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Ground Beef Consumption Patterns in the United States, FoodNet, 2006 through 2007

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Abstract

Infection resulting from foodborne pathogens, including *Escherichia coli* O157:H7, is often associated with consumption of raw or undercooked ground beef. However, little is known about the frequency of ground beef consumption in the general population. The objective of this study was to describe patterns of self-reported ground beef and pink ground beef consumption using data from the 2006 through 2007 FoodNet Population Survey. From 1 July 2006 until 30 June 2007, residents of 10 FoodNet sites were contacted by telephone and asked about foods consumed within the previous week. The survey included questions regarding consumption of ground beef patties both inside and outside the home, the consumption of pink ground beef patties and other types of ground beef inside the home, and consumption of ground beef outside the home. Of 8,543 survey respondents, 75.3% reported consuming some type of ground beef in the home. Of respondents who ate ground beef patties in the home, 18.0% reported consuming pink ground beef. Consumption of ground beef was reported most frequently among men, persons with incomes from $40,000 to $75,000 per year, and persons with a high school or college education. Ground beef consumption was least often reported in adults ≥65 years of age. Men and persons with a graduate level education most commonly reported eating pink ground beef in the home. Reported consumption of ground beef and pink ground beef did not differ by season. Ground beef is a frequently consumed food item in the United States, and rates of consumption of pink ground beef have changed little since previous studies. The high rate of consumption of beef that has not been cooked sufficiently to kill pathogens makes pasteurization of ground beef an important consideration, especially for those individuals at high risk of complications from foodborne illnesses such as hemolytic uremic syndrome.

Consumption of raw or undercooked products of bovine origin is a risk factor for infection with *Escherichia coli* O157:H7, multidrug resistant *Salmonella*, and other foodborne

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pathogens (12, 17). In the United States, among the 235 outbreaks in 2007 that were attributed to a single food commodity, contaminated beef accounted for 16% of illnesses (7). Illnesses and outbreaks have commonly been linked to consumption of ground beef, specifically undercooked (pink) ground beef (15, 23). A few studies have been conducted on ground beef consumption in the general population (3, 8, 19). On average, 80% of persons in the United States have consumed fresh ground beef in the home within the previous 2 weeks, and ground beef is eaten an average of 1.7 times per week by those reporting eating ground beef at all (19). Of adult respondents reporting ground beef consumption, 9 to 23% reported eating pink ground beef (1, 16, 22, 30). However, these studies were conducted >10 years ago, with limited populations, or only among adults.

The Foodborne Diseases Active Surveillance Network (FoodNet) is a collaborative effort among the Centers for Disease Control and Prevention, the U.S. Department of Agriculture Food Safety and Inspection Service, the U.S. Food and Drug Administration, and selected state health departments. FoodNet conducts active surveillance for seven bacterial and two parasitic pathogens transmitted commonly through food and for cases of hemolytic uremic syndrome. FoodNet also has conducted periodic surveys of the general population to obtain data on exposures that might be risk factors for foodborne illness, including the consumption of potentially risky foods, and to determine the prevalence of self-reported diarrheal illness (5). We used data from the 2006 through 2007 FoodNet Population Survey to describe the demographic and seasonal patterns of ground beef consumption among persons residing within the FoodNet catchment area.

MATERIALS AND METHODS

Survey.

The survey was conducted from 1 July 2006 through 30 June 2007 among residents of the 10 FoodNet sites (in Connecticut, Georgia, Maryland, Minnesota, New Mexico, Oregon, and Tennessee and selected counties in California, Colorado, and New York). Methods for the FoodNet Population Survey have been described (13) and are similar to those used in the national Behavioral Risk Factor Surveillance System survey (1). For the survey, households were contacted by telephone, using a single-stage random-digit dialing system (13). One person from each household was randomly selected to participate in the study. Respondents ≥12 years of age were interviewed directly, and an adult parent or guardian responded for children <12 years of age. Verbal informed consent was obtained from all respondents and from parents of all children <18 years of age.

Among the 17,372 respondents, 8,543 were randomly selected to complete a series of seven questions on ground beef consumption both inside and outside the home. Respondents were first asked whether they had consumed fresh or prefrozen ground beef patties at home in the previous 7 days, a standard exposure window for foodborne outbreaks and analytic studies that encompasses incubation times for most foodborne pathogens. Those who reported ground beef consumption at home were then asked whether the patties were pink on the inside when eaten. Respondents also were asked whether they had consumed anything else made with ground beef at home and whether they had eaten any burgers or ground beef products at a fast-food restaurant or anywhere else away from home in the previous 7 days.

Questions about pink ground beef consumption were asked only of those who consumed ground beef patties in the home; respondents were not asked whether ground beef consumed at a restaurant or anywhere else away from home was pink nor were they asked about other types of pink ground beef consumption in the home.

Analysis.

We were interested in consumption of ground beef at home or outside the home and consumption of any pink ground beef patties inside the home. Predictor variables included respondent age, gender, race, state of residence, income, level of education, seasonality of ground beef consumption, and residential setting. For analysis of ground beef and pink ground beef patty consumption by age, respondents were grouped into three age categories: 0 to 17, 18 to 64, and 65 or more years of age. Self-reported race responses were categorized as white, black or African American, or other (i.e., American Indian or Alaskan Native, Asian or Pacific Islander). Respondents who did not report belonging to one of these categories were not included in the analysis by race. For analysis by education level, respondents were divided into three groups: completed high school or lower, any college or technical education, and any graduate education. Seasonal ground beef consumption was examined by month and by season for summer (May through October) and winter (November through April). Data were weighted to account for unequal probabilities of respondent selection and age and gender of the population surveyed using methods similar to those previously described for the Behavioral Risk Factor Surveillance System and previous cycles of the FoodNet Population Survey (13, 18). We performed statistical analysis using the Proc Surveyfreq and Proc Surveylogistic procedures in SAS version 9.2 (SAS Institute, Cary, NC). We conducted descriptive analyses and comparisons of proportions on weighted survey data. We also generated P values from modified Rao-Scott design-adjusted chi-square tests. Wald chi-square test P values and Wald 95% confidence intervals also were calculated for the multivariate logistic regression model conditioned on state location. A two-sided P value of <0.05 was considered significant.

Predictor variables that were significantly associated with ground beef consumption outcome variables at $P < 0.05$ in the univariate analyses were considered for inclusion in multivariable logistic regression models to examine factors independently associated with ground beef and pink ground beef patty consumption. Variables were retained in the model when the P value from the residual chi-square test was <0.05; the two-sided P value is reported here. We considered models with interaction terms; however, only the main effects model is presented because the interaction terms were not significant.

RESULTS

Of 17,372 respondents in the 2006 through 2007 FoodNet Population Survey, 8,543 randomly selected respondents who were asked about ground beef consumption were included in the analysis. Among individuals included in the survey (Table 1), 51.9% were female, 25.2% were children ≤17 years of age, and 1.5% were <1 year of age. Whites made up 78.3% of the respondents, and about one-third were in the lowest categories for education level and income (30.5 and 28.5%, respectively).

Overall, 75.3% of respondents reported consuming some type of ground beef in the previous 7 days (Table 1); 61.8% of these reported consuming ground beef inside the home and 45.8% reported consuming ground beef outside the home (Table 2). Among respondents who ate ground patties beef in the home, 18.0% reported consuming pink ground beef (Table 1). Consumption of pink freshly made hamburger patties was more frequently reported (13.9%) than consumption of pink previously frozen hamburger patties (5.9%; Table 2).

Male respondents reported eating ground beef (80.1%) and pink ground beef patties (20.2%) in the home more frequently than did female respondents (71.0 and 15.5%, respectively; Table 1). Children <18 years of age reported consuming ground beef most frequently (80.2%), whereas respondents ≥65 years of age reported consuming ground beef least frequently (70.2%; Table 1). Conversely, children reported consuming pink ground beef patties in the home the least often; 7.9% of children <18 years of age reported consuming pink ground beef patties compared with 22.5% of persons 18 to 64 years of age and 18.5% of persons ≥65 years of age (Table 1). Adults living in a household with at least one child <18 years of age were slightly more likely to eat pink ground beef patties in the home (20.7%) than were adults with no children living in the home (16.2%). A lower percentage of respondents with higher socioeconomic status (based on education and income level) reported consuming ground beef, but a higher percentage reported consuming pink ground beef patties in the home (Table 1). Similarly, respondents from California reported ground beef consumption least often (57.3%) and pink ground beef patty consumption in the home more often (26.5% of those who consumed ground beef) than did respondents from the eight other sites (Table 1). The analysis also indicated differences in ground beef and pink ground beef patty consumption among racial groups and between urban and rural dwellers (Table 1). Whites and rural dwellers reported ground beef consumption more frequently, and whites and urban dwellers reported pink ground beef patty consumption in the home more frequently than did their counterparts. No variation in ground beef or pink ground beef patty consumption in the home by season was observed (Table 1). Frequency of consumption of fresh and frozen ground beef patties, other types of ground beef consumed at home, and ground beef consumed away from home also differed by age and race. Persons ≥65 years of age reported eating ground beef outside the home less frequently than did other age groups, and blacks reported eating ground beef outside the home more frequently than did other races (data available at http://www.cdc.gov/foodnet/webappendix.htm). Although overall consumption of ground beef did not differ by month or season, consumption of fresh ground beef, other types of ground beef at home, and ground beef away from home were reported more frequently from November to April than from May to October (data available at http://www.cdc.gov/foodnet/webappendix.htm).

Factors significantly associated with ground beef consumption in the univariate analyses at $P < 0.05$ and therefore considered in the multivariate analyses were age, race, gender, residential setting, education, and income; for pink ground beef, only age, race, and gender were significantly associated with consumption in the univariate analyses. In multivariate analyses, all of these factors remained independently associated with ground beef consumption, with the exception of income (Table 3). In the multivariate model for pink ground beef patty consumption in the home, only age 18 to 64 years (odds ratio, 2.9; 95%

confidence interval [CI], 1.9 to 4.3), age ≥65 years (odds ratio, 2.4; 95% CI, 1.6 to 3.6), and male (odds ratio, 1.8; 95% CI, 1.4 to 2.3) were significantly associated (Table 3).

DISCUSSION

Ground beef is a frequently consumed food item in the United States. In this survey of residents of the 10 FoodNet sites, most respondents reported eating ground beef in the previous week, and nearly one in five persons who ate ground beef patties at home reported eating pink ground beef patties at home, a marker (although imperfect) for the consumption of undercooked ground beef. We also found that ground beef consumption patterns differed according to several demographic factors, i.e., age, gender, race, education, income, and residential setting, but that patterns of consumption did not differ by month or season.

We noted a distinct lack of seasonality in the consumption of ground beef or pink ground beef patties in the home. This contrasts with the marked seasonality reported for *E. coli* O157:H7 infections in humans, which peaks in the summer months (24). These data suggest that factors other than seasonality in ground beef consumption, such as differences in food handling practices or increases in the amount of bacterial contamination on meat and other foods or environmental sources during warmer months, are responsible for the seasonal increase in *E. coli* O157:H7 infections. Shedding of *E. coli* O157:H7 by cattle peaks during the spring and summer months (2, 11, 28), corresponding to the period of the highest incidence of human infections (24). Others have suggested that fluctuations in *E. coli* O157:H7 prevalence in cattle may be linked to human infections (11). Our data support this hypothesis and suggest that further attention to preharvest food safety interventions may be warranted to decrease the numbers of organisms shed in cattle feces and, ultimately, decrease the number of human infections.

Although children were the age group least likely to consume pink ground beef patties in the home, 7.9% of children who ate ground beef reported consuming pink ground beef patties, indicating continued potential for exposure to *E. coli* O157:H7 by this route among this vulnerable population (24). Children are particularly susceptible to developing hemolytic uremic syndrome, a serious complication of *E. coli* O157:H7 infections that can cause severe illness and death (10). This finding indicates a need to further explore efforts to change food safety behaviors in parents. Similarly, rates of death from *E. coli* O157:H7 infection and hemolytic uremic syndrome are highest among persons ≥60 years of age (10). Because almost 20% of persons in this age group who ate ground beef reported consuming pink ground beef patties in the home, this finding indicates a need to improve communication of the risks to seniors.

Although persons with higher education and income reported consuming pink ground beef patties in the home more often, this group consumed ground beef overall less frequently. These findings do not explain these patterns, but we speculate that the increased level of risky behavior among more highly educated and higher income respondents may be due to several factors. These persons may not prepare food at home as often as other groups (25) and therefore may be less practiced in appropriate safe food handling and cooking practices or they may prefer pink ground beef. Higher income persons have been shown both to have

more confidence in the safety of the national food supply and to be more likely to use unsafe food practices than lower income persons (20). Persons that are more educated may also perceive themselves to be at less risk for foodborne illness and consequently be more likely to engage in risky behaviors. The increased willingness among this population to engage in unsafe food-related behaviors has been suggested to rise from more prevalent beliefs that they understand and can control food safety risks (9). Information on food safety knowledge was not collected in this study; therefore, differences in pink ground beef consumption among more and less educated persons with similar food safety knowledge and behaviors could not be assessed.

In the current study, pink ground beef consumption was reported by 18.0% of people who consumed ground beef patties in the home, almost twice the 10% reported in a previous FoodNet study among all ground beef consumed. This finding suggests that consumption patterns have not improved (22). In 1995 and 1996, 9% of Kansas residents reported eating undercooked hamburger in the 12 months before the interview (30). In another study conducted in eight states, 20% of residents reported eating hamburger that was still pink in the center (1). Even among our study population, state of residence modified the effects of age and race on pink ground beef consumption. Although we conditioned by state in our analysis, we reported the overall effect because the state-specific results did not differ greatly from the overall effect. When we restricted our analysis to adults, 21% consumed pink ground beef patties at home. This result remains at the higher end of rates found in other studies that included only adults. Consistent with our findings, higher rates of pink ground beef consumption have generally been reported among men, middle-aged persons, persons in the highest income bracket, and those with more than a high school education (1, 16, 22, 30). Our data demonstrate that these patterns have not changed over the past decade. In previous studies, more rural than urban residents consumed ground beef and consumption of ground beef differed by race and ethnicity and economic status (8, 29). Although fewer blacks than whites reported ground beef consumption in the current study, blacks previously were reported to consume larger quantities of ground beef per capita than other races (8). It is not clear whether methodological differences between studies, such as respondent recall periods and study populations, or true differences in consumption by race are responsible for these disparate findings.

There are several limitations to this study. First, this survey included only persons residing within the FoodNet catchment areas, so the findings might not be representative of the entire United States. The FoodNet population is demographically similar to the U.S. population as a whole, except for a slight underrepresentation of Hispanics (21); however, this study may not give a fully accurate picture of ground beef or pink ground beef consumption. Second, all questionnaire responses were self-reported and could not be validated. If respondents underreported perceived unsafe practices such as eating pink ground beef, the proportion of people engaging in these behaviors would be underestimated. Color is not a reliable indicator of ground beef doneness, and thermometer use was not assessed (26, 27), so self-reported consumption of pink ground beef may not truly represent consumption of undercooked beef. Recall also may be imperfect; information collected might reflect general patterns of consumption rather than the foods actually consumed during the period in question. Data on pink ground beef consumption were limited to consumption of ground

beef patties inside the home; the survey did not include questions on consumption of pink ground beef prepared outside the home or other types of ground beef served within the home. Because consumption of food prepared outside the home is a significant risk factor for foodborne infection (14), conclusions of this study may not be relevant for all foodborne illnesses associated with consumption of pink ground beef. This study also could not link food exposure to subsequent diarrheal illness; therefore, we were not able to assess whether pink ground beef consumption was associated with increased risk for diarrheal illness among this population. Although adults living in households with children were slightly more likely to report consuming pink ground beef themselves, surrogate responses for exposures have generally been associated with more uncertainty than directly reported exposures. Parents who responded for children younger than 12 years of age may be less likely to report their children practicing this risky behavior, leading to an underestimation of pink ground beef consumption among children.

Food safety regulations and process changes implemented by the food industry have decreased the risk of foodborne illness associated with eating ground beef (4, 27). Beef slaughter and processing facilities have implemented hazard analysis and critical control point systems. Observed decreases in human infections with *E. coli* O157:H7 of up to 44% from baseline measures suggest progress is being made (6). However, many people still consume pink ground beef and are at risk for complications from *E. coli* O157:H7 infections. Based on observed differences in consumption, education and risk communication campaigns targeted at specific high-risk groups are an important component of efforts to decrease foodborne infections related to ground beef consumption. However, the potential impact of campaigns directed at consumers is undoubtedly limited. Preconsumer interventions, including measures to lower contamination levels in live cattle and ground beef, also should be considered. Decreasing foodborne infections will likely require continued or expanded efforts in education, risk communication, and pre- and postharvest food safety interventions across the farm-to-table continuum.

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REFERENCES

1. Altekruse SF, Yang S, Timbo BB, and Angulo FJ. 1999. A multi-state survey of consumer food-handling and food-consumption practices. Am. J. Prev. Med 16:216–221. [PubMed: 10198661]
2. Barkocy-Gallagher GA, Arthur TM, Rivera-Betancourt M, Nou X, Shackelford SD, Wheeler TL, and Koohmaraie M. 2003. Seasonal prevalence of Shiga toxin–producing *Escherichia coli*, including O157: H7 and non-O157 serotypes, and *Salmonella* in commercial beef processing plants. J. Food Prot 66:1978–1986. [PubMed: 14627272]
3. Centers for Disease Control and Prevention. 2004. Foodborne Diseases Active Surveillance Network (FoodNet): population survey atlas of exposures, 2002. Available at: http://www.cdc.gov/foodnet/surveys/pop/2002/2002atlas.pdf. Accessed 14 June 2011.
4. Centers for Disease Control and Prevention. 2004. Preliminary FoodNet data on the incidence of infection with pathogens transmitted commonly through food—selected sites, United States, 2003. Morb. Mortal. Wkly. Rep 53:338–343.

5. Centers for Disease Control and Prevention. 2006. FoodNet studies and surveys—population survey. Available at: http://www.cdc.gov/foodnet/studies_pages/pop.htm. Accessed 20 September 2010.
6. Centers for Disease Control and Prevention. 2010. Preliminary FoodNet data on the incidence of infection with pathogens transmitted commonly through food—10 states, 2009. Morb. Mortal. Wkly. Rep 59:418–422.
7. Centers for Disease Control and Prevention. 2010. Surveillance for foodborne disease outbreaks—United States, 2007. Morb. Mortal. Wkly. Rep 59:973–979.
8. Davis C, and Lin B. 2005. Factors affecting US beef consumption. LDP-M-135-02 U.S. Department of Agriculture, Economic Research Service. Available at: http://www.ers.usda.gov/publications/ldp/Oct05/ldpm13502/ldpm13502.pdf. Accessed 23 August 2011.
9. Dosman DM, Adamowicz WL, and Hrudey SE. 2001. Socioeconomic determinants of health- and food safety–related risk perceptions. Risk Anal. 21:307–318. [PubMed: 11414539]
10. Gould LH, Demma L, Jones TF, Hurd S, Vugia DJ, Smith K, Shiferaw B, Segler S, Palmer A, Zansky S, Griffin PM, and Emerging Infections Program FoodNet Working Group. 2009. Hemolytic uremic syndrome and death in persons with *Escherichia coli* O157:H7 infection, Foodborne Diseases Active Surveillance Network sites, 2000–2006. Clin. Infect. Dis 49:1480–1485. [PubMed: 19827953]
11. Hancock DD, Besser TE, Rice DH, Herriott DE, and Tarr PI. 1997. A longitudinal study of *Escherichia coli* O157 in fourteen cattle herds. Epidemiol. Infect 118:193–195. [PubMed: 9129597]
12. Hussein H 2007. Prevalence and pathogenicity of Shiga toxin–producing *Escherichia coli* in beef cattle and their products. J. Anim. Sci 85:E63. [PubMed: 17060419]
13. Imhoff B, Morse D, Shiferaw B, Hawkins M, Vugia D, Lance-Parker S, Hadler J, Medus C, Kennedy M, Moore MR, and Van Gilder T. 2004. Burden of self-reported acute diarrheal illness in FoodNet surveillance areas, 1998–1999. Clin. Infect. Dis 38:219–226.
14. Jones TF, and Angulo FJ. 2006. Eating in restaurants: a risk factor for foodborne disease? Clin. Infect. Dis 43:1324–1328. [PubMed: 17051501]
15. Kassenborg HD, Hedberg CW, Hoekstra M, Evans MC, Chin AE, Marcus R, Vugia DJ, Smith K, Desai Ahuja S, Slutsker L, and Griffin PM. 2004. Farm visits and undercooked hamburgers as major risk factors for sporadic *Escherichia coli* O157: H7 infection: data from a case-control study in 5 FoodNet sites. Clin. Infect. Dis 38:271–278. [PubMed: 14699461]
16. Klontz KC, Timbo BB, Fein S, and Levy A. 1995. Prevalence of selected food consumption and preparation behaviors associated with increased risks of food-borne disease. J. Food Prot 58:927–930. [PubMed: 31137398]
17. Lynch M, Painter J, Woodruff R, and Braden C. 2006. Surveillance for foodborne-disease outbreaks—United States, 1998–2002. Morb. Mortal. Wkly. Rep 55:1–34.
18. National Center for Chronic Disease Prevention and Health Promotion. 2004. Behavioral Risk Factor Surveillance System (BFRSS): turning information into health. Available at: http://www.cdc.gov/brfss/. Accessed 17 March 2010.
19. Redson BA 2010. Ground beef leads in-home beef usage. National Cattlemen's Association. March–May 2009. Available at: http://www.beefresearch.org/CMDocs/BeefResearch/Market%20Research/Ground%20beef%20leads%20in%20-%20web.pdf. Accessed 20 September 2010.
20. Roseman M, and Kurzynske J. 2006. Food safety perceptions and behaviors of Kentucky consumers. J. Food Prot 69:1412–1421. [PubMed: 16786865]
21. Scallan E, and Angulo FJ. 2007. Activities, achievements, and lessons learned during the first 10 years of the Foodborne Diseases Active Surveillance Network: 1996–2005. Clin. Infect. Dis 44:718–725. [PubMed: 17278067]
22. Shiferaw B, Yang S, Cieslak P, Vugia D, Marcus R, Koehler J, Deneen V, Angulo FJ, and the FoodNet Working Group. 2000. Prevalence of high-risk food consumption and food-handling practices among adults: a multistate survey, 1996 to 1997. J. Food Prot 63:1538–1543. [PubMed: 11079697]

23. Slutsker L, Ries AA, Maloney K, Wells JG, Greene KD, and Griffin PM. 1998. A nationwide case-control study of *Escherichia coli* O157: H7 infection in the United States. J. Infect. Dis 177:962–966. [PubMed: 9534969]

24. Tarr PI, Gordon CA, and Chandler WL. 2005. Shiga-toxin–producing *Escherichia coli* and haemolytic uraemic syndrome. Lancet 365:1073–1086. [PubMed: 15781103]

25. Thornton LE, Crawford DA, and Ball K. 2010. Who is eating where? Findings from the SocioEconomic Status and Activity in Women (SESAW) study. Public Health Nutr. 14:523–531. [PubMed: 21144099]

26. U.S. Department of Agriculture, Economic Research Service. 2002. Consumer food safety behavior: a case study in hamburger cooking and ordering. AER-804 Measuring hamburger cooking and ordering behavior. Available at: http://www.ers.usda.gov/publications/aer804/aer804c.pdf. Accessed 23 August 2011.

27. U.S. Department of Agriculture, Food Safety and Inspection Service. 2011. Color of cooked ground beef as it relates to doneness. U.S. Department of Agriculture, Food Safety and Inspection Service. Available at: http://www.fsis.usda.gov/factsheets/Color_of_Cooked_Ground_Beef/index.asp. Accessed 23 August 2011.

28. Van Donkersgoed J, Graham T, and Gannon V. 1999. The prevalence of verotoxins, *Escherichia coli* O157: H7, and *Salmonella* in the feces and rumen of cattle at processing. Can. Vet. J 40:332–338. [PubMed: 10340094]

29. Yang S, Leff MG, McTague D, Horvath KA, Jackson-Thompson J, Murayi T, Melnik A, Gildemaster MC, Ridings DL, Altekruse SF, and Angulo FJ. 1998. Multistate surveillance for food-handling, preparation, and consumption behaviors associated with foodborne diseases: 1995 and 1996 BRFSS food-safety questions. Morb. Mortal. Wkly. Rep 47:33–54.

30. Zhang P, Penner K, and Johnston J. 1999. Prevalence of selected unsafe food-consumption practices and their associated factors in Kansas. J. Food Saf 19:289–297.

TABLE 1.

Characteristics of respondents reporting consumption of ground beef and pink ground beef patties in the previous 7 days, FoodNet Population Survey, 2006 through 2007[a]

Characteristic		% total respondents (*n* = 8,543)	% (95% CI) respondents reporting ground beef consumption (*n* = 5,980)	% (95% CI) respondents reporting pink ground beef consumption among respondents reporting ground beef patty consumption in the home (*n* = 2,944)
Total			75.3 (74.0–76.7)	18.0 (16.0–20.0)
Gender[b,c]	Male	48.1	80.1 (78.1–82.0)	20.2 (17.2–23.2)
	Female	51.9	71.0 (69.2–72.9)	15.5 (12.9–18.1)
Age (yr)[b,d]	≤17	25.2	80.2 (77.4–83.1)	7.9 (5.1–10.7)
	18–64	62.5	75.3 (73.6–77.0)	22.5 (19.6–25.4)
	≥65	12.3	70.2 (67.7–72.6)	18.5 (15.2–21.8)
Education[b,c]	High school	30.5	78.9 (76.5–81.3)	15.5 (11.9–19.1)
	College or technical	52.0	75.3 (73.5–77.2)	18.5 (15.7–21.2)
	Graduate	17.5	67.3 (64.0–70.6)	23.1 (17.6–28.7)
Income (per year in U.S. dollars)[b]	<$40,000	28.5	75.2 (72.6–77.8)	16.1 (12.3–19.9)
	$40,000–$75,000	37.9	79.4 (77.7–81.2)	16.9 (13.9–19.9)
	>$75,000	33.6	70.9 (68.3–73.4)	21.2 (17.5–24.9)
Race[e]	White	78.3	77.1 (75.9–78.4)	18.5 (16.4–20.7)
	Black	13.8	71.3 (66.0–76.6)	10.4 (5.3–15.4)
	Other	8.0	69.7 (62.7–76.7)	16.3 (7.1–25.5)
Site[b,c]	California	7.2	57.3 (51.3–63.2)	26.5 (14.9–38.1)
	Colorado	6.0	76.3 (72.7–79.8)	22.5 (15.6–29.4)
	Connecticut	7.6	71.1 (67.4–74.8)	27.4 (20.9–33.9)
	Georgia	20.6	75.1 (71.0–79.2)	15.8 (10.1–21.5)
	Maryland	12.0	71.0 (67.3–74.7)	19.9 (14.2–25.6)
	Minnesota	11.7	83.0 (80.1–85.9)	18.8 (13.2–24.4)
	New Mexico	4.2	79.1 (75.2–83.0)	14.3 (8.9–19.7)
	New York	9.4	76.7 (73.3–80.1)	19.4 (13.0–25.8)
	Oregon	8.2	75.1 (71.7–78.5)	15.9 (10.7–21.0)
	Tennessee	13.0	82.8 (79.8–85.7)	11.8 (8.0–15.6)
Community[b,d]	Urban or suburban	77.4	72.9 (71.2–74.6)	20.0 (17.3–22.6)

Characteristic		% total respondents (*n* = 8,543)	% (95% CI) respondents reporting ground beef consumption (*n* = 5,980)	% (95% CI) respondents reporting pink ground beef consumption among respondents reporting ground beef patty consumption in the home (*n* = 2,944)
	Rural	22.6	81.5 (78.9–84.1)	13.0 (9.7–16.3)
Season	May–Oct	60.2	76.2 (74.6–77.9)	17.1 (14.7–19.5)
	Nov–Apr	39.8	74.0 (71.8–76.2)	19.6 (16.0–23.2)

[a]For some items, *n* may vary by small numbers. CI, confidence interval.

[b]Modified Rao-Scott chi-square statistic at $P < 0.001$ for ground beef.

[c]Modified Rao-Scott chi-square statistic at $P < 0.05$ for pink ground beef.

[d]Modified Rao-Scott chi-square statistic at $P < 0.001$ for pink ground beef.

[e]Modified Rao-Scott chi-square statistic at $P < 0.05$ for ground beef.

TABLE 2.

Reported consumption of ground beef products in the previous 7 days, FoodNet Population Survey, 2006 through 2007

Location of ground beef consumption and type of ground beef consumed[a]	Weighted % reporting consumption (n = 8,543)	95% confidence interval
Inside the home	61.8	60.3–63.3
Fresh hamburger patties	27.5	26.1–28.9
Fresh hamburger patties eaten pink[b]	13.9	12.1–15.6
Frozen hamburger patties	15.8	14.6–17.0
Frozen hamburger patties eaten pink[b]	5.9	4.7–7.2
Other type of ground beef	45.4	43.8–47.0
Outside the home	45.8	44.2–47.4
Fast-food restaurant	39.0	37.4–40.6
Other location	19.9	18.6–21.3

[a]Categories of ground beef consumed were not mutually exclusive; therefore, percentages may not sum to 100%.

[b]Consumption among participants who ate fresh or frozen ground beef patties (n = 2,944).

TABLE 3.

Predictors of ground beef and pink ground beef patty consumption from multivariate models

Predictors	Odds ratio	95% confidence interval
Predictors of ground beef consumption		
≤17 yr of age	1.55	1.23–1.95
18–64 yr of age	Reference	
≥65 yr of age	0.53	0.41–0.69
White race	Reference	
Black race	0.70	0.52–0.94
Other race	0.64	0.45–0.91
Female	Reference	
Male	1.72	1.47–2.02
Rural community	Reference	
Urban or suburban community	0.77	0.62–0.95
Graduate education	Reference	
Less than graduate education	0.64	0.53–0.77
Income <$40,000	Reference	
Income $40,000–$75,000	1.19	0.98–1.44
Income >$75,000	0.80	0.64–1.0
Predictors of pink ground beef patty consumption		
≤17 yr of age	Reference	
18–64 yr of age	2.85	1.92–4.25
≥65 yr of age	2.36	1.55–3.59
White race	Reference	
Black race	0.45	0.26–0.75
Other race	0.65	0.34–1.24
Female	Reference	
Male	1.75	1.36–2.26