

Predictors of Eating *Raw or Undercooked Meat, Poultry, Seafood, and Eggs* among Older Adults



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SUMMARY

Adults aged 60 years or older are more likely than those in other age groups to experience complications, hospitalization, and death because of foodborne infections. To reduce their risk of illness, older adults should avoid eating certain foods, such as raw or undercooked meat, poultry, seafood, and eggs. This study examined the relationship between consumption of risky foods and demographic characteristics and risk perceptions, using data from a nationally representative survey of older adults ($n = 1,140$). By use of logistic regression analysis, risky food consumption was modeled as a function of demographics, health status, disease diagnosis, self-assessment of food safety knowledge, perceptions about seriousness of food contamination, and perceptions that older adults are at increased risk of contracting foodborne illness. Age, race/ethnicity, education, perceptions about seriousness of food contamination, and self-assessment of food safety knowledge were predictors of consumption of risky food. Food safety educators, dietitians, and other practitioners who work with older adults can inform individuals with these characteristics about the risks of eating certain foods and thus help prevent foodborne diseases.

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INTRODUCTION

According to the Centers for Disease Control and Prevention (CDC), about 48 million (1 in 6) Americans get sick, 128,000 are hospitalized, and 3,000 die each year from foodborne diseases (19, 20). Based on 2010 CDC surveillance data for 10 foodborne pathogens, the percentage of patients who contracted and were hospitalized for foodborne diseases (40%) and the case fatality rate associated with foodborne diseases (1.5%) were highest among adults aged 60 years or older (9). Factors that may increase the susceptibility of older adults to foodborne diseases include weakened immune systems, inadequate nutrition, decreased food consumption, major surgeries, and use of certain over-the-counter and prescription medications, such as antimotility drugs (to relieve diarrhea), antacids, and some antibiotics (4, 21).

Based on Foodborne Diseases Active Surveillance Network (Food-Net) data reported by CDC for 2010, *Salmonella* infection was the most commonly reported foodborne infection (8,256 infections, 17.6 illnesses per 100,000 persons) and had the largest number of hospitalizations (2,290) and deaths (29)(7). Over 400 (5%) of these infections were associated with recognized outbreaks (7). For example, a national outbreak of *Salmonella* infections in 2010 was caused by contamination of eggs, leading to a massive recall of approximately 500 million eggs (23). Additionally, the incidence of infection caused by a common type of *E. coli* (Shiga toxin-producing *Escherichia coli* (STEC) O157) was 0.9 illnesses per 100,000 persons in 2010 (7). Of these STEC O157 infections, 17% were associated with recognized outbreaks, and 184 hospitalizations and two deaths resulted (7).

Although people of any age can contract a foodborne disease, infected persons aged 60 years or older are at highest risk for hospitalization and death from most foodborne infections (7). Timely diagnosis and treatment of foodborne infections, as well as careful attention to food safety, is therefore particularly important among older adults. Foodborne diseases can be prevented if older adults avoid eating certain foods, including raw or undercooked meat or poultry (STEC O157 and *Salmonella*) and raw or undercooked eggs (i.e., eggs cooked so that they are still runny or soft) (*Salmonella*), and take precautions when handling, storing, and preparing food at home (13).

The objective of this study was to examine the relationship between older adults' consumption of raw or undercooked meat, poultry, seafood, and eggs and their demographic characteristics and risk perceptions. This study tested the hypothesis that older adults who consumed raw or undercooked meat, poultry, seafood, and eggs would have a different demographic profile and would be less risk averse than older adults who did not consume these foods.

MATERIALS AND METHODS

Logistic regression analysis was conducted using data from a nationally representative survey of adults aged 60 years or older. We surveyed a national sample of adults aged 60 years or older using a Web-enabled panel survey approach. RTI International's Committee for the Protection of Human Subjects, which serves as RTI's Institutional

Review Board, reviewed and approved the study protocol. The survey results can be found in a previous paper (5).

Sample

The sample was selected from a Web-enabled panel developed and maintained by Knowledge Networks (Menlo Park, CA). The panel, constructed by use of a list-assisted, random-digit-dial (RDD) sample selected from all 10-digit telephone numbers in the United States, is designed to represent the U.S. population (9). Households selected for the panel that do not have Internet access are provided with a free computer and Internet access. Currently, 6% of active English-speaking panel members have computers and Internet access supplied by Knowledge Networks. For these individuals, Knowledge Networks provides printed, detailed instructions on how to use the computer and access the Internet.

A sample of 1,329 adults aged 60 years or older was selected from the panel, using an implicitly stratified systematic sample design. The sample was matched to reflect the Current Population Survey benchmarks for adults aged 70 years or older by gender and by annual income less than \$10,000 to ensure adequate representation of these subpopulations. Additionally, the sample was matched to the percentage of older adults with diabetes, cancer, and kidney disease using data from the National Health Interview Survey to ensure adequate representation of older adults with preexisting conditions that can increase susceptibility to foodborne diseases.

Questionnaire

The questionnaire was designed to collect information on knowledge of specific foodborne pathogens, risk perceptions and attitudes toward food safety, reported knowledge and use of recommended food safety practices and consumption practices, as well as preferred methods for receiving information on food safety. Respondents answered questions on a variety of food handling and consumption practices. To measure whether respondents consumed specific foods that, if contaminated with foodborne pathogens, may cause illness among older adults, respondents were asked, "In the past year, which of the following foods have you eaten?" The list of responses included the foods that food safety experts recommend that older adults avoid to reduce their risk of foodborne diseases (13).

Knowledge Networks maintains demographic and health information on its panelists, so it was not necessary to collect this information in the survey. The draft survey instrument was tested with 10 adults, using cognitive interviewing techniques (24). The instrument was refined, and a pilot survey was conducted with 34 panel members before full-scale administration of the survey.

Survey procedures and response

A link to the survey was e-mailed to selected panel members, and two e-mail reminders were sent to nonrespondents to encourage participation. Data were collected over a 3-week period. The total number of completed surveys was 1,140 (86% completion rate).

Weighting procedures

Survey weights were developed to reflect the selection probabilities of sampled units and to compensate for differential nonresponse and undercoverage. The initial weights were based on the inverses of their overall selection, and a poststratification weighting adjustment was performed to make the sample reflect the most current population benchmarks. The final weights were trimmed and scaled to sum to the total U.S. population aged 60 years or older. All analyses were conducted using the survey weights.

Logistic regression analysis

The logistic regression analysis examined the consumption of the following foods: (1) raw or undercooked meat, poultry, and/or seafood and (2) undercooked eggs (i.e., cooked so that the eggs are still runny). Separate regression models were estimated for each type of food. The outcome variable was defined as a dichotomous variable: 0 = did not eat risky food, and 1 = ate risky food. For raw or undercooked meat, poultry, and/or seafood, respondents were assigned a "1" if they reported eating any of these foods during the past year: raw or undercooked meat or poultry (e.g., rare or medium-rare hamburgers, steak tartare) or raw or undercooked seafood (e.g., sushi, raw oysters). For undercooked eggs, respondents were assigned a "1" if they reported cooking eggs so that they were runny the last time they cooked eggs (fried, poached, boiled, scrambled, omelet, frittata) to eat at home.

The following explanatory variables describing the demographic characteristics of the respondents and their households were included in the analysis: age category, sex, race/ethnicity, education level, and number of adults in the household. The following explanatory variables describing the health of the respondent were included in the analysis: respondent's perceived health status and whether the respondent had been self- or doctor-diagnosed with diabetes, kidney disease, or cancer. The following explanatory variables describing the perceptions of the respondent were included in the analysis: "I think contamination of food by bacteria or viruses is a serious problem," "I am knowledgeable about how to keep the food I prepare and eat at home safe," and "Because I am 60 years old or older, I am at an increased risk of getting food poisoning or foodborne illness." For each of the perception variables, a categorical variable was used with two levels: strongly disagree/disagree versus strongly agree/agree). All analyses were conducted using SAS/STAT software, Version 9.2 of the SAS System for Windows (18).

RESULTS

Table 1 shows the values for the outcome and explanatory variables included in the logistic regression models. Twenty-two percent of respondents had eaten raw or undercooked meat, poultry, and/or seafood during the past year and 50% had prepared eggs so that they were undercooked (i.e., runny) the last time they ate eggs at home. Fifty-six percent of respondents were female, 80% were White, non-Hispanic, and 51% were between the ages of 60 and 69.

Table 2 shows the odds ratios (ORs), 95% confidence interval (CI), and the significance of the P values for the t -test ($P > |t|$) for the logistic regression models estimated for raw or undercooked meat, poultry and/or seafood and undercooked eggs. An OR greater than 1 indicates that older adults with the given characteristic are more likely than the reference group to consume the specific potentially risky food, whereas an OR less than 1 indicates that older adults with the given characteristic are less likely than the reference group to consume the specific potentially risky food.

Older adults with certain demographic characteristics were more likely than other older adults to consume raw or undercooked meat, poultry, and/or seafood and/or undercooked eggs. Adults aged 60 to 64 years were 2.07 times as likely as adults aged 75 years or older to eat raw or undercooked meat, poultry, and/or seafood ($P < .001$), and adults aged 65 to 69 years were 1.74 times as likely as adults aged 75 years or older to eat raw or undercooked meat, poultry, and/or seafood ($P < .01$). White non-Hispanics were 2.56 times as likely as black non-Hispanics to eat raw or undercooked meat, poultry, and/or seafood ($P < .01$). White non-Hispanics were 5.26 times as likely as black non-Hispanics to eat undercooked eggs ($P < .001$) and white non-Hispanics were 1.69 times as likely as Hispanics to eat undercooked eggs ($P < .05$). Older adults with a bachelor's degree or higher were about twice as likely as those with a high school education or less to eat raw or undercooked meat, poultry, and/or seafood ($P < .001$). With regard to the health of the respondent, individuals with a health status of "fair" or "poor" were 1.49 times as likely as individuals with a health status of "excellent" or "very good" to eat undercooked eggs ($P < .05$).

Consumer perceptions regarding food safety may also influence the likelihood of consuming potentially risky foods. Older adults who disagreed that food contamination "is a serious problem" were 1.54 times as likely as those who agreed with this statement to eat raw or undercooked meat, poultry, and/or seafood ($P < .05$). Older adults who perceived themselves as not being knowledgeable about food safety were 1.74 times as likely to eat undercooked eggs ($P < .05$) as those who perceived themselves as knowledgeable.

DISCUSSION

Our analysis found that age, race/ethnicity, education level, perceptions about the seriousness of food contamination, and perceived food safety knowledge were predictors of consumption of raw or undercooked meat, poultry, seafood, and eggs. Previous studies have reported similar findings. For example, Anderson, Verrill, and Sahyoun (2) found that among adults aged 60 or older, those with less education and nonwhites generally had better food safety practices and a greater awareness of food safety risk. A meta-analysis conducted by Patil and colleagues (17) found that African Americans reported lower consumption of raw or undercooked foods than other races and ethnicities. Individuals without a high school education reported the lowest consumption of raw or undercooked ground beef and shellfish, compared with individuals with a high school education or more. Other studies have found consumption of raw shellfish to be more common among those with higher education and those with higher incomes (22). Anderson and colleagues (2) reported that more educated people may

TABLE 1. Variables used in models to estimate likelihood of eating raw or undercooked meat, poultry, and/or seafood and undercooked eggs

Variable	Percent
ATE RAW OR UNCOOKED MEAT, POULTRY, AND/OR SEAFOOD	
NO	78.0
YES	22.0
ATE UNDERCOOKED EGGS	
NO	49.7
YES	50.3
AGE	
60 TO 64	29.8
65 TO 69	20.9
70 TO 74	16.3
75 OR OLDER	33.0
SEX	
MALE	44.3
FEMALE	55.7
RACE/ETHNICITY	
HISPANIC	7.4
BLACK, NON-HISPANIC	8.5
OTHER RACE, NON-HISPANIC	4.4
WHITE, NON-HISPANIC	79.7
EDUCATION LEVEL	
LESS THAN HIGH SCHOOL	21.5
HIGH SCHOOL GRADUATE	34.8
SOME COLLEGE	21.6
BACHELOR'S DEGREE OR HIGHER	22.1

(continued)

TABLE 1. Variables used in models to estimate likelihood of eating raw or undercooked meat, poultry, and/or seafood and undercooked eggs (continued)

Variable	Percent
NUMBER OF ADULTS IN THE HOUSEHOLD	
ONE ADULT	26.0
MORE THAN ONE ADULT	74.0
HEALTH STATUS	
EXCELLENT/VERY GOOD	36.6
GOOD	39.4
FAIR/POOR	24.0
DIAGNOSED WITH DIABETES, KIDNEY DISEASE, OR CANCER	
NO	62.3
YES	37.7
“I THINK CONTAMINATION OF FOOD BY BACTERIA OR VIRUSES IS A SERIOUS PROBLEM”	
STRONGLY DISAGREE/DISAGREE	12.3
STRONGLY AGREE/AGREE	87.2
“I AM KNOWLEDGEABLE ABOUT HOW TO KEEP THE FOOD I PREPARE AND EAT AT HOME SAFE”	
STRONGLY DISAGREE/DISAGREE	7.8
STRONGLY AGREE/AGREE	92.2
“BECAUSE I AM 60 YEARS OLD OR OLDER, I AM AT AN INCREASED RISK OF GETTING FOOD POISONING OR FOODBORNE ILLNESS”	
STRONGLY DISAGREE/DISAGREE	41.2
STRONGLY AGREE/AGREE	58.8
NUMBER OF RESPONDENTS (N = 1,140)	

TABLE 2. Logistic regression models predicting likelihood of eating raw or undercooked meat, poultry, and/or seafood and undercooked eggs

Variables	OR (95% CI)	
	Raw or Undercooked Meat, Poultry, and/or Seafood	Undercooked Eggs
AGE (REFERENCE = 75 OR OLDER)		
60 TO 64	2.07 (1.407–3.031)***	1.36 (0.980–1.887)
65 TO 69	1.74 (1.142–2.657)**	1.12 (0.777–1.613)
70 TO 74	1.40 (0.871–2.247)	1.09 (0.740–1.605)
SEX (REFERENCE = FEMALE)		
MALE	1.02 (0.751–1.375)	1.17 (0.896–1.524)
RACE/ETHNICITY (REFERENCE = WHITE, NON-HISPANIC)		
HISPANIC	1.08 (0.632–1.833)	0.59 (0.364–0.964)*
BLACK, NON-HISPANIC	0.39 (0.200–0.757)**	0.19 (0.106–0.332)***
OTHER RACE, NON-HISPANIC	0.67 (0.317–1.433)	0.35 (0.184–0.678)**
EDUCATION LEVEL (REFERENCE = BACHELOR'S DEGREE OR HIGHER)		
LESS THAN HIGH SCHOOL	0.41 (0.258–0.664)***	0.80 (0.530–1.192)
HIGH SCHOOL GRADUATE	0.49 (0.331–0.729)***	0.82 (0.577–1.176)
SOME COLLEGE	0.74 (0.490–1.115)	1.38 (0.933–2.048)
NUMBER OF ADULTS IN THE HOUSEHOLD (REFERENCE = ONE ADULT)		
MORE THAN ONE ADULT	0.88 (0.624–1.232)	0.90 (0.666–1.208)
HEALTH STATUS (REFERENCE = FAIR/POOR)		
EXCELLENT/VERY GOOD	0.86 (0.571–1.297)	0.67 (0.466–0.967)*
GOOD	0.95 (0.642–1.403)	0.80 (0.571–1.132)
DIAGNOSED WITH DIABETES, KIDNEY DISEASE, OR CANCER (REFERENCE = YES)		
NO	0.96 (0.703–1.311)	0.80 (0.609–1.049)

(continued)

TABLE 2. Logistic regression models predicting likelihood of eating raw or undercooked meat, poultry, and/or seafood and undercooked eggs (continued)

Variables	OR (95% CI)	
	Raw or Undercooked Meat, Poultry, and/or Seafood	Undercooked Eggs
“I THINK CONTAMINATION OF FOOD BY BACTERIA OR VIRUSES IS A SERIOUS PROBLEM” (REFERENCE = STRONGLY AGREE/AGREE)		
STRONGLY DISAGREE/DISAGREE	1.54 (1.010–2.344)*	1.09 (0.730–1.620)
“I AM KNOWLEDGEABLE ABOUT HOW TO KEEP THE FOOD I PREPARE AND EAT AT HOME SAFE” (REFERENCE = STRONGLY AGREE/AGREE)		
STRONGLY DISAGREE/DISAGREE	1.03 (0.596–1.785)	1.74 (1.041–2.894)*
“BECAUSE I AM 60 YEARS OLD OR OLDER, I AM AT AN INCREASED RISK OF GETTING FOOD POISONING OR FOODBORNE ILLNESS” (REFERENCE = STRONGLY AGREE/AGREE)		
STRONGLY DISAGREE/DISAGREE	0.88 (0.642–1.196)	0.91 (0.695–1.192)
NUMBER OF RESPONDENTS	1,140	1,140

OR = odds ratio

CI = confidence interval

* $P < .05$

** $P < .01$

*** $P < .001$

have riskier practices because they may be more likely to purchase and consume unsafe foods, such as raw shellfish, which are considered a delicacy and are relatively expensive, and because people with higher education and incomes take more risks in general. Differences in risky consumption practices with regard to race and ethnicity may be due to cultural differences and personal preferences.

Although several studies have found that older adults' food safety knowledge and practices are better than those of younger adults (1, 14, 15), other studies have concluded that some older adults do not follow recommended food safety practices, thus increasing their risk of contracting foodborne diseases (10, 11). Similar to the finding presented in this paper, Anderson and colleagues (2) found that adults aged 60 to 69 years were 1.48 times as likely as adults aged 70 years or older to eat potentially risky foods (e.g., raw meat, poultry, and eggs). Thus, it appears that as people age, they are more likely to avoid eating

potentially risky foods. Other research suggests that the interests and needs of older adults between the ages of 60 and 70 years may be quite different from those individuals aged 70 years or older (8). As suggested by Mehrotra (16), educational materials need to be targeted to subgroups of older adults who are relatively uninformed or who exhibit risky behaviors.

Despite widely available information on recommended food safety practices, such as government and other Web sites, printed information available from cooperative extension offices, and the media, many consumers put themselves at risk of contracting foodborne diseases by not following recommended practices. Previous research with older adults identified health care providers as a trusted and desired source of information on foodborne illness prevention (3, 5, 6). However, physicians and other health care providers generally do not provide information on food safety and safe food handling practices to older

adults (12, 25). Dietitians, educators, and other individuals who work with older adults have the opportunity to inform individuals and their caregivers about the risks of eating certain foods to help prevent foodborne diseases. It may be useful to target such communications to older adults aged 60 to 69 years old, white non-Hispanics, and individuals with a college education.

A limitation of this study is that the survey data were self-reported and thus were subject to reporting errors and potential biases, such as social desirability bias. Strengths of the study are the large sample size and the use of a nationally representative panel for survey administration.

CONCLUSIONS

Adults aged 60 years or older are more likely than individuals in other age groups to experience complications, hospitalization, and death because of foodborne infections. Thus, this subpopulation warrants special attention with regard to foodborne illness prevention. Although the Internet and the media offer an abundance of information on recommended food safety practices, older adults may benefit from a more personal approach in which food safety educators, dietitians, and other health care providers talk one on one with them about recommended food safety practices.

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