

Awareness of foodborne pathogens among US consumers

Introduction

The more common pathogens associated with foodborne illness include *Salmonella*, *Campylobacter jejuni*, and *Escherichia coli* O157:H7. Some victims of *E. coli* O157:H7 caused illness, particularly the very young, have developed hemolytic uremic syndrome (HUS), characterized by renal failure and hemolytic anemia which can lead to permanent loss of kidney function. Foodborne illness associated with *Listeria monocytogenes*, though relatively low in number, is associated with many deaths. Also, listeriosis in pregnant women can result in miscarriage, fetal death, and severe illness or death of a newborn infant.

Four major foodborne pathogens	
<i>Salmonella</i>	
Associated foods:	Raw meats, poultry, eggs, milk and dairy products, fish, shrimp, frog legs, yeast, coconut, sauces and salad dressing, cake mixes, cream-filled desserts and toppings, dried gelatin, peanut butter, cocoa, and chocolate.
Symptoms of illness:	Nausea, vomiting, abdominal cramps, diarrhea, fever, and headache.
Chronic consequences:	arthritic symptoms may follow 3-4 weeks after onset of acute symptoms.
<i>Campylobacter jejuni</i>	
Associated foods:	Raw chicken, raw milk, non-chlorinated water
Symptoms of illness:	Diarrhea, fever, abdominal pain, nausea, headache and muscle pain. The illness usually occurs 2–5 days after ingestion. Illness generally lasts 7–10 days, but relapses are not uncommon (about 25% of cases).
<i>Escherichia coli</i> O157:H7	
Associated foods:	Undercooked or raw hamburger (ground beef), alfalfa sprouts, unpasteurized fruit juices, dry-cured salami, lettuce, game meat, cheese curds, raw milk.
Symptoms of illness:	Severe cramping (abdominal pain) and diarrhea that becomes grossly bloody. Occasionally vomiting occurs. Fever is either low-grade or absent. Lasts for an average of 8 days.
<i>Listeria monocytogenes</i>	
Foods with high or moderate risk:	Unpasteurized and pasteurized fluid milk, deli meats, frankfurters (not reheated), cheeses (particularly soft-ripened varieties), high-fat and other dairy products, pâté and meat spreads, smoked seafood, cooked and ready-to-eat crustaceans.
Symptoms of illness:	Septicemia, meningitis (or meningo-encephalitis), encephalitis, spontaneous abortion or stillbirth, fever, nausea, vomiting, and diarrhea.

While practices of food suppliers and food service establishments play an important role in reducing foodborne illness, existing research suggests that a substantial proportion of foodborne illness is attributable to improper in-home food handling, preparation, and consumption practices by consumers. Improper practices include, but are not limited to, inadequate cooking, inadequate cooling and storage of foods, cross-contamination of raw and cooked foods, inadequate personal hygiene such as hand washing, and consumption of raw, undercooked, or unsafe foods. Thus, consumer food handling and preparation behaviors are important means to reduce foodborne illness. Awareness of foodborne pathogens may play a positive role in reducing foodborne illness. US adult residents who had heard of *Salmonella* as a problem in food were more likely than others to know that “cooking meat until well-done reduces the risk of food poisoning”. In addition, it was found that those who had heard of *Salmonella* were more likely than others to (1) wash hands after handling raw meat, (2) wash or change cutting board after cutting raw meat or poultry, (3) think

washing hands reduces risk of food poisoning, (4) think serving steak on a plate that held raw steaks increases risk of food poisoning, and (5) think cooking meat “well-done” decreases food poisoning. **Nevertheless**, the awareness of *Salmonella* was not associated with the degree of **doneness** (the state of being fully cooked) in hamburgers served. **Hence, these studies** suggest that awareness of foodborne pathogens goes hand in hand with better knowledge of safe food handling and preparation principles and safer food handling and preparation practices; both should ultimately contribute to a reduction in foodborne illness.

Consumer education programs are often used to promote safer food handling and preparation practices, and increasing the level of awareness of foodborne pathogens appears to be helpful in enhancing the outcomes of consumer education. In particular, consumer education programs may target individuals who are less likely to be aware of foodborne pathogens as a food safety problem, and **thus** may practice less safe food handling and preparation behaviors. **This** in turn requires an understanding of which consumers are aware of pathogens and what factors, such as, food safety perceptions, attitudes and information, and demographic characteristics, are associated with their awareness.

This study built on existing research and investigated consumer awareness of four major foodborne pathogens, *Salmonella*, *Campylobacter*, *Listeria*, and *E. coli*. By using data collected in a 2001 national telephone survey of US adults, the study examined the relationships between the awareness and its explanatory variables for each pathogen simultaneously and the differential relationships among the four different pathogens.

Questionnaire

The questionnaire covered awareness of pathogens as problems in food, food safety perceptions, food handling and consumption practices, perceived vulnerability from unsafe food handling and consumption practices, awareness and consumption of potentially risky foods, awareness of new food processing technologies, food allergies, foodborne illness experience, and demographics. In this study, we focused on the analysis of awareness of four different pathogens (*Salmonella*, *Campylobacter*, *Listeria*, and *E. coli*). Specifically, the survey asked “Have you ever heard of (a pathogen) as a problem in food?” The possible responses were “yes” and “no”.

Methods: Food safety perceptions

We hypothesized that consumers who perceive higher risk of foodborne illness are more likely to be aware of the pathogens **because they** may pay more attention to food safety information and be more motivated to learn about food safety, such as the causes of foodborne illness. Answers to the following survey questions were used to construct four binary explanatory variables to represent food safety perceptions. **First**, “Where do you think food safety problems are most likely to occur, would you say farms, food processing plants, warehouses, supermarkets, restaurants, or homes” (FROMHOME). **Second**, “How common do you think **it** is for people in the United States to become sick because of the way (that) food is handled or prepared in their homes” (HOMERISK). **Third**, “Do you think contamination of food by micro-organisms, such as germs, is a very serious food safety problem, a serious food safety problem, somewhat of a problem, or not a food safety problem at all” (GERMRISK). The **fourth** variable, VULNERABLE, is a binary variable constructed from responses to four questions: (1) “**If** you forget to wash your hands before you begin cooking, how likely are you to get sick”, (2) “**If** vegetables you will eat raw happen to touch raw meat or chicken, how likely are you to get sick”, (3) “**If** you eat meat or chicken that is not thoroughly cooked, how likely are you to get sick”, and (4) “**If** you happen to leave cooked food out of the refrigerator for more than 2 hours after it has finished cooking, how likely are you to get sick.”

Results

The majority of US consumers said they had heard of *Salmonella* (94%) and *E. coli* (90%) as a problem in food. **In contrast**, about one third of **them** were aware of *Listeria* (32%) and only 7% were aware of *Campylobacter*. About 17% of US consumers thought homes were where food safety problems were most likely to occur. Sixty-two percent thought **it** was very common or somewhat common for people in the United States to become sick because of the way food was handled or

prepared in their homes. About half of US consumers considered food contamination by micro-organisms a very serious or serious food safety problem. They perceived themselves to be somewhat likely to get sick from four unsafe food handling practices. Sixty-seven percent of the consumers perceived at least a moderate likelihood of getting sick from unsafe food handling practices (see VULNERABLE defined above). Most consumers claimed they always washed their hands before preparing food, and the hamburgers served at their homes were usually thoroughly cooked (*i.e.*, well-done or brown all the way through). About one quarter (23%) of consumers had stopped buying specific foods because of food safety concern. **As to** awareness of other food safety issues, **while** a large portion of consumers (69%) said they had heard or read about possible health problems related to mercury in some fish, much fewer consumers said they had heard or read about possible health problems of eating sprouts (15%) or about health problems of drinking unpasteurized juice (29%). One in three consumers thought they themselves or someone in the household had been sick from eating spoiled or unsafe food; 12% of the consumers said they had one or more health conditions, including liver disease, diabetes, reduced gastric acidity, HIV, AIDS, a weakened immune system, or were under chemotherapy or radiation therapy. Fifty-five percent of consumers were main meal preparers in their households.

Based on estimated marginal effects, awareness of *Salmonella* is more likely among consumers who perceive homes are where food safety problems are most likely to occur, who perceive **it** is very common or somewhat common that people get sick from food handled or prepared at home, who consider pathogen contamination as a very serious or serious food safety problem, who perceive higher risk from unsafe food handling practices, or who always wash hands with soap before food preparation. Those who have heard of possible health problems related to drinking unpasteurized juices or related to mercury in some fish are **also** more likely to be aware of *Salmonella*. Consumers from homes that usually serve thoroughly cooked hamburgers (well-done or brown all the way through) are less likely to be aware of *Salmonella*. **As for** *Campylobacter*, consumers are more likely to have heard of it **if** thoroughly-cooked hamburgers are usually served in their homes. **In addition**, awareness of health problems related to eating sprouts, drinking unpasteurized juices, or mercury in some fish is also associated with a larger probability of having heard of *Campylobacter*. **Likewise, the same awareness** is associated with the probability of having heard of *Listeria*. **Meanwhile**, those who perceive pathogen contamination as a very serious or serious food safety problem, who perceive higher likelihood of getting sick from unsafe practices, who have household member(s) with sickness possibly caused by eating spoiled or unsafe food, or who are the main meal preparers in their households are also more likely to be aware of the pathogen. Having heard of the pathogen *E. coli* is more likely among those who think it is very common or somewhat common for people in the United States to become sick because of the way food is handled or prepared in their homes, who perceive higher likelihood of getting sick from unsafe food handling practices, who are from a household where thoroughly-cooked hamburgers are usually served, or who have heard about possible health problems related to drinking unpasteurized juices or related to mercury in some fish. **But** awareness of *E. coli* is less likely among consumers who have stopped buying specific kinds of food due to safety concern.

Awareness of a pathogen is **also** associated with demographic characteristics. Consumers with at least some college education are more likely to have heard of any one of the four pathogens, except for *Salmonella*, than those with less education. Female consumers are more aware of *Salmonella* or *E. coli* than males. Awareness of *Salmonella*, *Listeria*, or *E. coli* is higher among those who have one or more children younger than 5 years old in their households or who come from households with annual income above \$20,000. Consumers age 30 to 49 have higher awareness of *Salmonella* or *Listeria* than older consumers (50 and above). Compared to White consumers, Black, Hispanic, and other-race consumers are generally less aware of the pathogens, particularly *Salmonella* and *E. coli*. Northeastern consumers are more aware of *Salmonella* and *E. coli* and Western consumers less aware of *Campylobacter* or *Listeria*, than South consumers.