

CONSUMPTION OF RISKY FOODS AMONG ADULTS AT HIGH RISK FOR SEVERE FOODBORNE DISEASES: ROOM FOR IMPROVED TARGETED PREVENTION MESSAGES

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Accepted for Publication October 11, 2006

ABSTRACT

Foodborne disease is of particular concern in populations at risk for severe consequences, including the elderly and persons with immune-compromising conditions. Using data from the Foodborne Diseases Active

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Surveillance Network (FoodNet) Population Survey, we examined the association of risky food consumption with gender, age, immune status, income and education. Gender, age and immune status were associated with consumption of risky foods. More males than females ate at least one risky food while persons aged ≥ 65 years were less likely than those 18–44 to eat risky foods. In the 18–44 group, those with immunosuppressive conditions were more likely to eat risky foods ($P < 0.001$). In the ≥ 65 group, those taking immunosuppressive drugs were more likely than healthy persons to eat risky foods ($P < 0.001$). Our findings suggest that young adults with immune-compromising conditions and elderly persons who take immunosuppressive drugs report eating more risky foods than their healthy counterparts.

PRACTICAL APPLICATIONS

The findings in this report suggest the need for improved foodborne disease prevention messages targeting selected populations at high risk for complications of foodborne infections. The populations studied in the report include elderly persons, persons with immune-compromising conditions and persons taking immunosuppressive drugs. Prevention messages should be designed to reach each specific population, emphasize that these groups are at an increased risk of severe complications from foodborne diseases and should be culturally sensitive and specific. The messages should describe specific foods to be avoided, including undercooked eggs, undercooked meats, sprouts, unpasteurized milk, raw cheeses and other risky foods and food products as they become known.

INTRODUCTION

Foodborne diseases result in an estimated 76 million illnesses, 325,000 hospitalizations and 500 deaths per year in the United States (Mead *et al.* 1999). Persons with compromised immune systems, because of either age, illness or therapy, are at an increased risk of severe complications from foodborne diseases (Altekruse *et al.* 1994; Angulo and Swerdlow 1995; Smith 1998; Buzby 2002; Tauxe 2002). For example, most persons diagnosed with listeriosis, a particularly invasive foodborne disease with a high case-fatality rate, either are elderly, have an immune-compromising illness/condition such as HIV or cancer, or are pregnant (Schuchat *et al.* 1992; Schlech 2000; Slutsker *et al.* 2000). With typically less severe illnesses, such as campylobacteriosis, elderly persons tend to be hospitalized more often than younger individuals (Samuel *et al.* 2004), and for both campylobacteriosis and salmo-

nellosis, persons with AIDS are more likely to have invasive infections than persons with normal immune function (Levine *et al.* 1991; Samuel *et al.* 2004; Vugia *et al.* 2004). Persons ≥ 65 year of age are considered to be at an increased risk of complications from foodborne diseases because of age-associated decreases in humoral and cellular immunity, changes in the gastrointestinal tract and increased antibiotic use (Morris and Potter 1997; Smith 1998; Yoshikawa 2000; Ginaldi *et al.* 2001).

The populations susceptible to severe complications of foodborne disease are growing in the United States. In 1940, only 9% of the U.S. population was over 65 years of age; by 2000 this had grown to approximately 35% and is expected to reach over 50% by 2020 (“A profile of older Americans” 1997). With the successes of highly active antiretroviral therapy for HIV infection and advances in cancer treatment and organ transplantation, the population of immunocompromised, nonelderly persons has also increased and will continue to grow.

Because of the increased risk of complications of foodborne disease, and the increasing number of elderly and immunocompromised individuals, many foodborne-disease prevention messages have been developed that are specifically directed toward these groups (“Eating defensively: Food safety advice for persons with AIDS” 1992; “Guidance for people with severely weakened immune systems” 1999; “Seniors and food safety” 1999; “Safe food and water: A guide for people with HIV infection” 2003; “Food safety for persons with AIDS 2006”; “Seniors need wisdom on food safety” 2006). However, little is known about the eating patterns of these populations and, in particular, whether they are less likely to eat risky foods than the general population.

The primary objective of this article is – given the development of foodborne-disease prevention messages focused on the elderly and immunocompromised persons – to determine whether these populations are less likely to consume foods that have been associated with outbreaks or with an increased risk of illness (“risky foods”) than their younger and/or healthier counterparts.

MATERIALS AND METHODS

FoodNet is the primary foodborne-disease component of the Centers for Disease Control and Prevention’s Emerging Infections Program and conducts active laboratory-based surveillance for nine foodborne pathogens and special studies at selected sites in California, Colorado, Connecticut, Georgia, Maryland, New York, Oregon and Tennessee. Further details about FoodNet are described elsewhere (“FoodNet – Foodborne Diseases Active Surveillance Network” 2004). One of the FoodNet special studies is the FoodNet Population Survey.

The FoodNet Population Survey is conducted periodically and collects data on food consumption, medical conditions, demographics and questions selected each year on special topics of interest. The present study is based on data from the survey conducted during a 12-month period between February 1998 and February 1999 in Connecticut, Minnesota and Oregon, and selected counties in California, Georgia, Maryland and New York, representing a population of about 29 million or 11% of the U.S. population. Approximately 150 persons were enrolled each month from each site.

This FoodNet Population Survey used a random-digit-dialing telephone-based sampling method similar to the Behavioral Risk Factor Surveillance System to contact respondents (Gentry *et al.* 1985; Remington *et al.* 1988; "Behavioral Risk Factor Surveillance System" 2004). During the study period, persons are contacted using a single-stage random-digit-dialing method (Dayton 1996). This sampling scheme allows for the removal of nonworking and business telephones. One household member is randomly selected from each household contacted, using a computer algorithm that accounts for the number of persons in the household. All age groups are eligible for inclusion; if a child ≤ 12 years of age is selected, a parent is interviewed to ascertain information about the child's exposures. The study is restricted to persons who speak English, and interviews are conducted by a trained interviewer.

For this analysis, persons < 18 years of age were excluded and persons ≥ 18 years of age were grouped into the categories 18–44, 45–64 and ≥ 65 years of age. For this analysis, survey participants were categorized into one of three mutually exclusive, hierarchical immune status groups: (1) "immune condition," if the person reported an immune-compromising condition, such as HIV/AIDS, leukemia or other cancers; (2) "immune drug," if the person reported taking an immunosuppressive drug, such as prednisone or other steroids, cyclosporine, radiation therapy or chemotherapy, and did not report a current immune-compromising condition; and (3) "healthy," if the person did not report any of the above. Persons who reported chronic diarrhea were excluded from all analyses, regardless of immune status group.

The food section of the 1998/1999 survey consisted of 79 questions. Study subjects were asked whether or not they had eaten specific food items in the past 7 days. Categories of food items included sprouts, lettuce, berries, raw milk, eggs, chicken, meat, game meat and seafood. If eggs were consumed, the study subject was asked whether the yolk in any of the egg dishes was runny. For meat, poultry and seafood, multiple forms of the food and/or types of preparation were asked, such as baked, ground, broiled, etc. If any of these foods were consumed, the participant was asked whether the meat or poultry was pink when it was eaten and whether the seafood was eaten raw. For analysis, we chose foods as "risky foods" based on our knowledge of the foodborne-disease literature and recent outbreaks. These 10 items were (1)

pink chicken (a composite based on reported consumption of any of several different types [e.g., baked, ground, broiled] of pink chicken); (2) pink turkey (also a composite); (3) pink hamburgers; (4) pink ground pork; (5) raw fresh fish; (6) raw shellfish (a composite of raw clams, mussels, scallops or oysters); (7) raw/unpasteurized milk; (8) runny eggs; (9) alfalfa sprouts; and (10) unpasteurized apple juice/cider. The number of these risky foods, from 0 to 10, that a respondent consumed in the 7 days before the interview was a main variable for analysis, grouped into a dichotomous variable (0 or ≥ 1 risky foods) for statistical analysis and into an ordered categorical variable (0, 1, 2 or ≥ 3 risky foods) for tabular presentation. Percentages and standard chi-square statistics were computed to compare this dichotomous “risky food” variable by immune status, age group, gender, income and education. Independence of associations was assessed using standard logistic regression.

All statistical analyses and percentages related to reported risky food consumption are based on weighted analyses, taking into account the sample design and post-stratification weights used in the determination of population-based estimates. Totals N 's and demographic percents of the study population are based on unweighted data. Basic analysis was conducted using SPSS version 10.0 (SPSS, Inc., Chicago, IL) and weighted analysis was conducted using SAS version 9.1 (SAS Institute, Cary, NC).

RESULTS

Of the 12,755 persons interviewed during the survey, 10,209 (80%) were included in the analysis; 1,805 were excluded because they were <18 years of age; 489 were excluded because they reported chronic diarrhea; and 252 were excluded because there were missing data on one or more key variables. Of the 10,209, 5,824 (57%) were female; 5,196 (51%) were 18–44, 3,300 (32%) were 45–64 and 1,713 (17%) were ≥ 65 years of age; 401 (4%) reported having an immunosuppressive condition, 282 (3%) reported taking an immunosuppressive drug and 9,526 (93%) were classified as healthy. The study population was diverse with respect to education and income.

Among the risky foods, runny eggs were by far the most likely item to be consumed in the past 7 days (18%), followed by alfalfa sprouts (8%) and pink hamburgers (7%) (Table 1). Consumption of pink ground pork was very uncommon (0.3%), as was consumption of pink turkey (1.0%). The other five risky food items were eaten by between 1.5 and 5.1% of respondents. This general pattern held true in most age/gender groups, although in the youngest age group (18–44 years) more males reported consuming pink hamburgers than reported consuming alfalfa sprouts. Overall, 62% of participants reported not consuming any of the risky foods in the previous week, 28% reported

TABLE 1.
PROPORTION (%)* OF PERSONS EATING SPECIFIED FOODS IN THE PAST 7 DAYS, BY
GENDER AND AGE CATEGORY

	18–44 years (<i>n</i> = 5,196)		45–64 years (<i>n</i> = 3,300)		65–99 years (<i>n</i> = 1,713)		All ages (<i>n</i> = 10,209)		Total
	Male	Female	Male	Female	Male	Female	Male	Female	
Total (<i>N</i>)†	2,424	2,772	1,382	1,918	579	1,134	4385	5824	10,209
%† gender by age category	46.7	53.3	41.9	58.1	33.8	66.2	43.0	57.0	–
Number of risky foods									
0	59.5	66.0	52.8	65.2	61.6	68.7	57.8	66.2	62.2
1	27.5	25.0	35.4	27.7	28.9	26.8	30.0	26.1	28.0
2	9.8	6.8	8.6	5.6	8.0	3.8	9.2	5.9	7.5
≥3	3.3	2.2	3.1	1.5	1.6	0.7	3.0	1.7	2.3
Food items									
Runny eggs	18.1	14.0	24.2	17.3	22.5	15.3	20.4	15.2	17.7
Alfalfa sprouts	8.2	8.2	9.2	9.4	4.7	5.3	8.0	8.0	8.0
Pink hamburgers	9.9	5.9	9.2	5.1	4.0	2.9	8.9	5.1	7.0
Pink chicken	7.2	4.1	5.9	3.5	5.0	2.7	6.6	3.7	5.1
Raw apple juice/cider	4.1	5.1	3.8	3.1	5.6	4.1	4.2	4.4	4.3
Raw milk	4.6	3.9	4.0	2.1	2.8	4.4	4.2	3.5	3.9
Raw fresh fish	2.8	2.1	3.1	1.5	2.0	0.9	2.8	1.7	2.2
Raw shellfish	2.3	1.2	1.6	0.8	2.0	0.3	2.1	1.0	1.5
Pink turkey	1.4	0.6	1.1	1.2	0.8	0.6	1.2	0.8	1.0
Pink ground pork	0.4	0.1	0.5	0.2	0.1	0.1	0.4	0.1	0.3

* Weighted for study design and post-stratification adjustment.

† Unweighted.

consuming 1 of the foods, 8% reported consuming 2 of the foods, and 2% reported consuming ≥ 3 in the previous week. This pattern differed by both age and gender. Overall, males were more likely than females to consume ≥ 1 risky food item (42 vs. 34%, respectively, $P < 0.001$), and males in all three age groups were more likely to consume ≥ 1 risky foods than females in any age group (Table 1; Fig. 1). Overall, age was associated with consumption of risky foods, with persons ≥ 65 years of age less likely to eat risky foods (34%) compared with those 18–44 years of age (37%, $P = 0.005$) or those 45–64 years of age (41%, $P = 0.001$). Among persons ≥ 65 years of age, both males and females were less likely to consume any risky food compared with their younger counterparts (Table 1; Fig. 1).

By immune status, the same general pattern of specific food items was observed, with runny eggs being the item most likely to be consumed in the past 7 days by all groups (Table 2). However, among persons reporting an

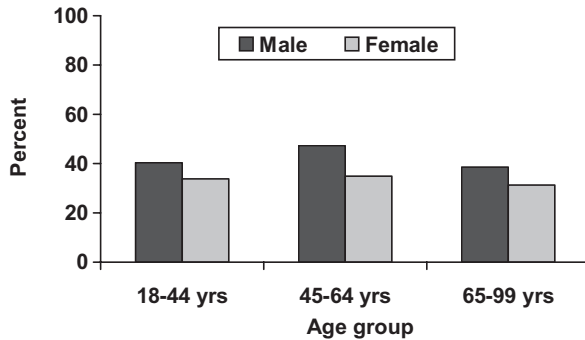


FIG. 1. PERCENT EATING ONE OR MORE RISKY FOODS, BY AGE AND GENDER, FOODNET POPULATION SURVEY, 1998–1999

immune condition in the youngest age group (18–44), consuming raw/unpasteurized milk was the second most commonly reported item (18%) and was much more commonly reported by this group than by their healthy counterparts (4%). In each age group, persons with immunosuppressive conditions were *more* likely than their healthy counterparts to report consuming at least one of the risky food items, with this difference being statistically significant in the youngest age group ($P < 0.001$, Fig. 2). In the oldest age group, individuals taking an immunosuppressive drug were also more likely than their healthy counterparts to report eating at least one risky food ($P < 0.001$, Fig. 2).

Multivariate analysis controlling for income and education confirmed the increased likelihood of consuming risky foods for males (odds ratio [OR] = 1.4, 95% confidence interval [CI] 1.2–1.6), for persons with an immunosuppressive condition (OR = 1.5, 95% CI 1.1–2.0) and for persons 45–64 years of age compared with persons 18–44 years of age (OR = 1.1, 95% CI 1.01–1.3, Table 3).

DISCUSSION

Our most surprising finding was that persons with an immune-compromising condition, particularly young adults, were more likely than their healthy counterparts to eat at least one risky food in the week before the interview, even though there have been food safety educational efforts specifically targeted at this group (“A profile of older Americans” 1997; “Seniors and food safety” 1999; Yoshikawa 2000; Ginaldi *et al.* 2001; “Food safety for persons with AIDS” 2006; “Seniors need wisdom on food safety” 2006). In

TABLE 2.
PROPORTION (%)* OF PERSONS EATING SPECIFIED FOODS IN THE PAST 7 DAYS, BY IMMUNE/HEALTH STATUS AND AGE CATEGORY

	18-44 years			45-64 years			65-99 years			Total		
	Immune condition	Immune drug	Healthy	Immune condition	Immune drug	Healthy	Immune condition	Immune drug	Healthy	Immune condition	Immune drug	Healthy
Total (N)†	120	112	4,964	160	95	3,045	121	75	1,517	401	282	9,526
%† immune category by age	2.3	2.2	95.5	4.8	2.9	92.3	7.1	4.4	88.6	3.9	2.8	93.3
Number of risky foods												
0	45.5	68.0	63.0	56.1	66.9	59.0	61.4	46.9	67.1	54.0	62.2	62.5
1	30.1	27.4	26.2	31.2	25.5	31.7	33.0	38.4	26.7	31.3	29.6	27.8
2	20.0	4.3	8.1	10.4	4.6	7.0	4.2	13.4	5.2	11.8	6.7	7.4
≥3	4.5	0.3	2.7	2.4	3.0	2.3	1.4	1.3	1.0	2.8	1.4	2.4
Food items												
Runny eggs	26.6	18.9	15.8	26.3	16.1	20.6	25.0	32.3	16.8	26.0	22.2	17.3
Alfalfa sprouts	5.2	4.7	8.3	7.3	8.8	9.4	3.4	4.7	5.2	5.4	6.0	8.2
Pink hamburgers	10.6	4.4	7.9	6.5	8.9	7.1	4.7	3.7	3.2	7.4	5.6	7.0
Pink chicken	12.1	4.0	5.6	3.4	4.2	4.7	2.0	6.9	3.6	6.0	4.8	5.1
Raw apple juice/cider	8.1	3.9	4.5	5.1	1.7	3.4	4.7	7.7	4.5	6.0	4.2	4.2
Raw milk	17.9	0.1	4.1	5.4	2.1	3.0	3.3	7.3	3.6	9.1	2.6	3.7
Raw fresh fish	1.8	0.3	2.5	1.3	0.0	2.4	0.0	0.8	1.5	0.6	0.2	0.2
Raw shellfish	1.1	0.0	1.8	1.4	1.1	1.2	0.5	2.8	1.0	1.0	1.0	1.5
Pink turkey	0.1	0.7	1.0	2.4	2.0	1.1	1.6	0.0	0.7	1.4	0.9	1.0
Pink ground pork	0.0	0.3	0.3	0.0	0.0	0.4	0.3	0.0	0.1	0.1	0.1	0.3

* Weighted for study design and post-stratification adjustment.

† Unweighted.

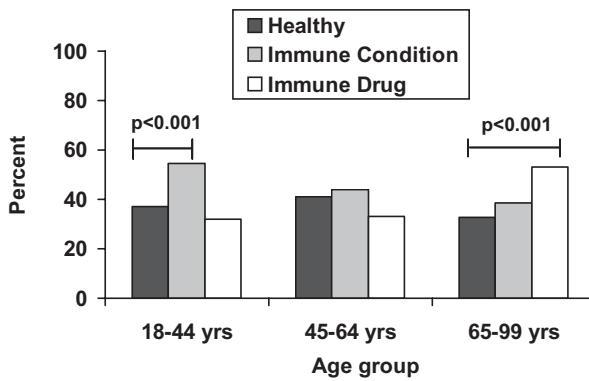


FIG. 2. PERCENT EATING ONE OR MORE RISKY FOODS, BY IMMUNE GROUP AND AGE, FOODNET POPULATION SURVEY, 1998–1999

TABLE 3.
ODDS OF EATING ONE OR MORE RISKY FOODS, UNIVARIATE AND MULTIVARIATE ANALYSES*, FOODNET POPULATION SURVEY, 1998–1999

	0 versus ≥ 1 foods ($n = 10,146$)				
	Univariate		Multivariate†		
	% risk	Odds ratio	Odds ratio	Confidence interval	<i>P</i> -value
Immune health status					
Healthy	37.5	Reference	–	–	–
Immune condition	46.0	1.42	1.47	(1.11–1.96)	0.007
Immune drug	37.8	1.01	1.04	(0.75–1.45)	0.8
Gender					
Female	33.7	Reference	–	–	–
Male	42.2	1.43	1.39	(1.24–1.56)	<0.001
Age group (years)					
18–44	37.3	Reference	–	–	–
45–64	40.9	1.16	1.14	(1.01–1.29)	0.049
≥ 65	34.2	0.87	0.88	(0.75–1.04)	0.1

* Weighted study design and post-stratification adjustment.

† Also controlled for income and education.

addition, among persons 65 years of age and older, those taking an immunosuppressive drug were, again surprisingly, more likely than their healthy counterparts to eat risky foods. Less surprising, but noteworthy, was that more males than females and more younger adults than elderly adults ate at least one risky food item. Similar results have been observed elsewhere (Altekruse *et al.* 1999).

It is disturbing that persons with immune-compromising conditions and those taking immunosuppressive drugs ate more risky foods than their healthy counterparts, and not less as would be expected if current food-safety messages had been reaching these populations. It is unclear why this is so.

In all age groups and immune categories, including among healthy persons, runny eggs were by far the most commonly consumed of the risky food items. Runny eggs were eaten by an overall average of 18% of survey respondents, and most commonly (32%) by persons ≥ 65 taking an immunosuppressive drug. Even the lowest percentage (16%) among healthy 18–44-year-olds was remarkably high. Furthermore, although we believe the comparison of 0 to ≥ 1 risky foods is useful in this analysis, much of the difference we report between groups was due to differences in consumption of runny eggs. Consumption of food items containing eggs with the yolk still runny is associated with a risk for *Salmonella* Enteritidis and has been implicated in numerous outbreaks and studies of sporadic cases (Morse *et al.* 1994; Mohle-Boetani *et al.* 1998; Centers for Disease Control and Prevention 2000). *Salmonella* Enteritidis infections can be particularly severe in the elderly (Mead *et al.* 1999). Because of these well-documented risks, the avoidance of eating runny eggs has been a target of foodborne-disease prevention messages, with many messages emphasizing the risk for the elderly and immunocompromised persons (“Playing it safe with eggs” 2001; “Shell eggs from farm to table” 2006). However, most Americans may perceive cooked eggs with a runny yolk not to be a risk but a standard of American cuisine.

Gender and age differences in high-risk food consumption have been reported in previous studies (Yang *et al.* 1998; Altekruse *et al.* 1999; Shiferaw *et al.* 2000). With respect to gender, the differences may have been related to greater levels of male risk-taking in general, and/or a lower level of knowledge among males about food-related risk (“Shell eggs from farm to table” 2006). The difference is *not* only due to males eating more food items (e.g., hamburger, chicken) of which a subset of each item (e.g., pink hamburger, pink chicken) is considered risky in this analysis. We examined this possibility, and although we did find males eating more of the general food item, among them a greater proportion ate the risky preparation of the item than did females who ate the same general item. With respect to age, it is encouraging to observe that, in general, the elderly, compared with younger groups, reported eating less risky foods. Older people may pay more attention to their health and nutrition and may be more educated about food safety from clinicians and/or other sources.

A number of limitations are present in this study, which may influence some of the observed results. First, the survey asked about *any* consumption of the specific food item in the past week, with no additional questions about frequency or quantity. Therefore, a person who ate a very small amount of a

risky item once would be coded the same as a person who ate a large amount often, even though the risk for foodborne disease of the latter person might be much greater. Along these lines, persons who knew their risk of complications for severe disease from certain food is greater may have been more likely to have recalled consuming that specific item than a person not at an increased risk. Some aspects of the design of the FoodNet Population Survey may have also influenced our results. Because this survey was based on a random-digit-dial telephone survey, it may not have been fully representative of the target population as persons with a home telephone may have been different from persons without phones. The survey did not collect data on awareness of prevention messages.

CONCLUSIONS

The elderly and persons with immune-compromising conditions are at an increased risk for foodborne diseases. Although the elderly, compared with their younger counterparts, appear to eat less risky foods, persons with immune-compromising conditions do not. Instead, we found that persons with immunosuppressive conditions were more likely than their healthy counterparts to eat risky food items. Additional research is needed to confirm our observations and to assess the prevalence of awareness of risky foods among high-risk populations. Our results also demonstrate that there is room for improved foodborne-disease prevention messages that target persons at high risk for complications of foodborne infections, including persons with immune-compromising conditions and persons taking immunosuppressive drugs.

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