "Food-stuffed toys (like Kong)".*

I rinse them with water only

- ☐ Never
- ☐ Sometimes
- ☐ Always

I wash them with soap

- ☐ Never
- ☐ Sometimes
- ☐ Always

I sanitize them after wash

- ☐ Never
- ☐ Sometimes
- ☐ Always

I wash them in the dishwasher

- ☐ Never
- ☐ Sometimes
- ☐ Always

48. How do you clean the TREAT OR TRAINING POUCHES that you use for pet foods/treats?

*Display question 48 if question 42 answered "Treat or training pouches".*

I rinse them with water only

- ☐ Never
- ☐ Sometimes
- ☐ Always

I wash them with soap

- ☐ Never
- ☐ Sometimes
- ☐ Always

I sanitize them after wash

- ☐ Never
- ☐ Sometimes
- ☐ Always

I wash them in the dishwasher

- ☐ Never
- ☐ Sometimes
- ☐ Always

## Safety Questions 2

49. Which of the following products can pose microbial food safety risk, like *Salmonella* and *E. coli*?

- ☐ Dry pet foods
- ☐ Dry (vegetable-based) pet treats, like biscuits
- ☐ Dry (animal parts or meat based) pet treats, like pig ears and hard or soft jerky
- ☐ Canned pet foods
- ☐ Frozen pet foods
- ☐ Home-prepared foods that are only for pet's consumption
- ☐ Raw meat
- ☐ Raw animal parts
- ☐ Raw vegetables
- ☐ Raw fruits
- ☐ Raw nuts
- ☐ Raw milk
- ☐ None of above

50. Have you heard of any pet food/treat that was involved in foodborne outbreaks or recalls, due to microbial contamination, like *Salmonella* and *E. coli*?

- ☐ Yes
- ☐ No
- ☐ Not sure

51. Read the following story headlines and answer how concerned you are about pet food safety after reading each story headline?

“143 PEOPLE got sick from bacteria tied to ABC brand dry pet treats.”

- ☐ Very concerned
- ☐ Somewhat concerned
- ☐ Not Concerned at all

“143 PETS got sick from bacteria tied to ABC brand dry pet treats.”

- ☐ Very concerned
- ☐ Somewhat concerned
- ☐ Not Concerned at all

52. Where did you hear about the outbreaks or recalls? (Check all that apply)

*Display question 52 if question 50 answered “Yes”.*

- ☐ Social media, like Facebook and Twitter
- ☐ Government agencies' websites, like FDA and CDC
- ☐ Veterinarian
- ☐ Pet owner listserv, for example, an email group that provides news about pet foods or pet disease control.
- ☐ Pet store employees
- ☐ The stores that I buy pet foods/treats from
- ☐ The pet food/treat companies
- ☐ Family or friends
- ☐ Health professionals (doctors, nurse, physician assistant, nutritionists, dietitians)
- ☐ Pet magazines
- ☐ TV news
- ☐ None of above

53. With respect to microbial food safety information about pet food/treat, who, do you think, is responsible to communicate the food safety risk to you? (Check all that apply)

- ☐ Government agencies, like FDA
- ☐ Veterinarian
- ☐ Pet owner listserv, for example, an email group that provides news about pet foods or pet disease control.
- ☐ Pet store employees
- ☐ The stores that I buy pet foods/treats from
- ☐ The pet food/treat companies
- ☐ Health professionals (doctors, nurse, physician assistant, nutritionists, dietitians)
- ☐ University extension
- ☐ No one's responsibility.
- ☐ Myself
- ☐ None of above

54. With respect to microbial food safety information about pet foods, who do you trust as a knowledge source?

Social media, like Facebook and Twitter

- ☐ Not at all
- ☐ Somewhat
- ☐ Very much

Government agencies, like FDA

- ☐ Not at all
- ☐ Somewhat
- ☐ Very much

Pet owner listserv, for example, an email group that provides news about pet foods or pet disease control.

- ☐ Not at all
- ☐ Somewhat
- ☐ Very much

Pet store employees

- ☐ Not at all
- ☐ Somewhat
- ☐ Very much

The stores that I buy pet foods/treats from

- ☐ Not at all
- ☐ Somewhat
- ☐ Very much

The pet food/treat companies

- ☐ Not at all
- ☐ Somewhat
- ☐ Very much

Family or friends

- ☐ Not at all
- ☐ Somewhat
- ☐ Very much

Health professionals (doctors, nurse, physician assistant, nutritionists, dietitians)

- ☐ Not at all
- ☐ Somewhat
- ☐ Very much

Veterinarian

- ☐ Not at all
- ☐ Somewhat
- ☐ Very much

Pet magazines

- ☐ Not at all
- ☐ Somewhat
- ☐ Very much



TV news

- ☐ Not at all
- ☐ Somewhat
- ☐ Very much

**Commercial Products Questions**

*Display questions 55 and 56 if questions 23, 29 and 35 answered “Pet stores”, “Supermarkets” and “Online, like Chewy, Amazon”.*

55. If the pet food/treat you bought is in a recall/outbreak related to microbial contamination, what will you do after the recall/outbreak is over?

- ☐ I will buy the same product from this brand immediately after the recall is over.
- ☐ I will buy the same product from a different brand for a few months before I go back to the recalled brand.
- ☐ I will never buy the same product from this brand anymore, but I will buy different products from this brand.
- ☐ I will never buy any related products from this brand anymore.
- ☐ None of above.

56. When choosing a pet food/treat, what are the labels and/or information affecting your choice?

(Check all that apply)

- ☐ Price
- ☐ My pet(s) like it.
- ☐ It is Organic.
- ☐ It is Non-GMO.
- ☐ It is Natural.
- ☐ It is Raw.
- ☐ Vet recommendations
- ☐ Pet employee recommendations
- ☐ Other pet owners' recommendations
- ☐ Use-by-date
- ☐ None of above

## Demographic Questions

57. Would you give us a guess of your total household's income (previous year) before taxes?

- ☐ Less than \$10,000
- ☐ \$10,000 - \$29,999
- ☐ \$30,000 - \$49,999
- ☐ \$50,000 - \$79,999
- ☐ \$80,000 and above
- ☐ Prefer not to answer

58. What is your highest level of education?

- ☐ Not High School graduate
- ☐ High School or GED Degree
- ☐ Some college or technical school
- ☐ Bachelor's Degree
- ☐ Graduate Degree
- ☐ Prefer not to answer

59. Which community type do you live in?

- ☐ Urban
- ☐ Suburban
- ☐ Rural
- ☐ Prefer not to answer

60. Do you have children?

*Pet owners answered this question if they reported that there are children or grandchildren younger than 5 years old living with them or visiting frequently.*

- ☐ Yes
- ☐ No
- ☐ Prefer not to answer

## APPENDIX X. CHOOSING RAW MEAT OR RAP DIETS AND PET FOOD CHOICES

Survey Question	Response n (%)
<b>Where did you first learn about feeding raw meat or raw animal parts for pets? (N=237) <sup>a</sup></b>	
<b>(Check all that apply)</b>	
Social media, like Facebook and Twitter	94(40)
Family or friends	77(33)
Veterinarian	72(30)
YouTube Influencers	62(26)
Pet store employees	61(26)
Bloggers	45(19)
Pet owner listserv, for example, an email group that provides news about pet foods or pet disease control.	44(19)
Book, magazine, or other printed sources	32(14)
Breeder instructions or advice	17(7)
None of the above	29(12)
<b>Why do you feed pet raw meat or raw animal parts? (N=237) <sup>a</sup></b>	
<b>(Check all that apply)</b>	
To improve the skin or coat.	71(30)
Feeding a raw animal product diet is more natural.	65(27)
To improve pet's immune system.	65(27)
Concern about safety/quality control/nutritional value of commercial foods.	64(27)
To improve dental or oral hygiene.	60(25)
To prevent food allergies.	58(25)
Feeding a raw animal product diet is healthier.	54(23)
The owner tries not to eat processed foods and does not want his pet to eat them either.	52(22)
Pet prefers a raw animal product diet.	31(13)
None of the above.	29(12)
<b>What kind of pet foods/treats do you feed your pet(s)? (N=1040)</b>	
Dry pet food	1011(97)
Dry (vegetable-based) pet treats like biscuits	730(70)
Dry (animal part or meat based) pet treats like pig ears and hard or soft jerky	561(54)
Canned pet food	706(68)

Table Scarps	640(62)
Home prepared foods that are only for pet consumption	391(28)
Raw animal part (RAP) and/ or raw meat	237(23)

<sup>a</sup> This question was asked only when pet owners reported feeding their pets raw meat and/or RAP diets.

**APPENDIX Y. INTERACTIONS AND PRACTICES AMONG PET OWNERS WHO FED THEIR PET(S) RAW MEAT AND RAP DIETS, [CHECK ALL THAT APPLY]**

Interactions and Practices	Response n (%) N = 237 <sup>a</sup>
Pet their pets(s)	194(82)
Cuddle with pet(s)	191(81)
Pet(s) lick them	175(74)
Pet(s) sleep with them	149(63)
Kiss Pets	166(70)
Wash hands with soap after playing with pet(s)	180(76)
Wash hands with soap after feeding pet(s)	143(60)
Palm Feed their pet(s)	127(54)

<sup>a</sup> This is the total number of pet owners who reported feeding their pet(s) raw meat and RAP diets

## APPENDIX Z. FOOD RECALL AND FOOD SAFETY KNOWLEDGE

Survey Questions	n (%)
<b>Have you heard of any pet food/treat that was involved in foodborne outbreaks or recalls, due to microbial contamination? (N=1040)</b>	
Yes	229(22)
No	608(59)
Not sure	203(20)
<b>Where did you hear about the outbreaks or recalls? (N=229) <sup>a</sup></b>	
<b>(Check all that apply)</b>	
TV news	137(60)
Social media, like Facebook and Twitter	97(42)
Family or friends	47(21)
Veterinarian	45(20)
Government agencies' websites, like FDA and CDC	44(19)
Pet magazines	33(14)
The stores that I buy pet foods/treats from	29(13)
The pet food/treat companies	28(12)
Pet store employees	26(11)
Health professionals (doctors, nurse, physician assistant, nutritionists, dietitians)	26(11)
Pet owner listserv, for example, an email group that provides news about pet foods or pet disease control.	24(11)
None of the above	5(2)
<b>If the pet food/treat you bought is recalled due to microbial contamination, what will you do? (N=1011) <sup>b</sup></b>	
<b>(Check all that apply)</b>	
Throw it in the garbage.	713(71)
Send it back to the facility that sold it to me.	426(42)
Clean and sanitize all pet foods/treat contacting surfaces.	414(41)
I don't know what to do.	44(4)
Continue using it.	41(4)
None of the above	14(1)
<b>If the pet food/treat you bought is in a recall/outbreak related to microbial contamination, what will you do after the recall/outbreak is over? (N=1011) <sup>b</sup></b>	
<b>(Check all that apply)</b>	
I will never buy any related products from this brand anymore.	316(31)
I will buy the same product from a different brand for a few months before I go back to the recalled brand.	294(29)
I will never buy the same product from this brand anymore, but I will buy different products from this brand.	232(23)

I will buy the same product from this brand immediately after the recall is over.	121(12)
None of the above.	48(5)
<b>Which of the following products can pose microbial food safety risk, like <i>Salmonella</i> and <i>E. coli</i>? (N=1040)</b>	
<b>(Check all that apply)</b>	
Raw meat	812(78)
Raw animal parts	709(68)
Raw milk	510(49)
Canned pet foods	391(38)
Raw vegetables	388(37)
Raw fruits	328(32)
Dry (animal parts or meat based) pet treats, like pig ears and hard or soft jerky	257(25)
Home-prepared foods that are only for pet's consumption	287(28)
Frozen pet foods	218(21)
Dry pet-foods	193(19)
Raw nuts	181(17)
Dry (vegetable-based) pet treats, like biscuits	140(14)
None of the above	42(4)

<sup>a</sup> This question was asked only if pet owners had heard of foodborne outbreaks or recalls due to microbial contamination.

<sup>b</sup> This question was asked only if pet owners reported feeding their pets dry pet food/ treats (vegetable-based, animal parts and animal-based).

## APPENDIX AA. FOOD SAFETY MESSAGES ON GROCERY STORE FLOUR AND BAKING MIX PACKAGES

	Package code	Message
Packages with short messages	S1	Please do not consume/eat raw cake batter
	S2	Do not eat raw cake batter
	S3	Do not eat raw cake batter or cookie dough
	S4	Do not eat raw batter, store in a cool, dry place
	S5	Do not eat raw batter
Packages with long messages	L1 <sup>a</sup>	Say no to raw dough: flour is a raw ingredient. Bake fully before enjoying.
		Do not eat raw flour, dough or batter. Raw flour is not ready-to-eat and must be thoroughly cooked or baked before eating to prevent illness from bacteria in the flour. Do not eat or play with raw dough; wash hands, utensils, and surfaces after handling. After opening, keep cool and dry in a sealed container. Freeze for prolonged storage.
	L2 <sup>a</sup>	Safe Handling Instructions: Raw flour is not ready-to-eat and must be thoroughly cooked before eating to prevent illness from bacteria in the flour. Do not eat or play with raw dough; wash hands, utensils, and surfaces after handling
	L3	CAUTION: Do not eat raw flour, dough, or batter. WARNING: Do not eat raw batter. Please cook fully before enjoying.
	L4	WARNING: Do not eat raw batter. Please cook fully before enjoying.
	L5	WARNING: Do not eat raw batter. Please cook fully before enjoying.

<sup>a</sup> Package had two separate flour safety messages



## APPENDIX BB. INTERVIEW CODEBOOK

Code	Definition	Representative quote
1. Loss Effectiveness	This code is when a participant receives a <b>loss</b> framed message in part 2 and talks about how effective it was as a flour safety message or how they felt about the message as a whole.	“Yeah I think it would be effective I do I do understand this well like shorter messages but I think for people that they're not too related like to the food safety area or food like handling food you will be able to message put a little more longer like the like effects it can have and then one that says like you can become ill from the bacteria so I think yeah that would be effective”
2. Gain Effectiveness	This code is when a participant receives a <b>gain</b> framed message in part 2 and talks about how effective it was as a flour safety message or how they felt about the message as a whole.	“Yeah, I thought the message was kind of weird, because it's like, enjoy baking if you do not consume and it just seemed like the wording was just like not used to, I'm hearing usually it's like, do not consume or like instead of if you do not. I don't know, it was just kind of weird to me.”
3. Non-Loss Effectiveness	This code is when a participant receives a <b>non-loss</b> framed message in part 2 and talks about how effective it was as a flour safety message or how they felt about the message as a whole.	“I think yes, it will be an effective flour safety message.... Because it has all the messages like properly cook before eating and why it is unsafe to eat without cooking it. And what could be the outcome. So, all three aspects of the warning are there.”
4. Control Effectiveness	This code is when a participant receives a <b>control</b> framed message in part 2 and talks about how effective it was as a flour safety message or how they felt about the message as a whole.	“Um, not really because people still eat raw batter or raw cookie dough. I think, um, additional sentence might be helpful to say why you shouldn't.”
5. Compared to Grocery Store	When a participant mentions what they feel is similar or different when it comes to the messages in part 2 (the messages researchers developed) versus the messages they see in the grocery store.	“Um, I think it's not a big difference because these are like actual products. The only thing at that, for, for this experiment, is time. I have enough time to look at the packages and, uh, and inspect it and search for the place.

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		But, and then, uh, in the actual store I'm usually in hurry so I don't have the time to look.” “Ready to eat? Yeah.”
6. Ready-to-Eat	When the participant mentions if they have heard of ready to eat or not.	
7. Ready-to-Eat Perception	When a participant mentions that they think ready-to-eat means. This can also be their expectations of the food itself.	“Foods ready to eat, I would assume that you don't have to cook it, or you don't have to wash it or anything like that.”
8. Not Ready-to-Eat Perception	When a participant mentions that they think NOT ready-to-eat means. This can also be their expectations of the food itself.	“That you have to, it's like raw, and you have to cook it or get it to a certain temperature, and you have to clean it too.”
9. Best Message	When a participant mentions what they think is the best message for them or if they mentioned a preferred way of seeing food safety messages.	“The best message for me was one that was like separated from too much text. I think it's easier for consumers like to find like this safety message if it's separated from too much text. I saw some black boxes back there that the safety message was like confusing to find because it was between too much text so I think would be better for us to separate it from like instructions or from ingredients from all this message for me what's easier to find them it's more clear”
10. Prior Belief of Flour Safety	When the participant mentions their belief about flour being a source of bacteria prior to the study.	“So actually, I've never considered flour as a source of bacteria actually yeah the way we use it in my country for example we do we use flour raw flour like when we make specifically like tortillas or something like that, we do use some raw so I don't think like for example in my culture people are aware that raw flour can make you sick”
11. Previous Sneaking a Taste	The answer that participant's give when they are asked if they sneaked a taste of raw batter or dough before the study. This can be yes/no or an explanation/ experience they share.	“yeah”

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12. Future Sneaking a Taste	When participants mention whether they will sneak a taste of raw dough or batter after this study and if they share an experience.	“Yeah, because I do know, now, the risk of trying raw dough and everything and even though some people may find it that it's good you know trying the raw dough it's sweet but and everything but once you know the effect it can have on your health then you yeah I won't do it again” (He said no).
13. Future Handling of Flour	When a participant mentions how they will handle raw flour in the future.	“Yes, so I'll be more careful with handling because it's what you use like some instruments in the kitchen that may have raw flour and the like be more careful when using this; washing them washing you know the like utensils I use when I use the flours. Yeah, so being more careful and more detailed when using this.”
14. General Thoughts on Flour Safety Messages	When participants express their general thoughts about flour safety messages on packaging.	“So, I think I do think they are necessary like to warn people what the like if you use it badly it like you can have an effect on your health and I generally yes I think they will be like for me a shorter message aside from all the text that a normal text would have it's more effective.”
15. Necessary Messages	When participants mention that the flour safety messages are necessary. They can also mention why they think this.	“Yeah, definitely necessary because many people like maybe me before this study did not know that you can have you know an illness from raw flour and yeah, they're necessary for companies like to protect themselves in case they have like a case of any bacteria is any of their batches they can maybe protect themselves by putting the message in the package.”
16. Not Necessary Messages	When participants mention that the flour safety messages are <b>NOT</b> necessary. They can also mention why they think this.	“Because I think it's very difficult that people eat raw dough. So probably this method can be just like the trend that people stop

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		<p>buying dough and buy directly like the bread or the pizza dough without making it and probably is worth it. When you're using the dough, you're usually going to bake it. So, all the bacteria are going to..."</p>
17. Other Platforms for Messages	When participants mention other ways, they would like to receive flour safety messages. They could say that the bag is fine or that there is no other way they would like to receive it.	<p>"You think they can say a little bit more in their promotions like when they promote their products like social media or yeah, they can promote it a little even a little bit more like to make people more aware that they have to be more careful about using raw flour."</p>
18. Additional Information	When participants mention additional food safety information they would like to receive on the packages, in store, on the website, or other places.	<p>"Yeah, I think putting that consuming raw flour can make you ill it's a general message for me that would be enough or maybe you can try to educate like consumers to find that message because some people don't care only look for expiration dates or ingredients but do not look for the safety message maybe educate consumers to find the safety message."</p>
19. Paying Extra	When a participant mentions whether they would pay more for pasteurized flour and why.	<p>"Now that I know that it may have like an effect on your health maybe yes it depends on how much more but yeah."</p>
20. Baking Experience	When a participant shares more about their baking experience (a question answer).	<p>"Baking experiences, like when I go to buy like flour, I never pay attention to the safety instruction, which I think I would do in the future. Uh, yeah, that's it I think. I think this study, it was interesting. I, I didn't expect it to be this."</p>
21. Thoughts about the Study	When a participant mentions their overall thoughts or takeaways from the study (last question).	<p>I think it's a good I believe it's a good study like to make people aware of these illnesses that raw flour can have you you never imagine in my case I will never</p>

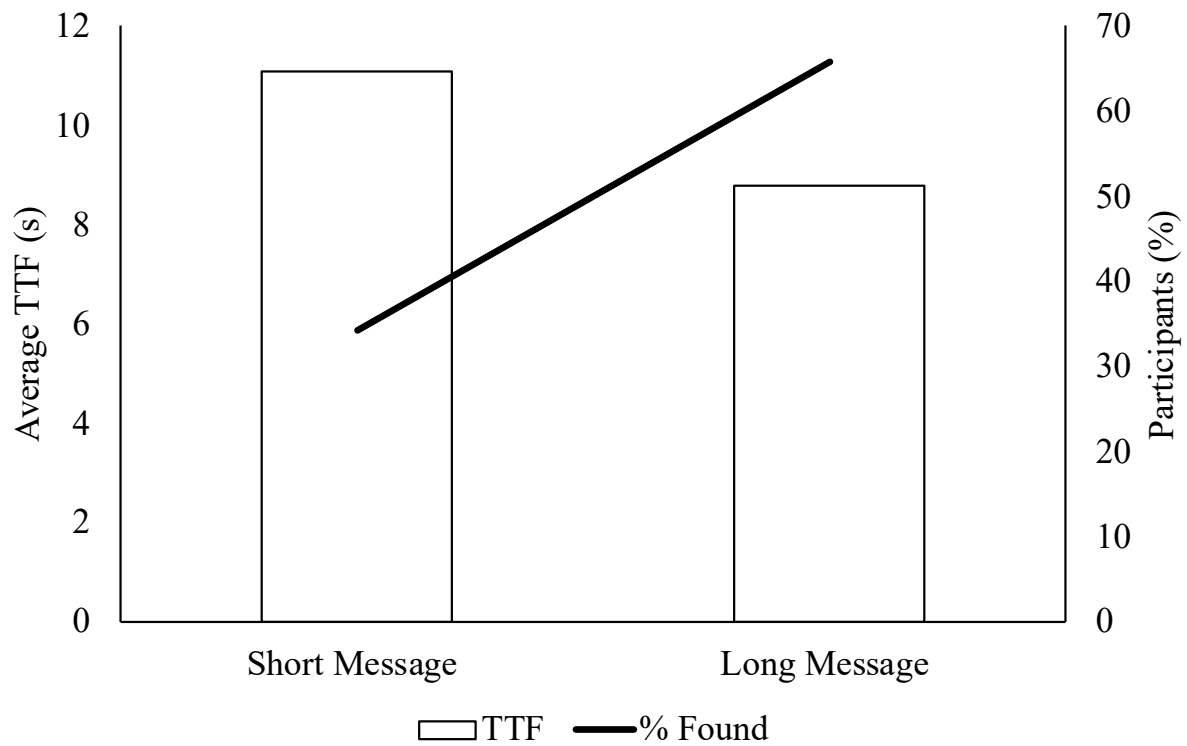
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imagine that raw flour make me sick and it's because I don't know the perception we have it's like it has low water activity and things like that so it's like really not many danger of having bacteria but then this kind of studies that make you realize that you can get sick and like really bad like badly sick so yeah I think it's a really good study for me and totally the rest of the consumers.

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## APPENDIX CC. COMPARING THE SHORT AND LONG MESSAGES ON L2



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