



## An In-Home Video Study and Questionnaire Survey of Food Preparation, Kitchen Sanitation, and Hand Washing Practices

Elizabeth Scott, PhD  
Nancie Herbold, RD, EdD

**Abstract** Foodborne illnesses pose a problem to all individuals but are especially significant for infants, the elderly, and individuals with compromised immune systems. Personal hygiene is recognized as the number-one way people can lower their risk. The majority of meals in the U.S. are eaten at home. Little is known, however, about the actual application of personal hygiene and sanitation behaviors in the home.

The study discussed in this article assessed knowledge of hygiene practices compared to observed behaviors and determined whether knowledge equated to practice. It was a descriptive study involving a convenience sample of 30 households. Subjects were recruited from the Boston area and a researcher and/or a research assistant traveled to the homes of study participants to videotape a standard food preparation procedure preceded by floor mopping.

The results highlight the differences between individuals' reported beliefs and actual practice. This information can aid food safety and other health professionals in targeting food safety education so that consumers understand their own critical role in decreasing their risk for foodborne illness.

### Introduction

Foodborne illnesses can pose a problem to all individuals but are especially significant for infants, the elderly, and individuals with compromised immune systems. A report from the Centers for Disease Control and Prevention (CDC) indicates that little progress has been made in controlling foodborne illness in the U.S. since 2004 and that enhanced measures are required to educate consumers about infection risks and prevention measures (Centers for Disease Control and Prevention [CDC], 2008). It is estimated that an average of 15,000 reported cases of foodborne illness occur in the U.S. annually

(CDC, 1996). When unreported cases are considered, an estimated 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths occur in the U.S. yearly (Mead et al., 1999). The annual economic cost of illness due to foodborne illnesses is estimated to reach over \$3 billion each year. In addition, the cost of lost productivity is estimated at between \$10 billion and \$83 billion each year (U.S. Food and Drug Administration [FDA], 2009). Approximately \$1 billion is spent annually on medical costs and lost wages due to salmonellosis alone (CDC, 2005). In 2003, costs for *E. coli* O157 were estimated at \$405 million, including \$370

million for premature deaths, \$30 million for medical care, and \$5 million in lost productivity (Frenzen, Drake, Angulo, & the Emerging Infections Program FOODNET Working Group, 2005).

A new interest has arisen in household practices as a result of the understanding that a link exists between contaminated inanimate surfaces and disease transmission and acquisition within settings such as the home (Cozad & Jones, 2003). Domestic sanitation practices, especially those employing wet sponges, cloths, and mops, have been found to further disseminate bacteria to other inanimate surfaces and directly to the hands, leading to cross-contamination with bacteria and the potential for bacteria to reach foodstuffs and the mouth (Scott, 1999).

Consumers need information about how cross-contamination occurs. Pathogens are continuously introduced into the home environment, especially via people, food, and pets (Kramer, Schwebke, & Kampf, 2006). In addition, inanimate surfaces, and especially hand and food contact surfaces, are a main route of pathogen transmission (Kramer et al., 2006). A number of bacteria such as *E. coli*, *Clostridium difficile*, and *Shigella* species can survive for months on dry surfaces, and longer on wet surfaces (Beumer et al., 2002; Lin, Guthrie, & Frazao, 1999).

While it is widely accepted by food experts that many cases of foodborne illness occur as a result of improper food handling and preparation by consumers in their own kitchens (Scott, 1999), consumers themselves are still largely unaware of this fact.

TABLE 1

**Participant-Rated Importance of Various Practices for Lowering Risk of Foodborne Illness (N = 30)**

Practices	Not Important (%)	Important (%)	Very Important (%)	Don't Know/No Opinion (%)
Use paper towel instead of sponge on kitchen counters	7	27	63	3
Mop before cooking	60	37	3	0
Wash vegetables	0	6.7	93.3	0
Wash raw chicken	7	7	83	3
Check refrigerator temperature annually	13	53	27	7
Check freezer temperature annually	17	53	23	7
Use a thermometer to check hamburgers	27	50	17	6
Shop at a clean supermarket	0	23	77	0
Keep raw meat separate from salad	17	17	60	6
Use different plate for raw and cooked meat	0	17	83	0
Refrigerate macaroni & cheese within two hours after leaving it at room temperature	7	50	40	3
Comply with sell by and use by dates	0	30	70	0

A recent study conducted by the Food and Drug Administration's (FDA's) Center for Food Safety and Applied Nutrition reported that respondents named restaurants (56%) as the most likely site for food poisoning problems to occur while only 14% of the respondents cited home as a likely site for problems (FDA, 2006).

The purpose of our study was to collect data on practices relating to home food preparation, personal hygiene, and kitchen sanitation in order to examine the relationship between consumer knowledge and practice.

### Materials and Methods

Our study is a descriptive study involving a convenience sample of 30 households recruited from the Boston metro area. A researcher and/or a research assistant traveled to the homes of study participants to videotape a standard food preparation procedure preceded by floor mopping. The video method was selected to allow us to analyze kitchen sanitation and food hygiene practices in freeze frame.

A food safety and sanitation practices questionnaire was administered by mail two weeks prior to the home videotaping. On the day of the in-home visit, subjects were instructed to mop the kitchen floor in their normal fashion and then to prepare a given hamburger sandwich recipe using ground beef while being videotaped. This video study was used for a food safety and sanitation practices evaluation.

Objective food safety data (refrigeration and cooking temperature) were also collected. The videotapes were viewed and coded using a video viewing assessment tool. Every hand washing observed on video was timed with a stopwatch. The inter-rater reliability score for the coders was 93 and considered acceptable for the study.

Subjects from the metro west and metro south areas of greater Boston were recruited by word-of-mouth and by flyers and followed up by personal contact. Criteria for inclusion of subjects were that they cooked at home and used mops to clean their kitchen floors.

The food safety and sanitation questionnaire was based on previously published instruments (FDA, 2006). The questionnaire also collected demographic data. Study procedures were approved by the Simmons College Institutional Review Board.

## Results

### Participant Sociodemographics

The subjects comprised a mix of elderly, middle-aged, and young white adults with 17 (57%) between the ages of 40 and 59, 9 (30%) under 39, and three (10%) older than 59. The majority (75%) were female. Thirteen out of the 30 subjects had a baccalaureate degree or higher. Twenty-eight (93%) participants were employed outside of the home. Fourteen participants had incomes of \$50,000 per year or higher, eight earned \$40,000 or less per year, and another eight did not answer. Fourteen homes (46%) contained a pet and of these, 10 homes contained a dog, four had a cat, and three homes had both a dog and cat. Most (93%) participant households included between one and four people and two households consisted of five or more people.

### Food Safety and Sanitation Knowledge Questionnaire

Participants were asked to rank the importance of various activities for lowering the risk of foodborne illness (Table 1). Sixty-three percent answered that it is very important to use paper towels instead of a sponge on kitchen counter. Eighty-three percent responded that it is very important to wash raw chicken, 93% responded that it is very important to wash raw vegetables, and 17% thought it is very important to use a thermometer to check hamburger temperature.

Participant attitudes about the importance of hand washing following a range of activities was ascertained (Table 2). Certain activities triggered an almost 100% response in the "very important" category for hand washing after certain activities, namely after petting cats and dogs (97%), using the toilet (97%), handling raw meat (100%), and taking out the garbage (90%). Washing hands after handling foods such as eggs and cantaloupe were considered "very important" by 73% and 30% of respondents, respectively. Sixty percent of

respondents considered it “very important” to wash hands after mopping the floor, 50% after touching face and hair, and 33% after answering the phone.

Another set of questions was used to probe for the perceived level of effectiveness of various actions in lowering the risk of foodborne illness. Sixty-four percent of respondents thought that using separate cutting boards for meat and non-meat items was an effective practice for lowering the risk of foodborne illness (Table 3). Seventy percent responded that 20 seconds for hand washing was effective, and 27% thought that thoroughly cooking meat leftovers was effective. Twenty-three percent responded that it was not effective to judge whether a hamburger is cooked and safe to eat by visual cues only.

Participants were asked to assess the risk associated with selected practices in causing food to become unsafe for consumption by healthy individuals. The percentage of respondents who answered “not risky,” “moderately risky,” or “very risky” to these questions are shown in Table 4. Eighty-one percent thought that keeping eggs in the refrigerator for six months was very risky and 60% thought using the same towel for drying hands and drying dishes was very risky. Fifty-four percent thought that eating hot dogs after the “use-by” date was moderately risky and 47% thought it was not risky if sinks and counters were not cleaned after disposing of mop water. Thirty percent of participants indicated they did not think thawing frozen beef at room temperature for 12 hours before cooking was very risky.

Subjects were asked to assess the risk of foodborne illness at certain points during food production and preparation within the home (Table 5). Seventy-seven percent thought that storage of unopened packages of food was not risky, 20% thought that cooking food at home was not risky and 30% thought storage of food at supermarkets was very risky.

Subjects were asked to indicate whether they were aware of links between a given pathogen and a given food or beverage. The percent of respondents who answered “aware,” “not aware,” and “never heard of” are shown in Table 6. Ninety percent of respondents were aware of a link between

TABLE 2

**Importance of Hand Washing After Certain Activities as Reported by Participants (N = 30)**

Activity	Not Important (%)	Important (%)	Very Important (%)	Don't Know/No Opinion (%)
After petting pet	0	3	97	0
After using toilet	0	3	97	0
After wiping counters	17	23	60	0
After mopping floor	13	27	60	0
After handling raw meat	0	0	100	0
After cracking an egg	0	27	73	0
After slicing a cantaloupe	17	53	30	0
After shaking hands	37	20	43	0
After handling money	3	27	70	0
After reading the newspaper	20	23	57	0
After answering the phone	10	57	33	0
After touching face or hair	10	37	50	3
After taking out the garbage	3	7	90	0

TABLE 3

**Perceived Effectiveness of Selected Practices in Lowering the Risk of Foodborne Illness (N = 30)**

Practice	Not Effective (%)	Moderately Effective (%)	Very Effective (%)	Don't Know/No Opinion (%)
Thoroughly cook meat leftovers	53	10	27	10
Judge hamburger safety by looking	23	53	20	4
Freeze food to kill germs	47	27	13	13
Use separate cutting board for meat and non-meat items	3	33	64	0
Use plastic cutting board	10	30	37	23
Wash hands for 10 seconds	20	23	57	0
Wash hands for 20 seconds	3	23	70	4
Use antibacterial soap to wash hands	13	50	33	4
Wash counter top with hot soapy water	3	43.5	43.5	10
Mop kitchen floor	20	37	33	10

*E. coli* and uncooked hamburger and 50% were aware of *E. coli* and unpasteurized apple cider. Seventy-seven percent had never heard of the link between *Vibrio* and oysters and 70% of participants had never heard of *Campylobacter*.

**Actual Behaviors**

Subjects were videotaped while mopping the floor and then preparing a hamburger sandwich and observations from these recordings are shown (Table 7). Thirty percent (n = 9) of subjects disposed of the dirty

TABLE 4

**Perceived Health Risk to Healthy Individual With Selected Practices (N = 30)**

Practice	Not Risky (%)	Moderately Risky (%)	Very Risky (%)	Don't Know/No Opinion (%)
Thawing frozen beef at room temperature 12 hours before cooking	0	30	64	6
Keeping milk in refrigerator for one week after sell by date	33	10	57	0
Keeping raw eggs in back of refrigerator for 6 months	3	13	81	3
Refrigerating warm leftover beef stew in 6 inch deep container	30	27	10	33
Consuming runny scrambled eggs	13	64	13	10
Eating hot dogs three days after use by date	13	54	33	0
Using same towel for hand drying and drying dishes	17	23	60	0

Note. Most appropriate answer bolded.

TABLE 5

**Perceived Risks to Food Safety During Production, Transportation, and Storage (N = 30)**

Activity	Not Risky (%)	Moderately Risky (%)	Very Risky (%)	Don't Know/No Opinion (%)
Producing food on farms	10	47	20	23
Commercial transporting of food	3	64	20	13
Commercial manufacturing of food	3	64	20	13
Storing food at supermarkets	3	64	30	3
Storing unopened packages of food at home	77	20	3	0
Cooking food at home	20	70	10	0
Storing cooked leftovers at home	10	77	10	3

mop water in the kitchen sink, and 45% of these sinks were not cleaned before food preparation. During meal preparation, 40% (n = 12) did not wash the lettuce and 27% (n = 8) did not wash the tomatoes before use. During cooking, only one subject used a thermometer to check the temperature of the hamburger and nine (30%) touched high risk areas that could cause cross-contamination during food preparation, such

as their face, hand contact surfaces, and the kitchen trash barrel.

Observations on hand washing are recorded in Table 8. Video data showed that approximately one-quarter (25%) of subjects did not wash their hands between mopping and food preparation while 87% responded to the questionnaire that this was an important practice. Thirty percent did not wash their hands after handling

raw meat whereas 100% reported this as an important practice when asked in the questionnaire. Approximately 73% did not wash after handling lettuce and tomatoes. Hand washing times ranged from one second to 30 seconds. Overall 40% of participants washed their hands for 10 seconds or less although 70% had responded that 20 seconds was an effective hand washing time to prevent food-borne illness.

## Discussion

Research indicates that 25% of reported food-borne illness outbreaks are due to inappropriate consumer food handling and preparation practices in the home (Mead et al., 1999; McCabe-Sellers & Beattie, 2004).

Our study results support previous studies in highlighting the differences between individuals reported beliefs and actual practice (Bloomfield, Exner, Beumer, & Scott, 2002; Clayton, Griffith, & Price, 2003; Medeiros, Kendall, Hillers, Chen, & DiMascola, 2001; Redmond & Griffith, 2003). Self-reported data demonstrates that consumers have more knowledge about food safety than they put into practice (Medeiros et al., 2001). While there is a growing amount of information about people's knowledge and self-reported practices, current knowledge of consumer attitudes and intentions with regard to safe food-handling behaviors is limited (Clayton et al., 2003). Our findings suggest that people are for the most part unaware of the ease at which home surface areas may become contaminated by inconsistent personal hygiene practices, inadequate surface cleaning practices, and cross-contamination.

In a survey study of 29 food safety or personal hygiene experts, washing hands with warm, soapy water before handling foods was ranked highest in importance (Redmond & Griffith, 2003). Hand washing was found to be inadequate in our study, however. Similar results were found by Anderson and co-authors (2004) who observed that the average length of time for hand washing was significantly lower than the 20-second recommendation.

In our study, 20% of respondents did not associate any risk with food cooked at home. While 71% of meals are prepared in the home, consumers continue to be more wary of food prepared outside the home as the cause for possible food safety problems (Lin et al., 1999). This might explain the lack of connec-

tion between consumer knowledge of food safety and personal hygiene and their actual practices in our study.

Our study indicates that the people are generally unaware of many of the potential dangers associated with foodborne pathogens. Furthermore, even though consumers have knowledge of the risk of *E. coli* O157 associated with ground beef, this knowledge does not necessarily translate into consistent adoption of preventative personal hygiene practices. In another study, 19% of the subjects said they did not wash their hands with soap after handling meat, and 59% said they do not wash their hands with soap after handling raw eggs (FDA, 2006).

Another risk factor is inadequate cooking temperature. Food safety experts ranked using a thermometer as the most important behavior for cooking foods adequately (Redmond & Griffith, 2003). In our study only one subject used a food thermometer to check the temperature of the hamburger, even though the majority of subjects reported knowledge of the risk of *E. coli* O157 contamination.

Our study supports a previous investigation suggesting that little is known about perceived risk for foodborne illness and the barriers to implementation of food safety practices by consumers (Bloomfield et al., 2002).

Two limitations of this study are the small sample size and racial homogeneity of our study population. Another limitation of conducting an in-home observational study is that people may change their behaviors when they are being observed in person and also videotaped.

The purpose of this study was to utilize a consumer kitchen observation and measurement system to compare observed consumer food-handling and preparation practices and kitchen sanitation practices with consumer knowledge of food safety recommendations. The results from our study indicate that knowledge of recommended behavior does not always translate into practice in the home. Relatively few in-home studies have been conducted in the U.S. and there is a lack of understanding of the barriers to consistent adoption of food safety practices in the home.

**Conclusion**

In conclusion, the results of our study indicate that additional consumer education regarding food safety and foodborne illness is needed,

TABLE 6

**Awareness of Links Between Foodborne Illness and Selected Foods (N = 30)**

Pathogen and Food	Aware (%)	Not Aware (%)	Never Heard Of (%)
<i>E. coli</i> and unpasteurized apple cider	50	47	3
<i>Campylobacter</i> and chicken	23	7	70
<i>Salmonella</i> and eggs	90	10	0
<i>Listeria</i> and cheese	40	17	43
<i>E. coli</i> and uncooked hamburger	90	10	0
<i>Cyclospora</i> and raspberries	17	36	47
<i>Vibrio</i> and oysters	10	13	77
<i>Cryptosporidium</i> and tap water	21	10	69
<i>Staphylococcus</i> and cream pastries	27	53	20
<i>E. coli</i> and alfalfa	23	70	7

TABLE 7

**Video Analysis of Food Preparation (N = 30)**

Observed Behavior	Yes	%	No	%	N/A*	%
Disposed of mop water in kitchen sink	9	30	21	70	0	0
Washed hands after mopping	23	77	7	23	0	0
Washed lettuce before preparation	16	53	12	40	2	7
Washed tomatoes before preparation	20	67	8	27	2	6
Used separate cutting boards for meat and non-meat foods	10	33	6	20	14	47
Used a thermometer to check temperature of hamburgers	1	3	29	97	0	0
Washed countertop during food preparation	5	17	24	80	1	3
Touched high-risk objects that would transfer contamination	9	30	21	70	0	0
Used same towel for hand washing as for drying dishes	2	7	13	43	15	50
Cleaned food preparation area after use	2	7	24	80	4	13

\* N/A incorporates not applicable and/or not observed.

and more importantly, implementation of sound personal hygiene practices are needed in the home. Further, more attention to consumer education around lesser-known pathogens may be beneficial. Food safety intervention specialists and other health care professionals play a key role as public educators in the area of food safety and preparation. 🍷

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**Corresponding Author:** Elizabeth Scott, Assistant Professor, Department of Biology, and Co-Director, Center for Hygiene and Health in the Home and Community, Simmons College, 300 The Fenway, Boston, MA 02115. E-mail: elizabeth.scott2@simmons.edu.

TABLE 8

**Hand Washing Observation**

Hand Washing Before or After Selected Activity	No. of Subjects Who Washed Hands (N = 30)	Length of Hand Washing in Seconds		
		Minimum	Median	Maximum
After mopping the floor	22	1	10	25
Before handling food	8	3	10	18
After handling lettuce/tomatoes	8	1	7	12
After handling raw meat	21	2	10	17
At other times during food preparation	16	2	4	30

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