Contribution of meat to vitamin B-12, iron, and zinc intakes in five ethnic groups in the U.S.: Implications for developing food-based dietary guidelines

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Abstract

Background—To describe the sources of meat and their contributions to vitamin B-12, iron, and zinc in five ethnic groups in the USA.

Methods—Dietary data for the Multiethnic Cohort, established in Hawaii and Los Angeles, were collected using a quantitative food frequency questionnaire from more than 215,000 subjects aged 45–75 years at baseline (1993–1996). Participants included African American, Latino, Japanese American (JpAm), Native Hawaiian (NH) and Caucasian men and women. Servings of meat items were calculated based on the USDA recommendations and their contributions to intakes of total meat, red meat, vitamin B-12, iron, and zinc were determined.

Results—Of all types of meat, poultry contributed the most to meat consumption, followed by red meat and fish among all ethnicities, except for Latino (born in Mexico and Central/South America) men who consumed more beef. Lean beef was the most commonly consumed red meat for all ethnic-sex groups (9.3–14.3%), except for NH and JpAm men, and JpAm women whose top contributor was stew/curry with beef/lamb and stir-fried beef/pork with vegetables respectively. The contribution of meat was most substantial for zinc (11.1–29.3%) and vitamin B-12 (19.7–40%), and to a lesser extent for iron (4.3–14.2%).

Conclusions—This is the first large multiethnic cohort study to describe meat sources and their contributions to selected nutrients among ethnic minorities in the U.S. These findings may be used to develop ethnic-specific recommendations for meat consumption to improve dietary quality among these groups.

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INTRODUCTION

Chronic diseases, including cancer, cardiovascular disease (CVD) and diabetes, are the leading causes of death for men and women of all races and ethnicities in the U.S. (NCHS, 2009). However, mortality and morbidity rates from these diseases differ by race and ethnicity. African Americans are more affected by death from CVD and cancer than Latinos, Asians or Caucasians in the USA (NCHS, 2009). Age-adjusted prevalence of CVD among men and women were 9.7% and 10.8% among African Americans, 9.0% and 7.6% for Latino Americans, and 14.0% and 11.8% for Caucasians, respectively (NCHS, 2009). Furthermore, age-adjusted cancer mortality rates for men and women, respectively, were 322 and 189 per 100,000 for African Americans, 235 and 161 for Caucasians, 142 and 97 for Asians and 162 and 107 for Latinos in 2008 (ACS, 2008). More information on the etiology and the disparities in rates of chronic diseases among these ethnic/racial groups is urgently needed.

Substantial evidence indicates that the consumption of meat, in particular red meat and processed meat, is associated with several chronic diseases including CVD (Sinha *et al.*, 2009; Wang & Beydoun, 2009), diabetes (Vang *et al.*, 2008) and cancer (Lee et *al.*, 2009; Sinha *et al.*, 2009). Carcinogenic compounds are formed when red meat is cooked at high temperature (Tasevska *et al.*, 2009). Red meats are also energy-dense and high in total fat and saturated fat, which have been linked to a high risk of obesity and associated co-morbidities such as diabetes, CVD and cancer (Leitzmann, 2005; Wang & Beydoun, 2009). In contrast, a higher intake of white meat (poultry and fish) has been associated with a decreased risk for total death as well as death from cancer (Sinha *et al.*, 2009). Fish contains high levels of omega-3-fatty acids, which are believed to have a positive effect on cholesterol levels and to be preventative against heart disease and cancer (Mozaffarian, 2009; Pot *et al.*, 2009).

Conversely, in most cases, meats are good sources of essential micronutrients, such as iron, zinc, selenium and vitamin B-12, which have important functions in many metabolic and physiological processes (Vaes *et al.*, 2009; Welch *et al.*, 2009). Zinc is involved in immune system function and has been associated with prevention of atherosclerosis and prostate cancer (Prasad, 2009; Lobo *et al.*, 2009). Iron is required in the formation of hemoglobin and inadequate iron intake can result in anemia, decreased intellectual and work performance, and functional alterations of the small bowel (Clark, 2008). In addition, animal-based sources of several micronutrients such as iron, zinc and vitamin B-12 have better bioavailability compared to plant-based food sources (Allen, 2008). Muscle tissue is a source of high quality protein and contains little carbohydrate; some researchers have advocated that a high protein and low-carbohydrate diet promotes weight loss and prevents obesity (Atkins, 2004; Gardner *et al.*, 2007; Halkjaer *et al.*, 2009).

The USA has the highest per capita consumption of meat in the world. Americans consumed 200 pounds (boneless weight) of beef, pork, chicken and fish per person in 2005 (USDA-ERS, 2010; Wang *et al.*, 2010). The debate over the health risks versus nutritional benefits of animal products in the diet raises the need to more closely investigate the contributions of meat to the diet, as well as the relationship between different meat sources and chronic disease. Unfortunately, to our knowledge, no studies have provided information regarding meat sources relative to micronutrient intake among ethnic minorities in the U.S. using a standardized dietary assessment methodology. The objective of the present study was to describe consumption of different meat sources and their relative contributions to vitamin B-12, iron, and zinc in five main ethnic groups in the USA.

PATIENTS AND METHODS

The Multiethnic Cohort (MEC) and dietary assessment methods have been detailed elsewhere (Kolonel *et al.*, 2000; Stram *et al.*, 2000). Briefly, the MEC includes representative population samples of more than 215,000 men and women of five ethnic/racial groups— African Americans (AfAm), Latinos - born in Mexico and Central/South America (Latino-Mexico) and born in the U.S. (Latino-US), Japanese Americans (JpAm), Native Hawaiians (NH) and Caucasians. Participants aged 45–75 years completed a 26-page, self-administered mailed questionnaire at baseline in 1993–1996 which included sections on anthropometric and demographic information (including migrant status), physical activity, medical and reproductive history, and a validated quantitative food frequency questionnaire (QFFQ) (Kolonel *et al.*, 2000). The QFFQ was developed specifically for the study population based on 3-day measured food records from approximately 60 men and 60 women from each ethnic/racial group. Ethnic-specific food items were added to the QFFQ irrespective of their contribution to nutrient intake (Kolonel *et al.*, 2000). Acceptable correspondence between the questionnaire and multiple 24-hour recalls for the ethnic-sex groups was shown in a calibration sub-study (Stram *et al.*, 2000).

Participants outside the range of mean +/− 3 SDs for energy and mean +/− 3.5 SDs for fat, protein and carbohydrate values were excluded. Likewise, individuals from mixed ethnic background and Latinos born in the Caribbean were not included in this analysis. Latino-Mexico, Latino-US and Latinos born elsewhere were separated because food consumption patterns have been shown to differ substantially between Latinos by birthplace (Sharma *et al.*, 2004). The present analysis included 31,852 AfAm, 13,629 NH, 51,248 JpAm, 42,951 Latinos (21,083 Latino-Mexico and 21,868 Latino-US) and 47,236 Caucasians.

The QFFQ included eight frequency categories for foods and nine for beverages, together with three choices of portion size. As an additional aid for quantification, photographs depicting selected foods and representative portion sizes were provided. The portion size options were based on typical serving sizes for each single food or grouping of foods as reflected in the original 3-day measured food records (Kolonel *et al.*, 2000). The detailed methods of developing and calculating servings of food groups for the MEC have been described previously (Sharma *et al.*, 2003). Servings of different types of meat consumed were determined using the U.S. Department of Agriculture (USDA) Pyramid serving's database file. Each individual's servings for each food group were computed by summing

the daily servings across the food items on the QFFQ. Composite dishes were disaggregated into their individual components. Nutrient intakes were analyzed based on the unique food composition table which was extended and adapted from USDA food composition database (Sharma *et al.*, 2003). In this paper, the average number of types of meat was calculated by ethnic-sex group and ranked.

The following meats were recorded either as an individual portion or as part of composite food: beef, pork, lamb, chicken, turkey and fish. Red meat was the sum of beef, pork and lamb. Poultry included chicken and turkey. Fish included baked/broiled/raw fish, canned tuna fish and shrimp/shellfish. Total meat constituted all of the above mentioned meats. In this paper, we present the types of meat contributing to total meat and red meat due to their association with chronic disease. Similar foods were combined to calculate the percent contributions of commonly consumed meats and other food items to daily vitamin B-12, iron, and zinc intakes.

All participants provided their informed consent. The study protocol was approved by the institutional review boards of the University of Hawaii and the University of Southern California.

RESULTS

The mean ages of 86,320 men and 100,596 women included in the analysis of this study ranged from 56 to 62 years among ethnic-sex groups. Among the ethnic-sex groups, NH men (28.5 kg/m^2) and AfAm women (28.4 kg/m^2) had the highest mean BMI (Table 1). NH had the highest energy intakes for men (2,760 kcal/day) and women (2,370 kcal/day), while AfAm men (2,194 kcal/day) and JpAm women (1,808 kcal/day) reported the lowest energy intake by ethnic-sex group.

Sources of meat intake

Table 2 lists the top ten most commonly consumed types of meat and their contribution to total meat intake. Of the top ten contributors, poultry products contributed the most (15.2–39.3%) to meat consumption, followed by red meat and fish in all ethnic-sex groups, except for Latino-Mexico men who consumed more red meat than poultry. Chicken (wings, roasted/baked) was the top contributor to total meat intake (5.2–12.2%) in all ethnic-sex groups, except for NH men and women and JpAm men for whom fish (canned tuna fish, and baked/broiled/raw fish, respectively) was the most commonly consumed type of meat (5.0–5.4%), and for Latino-Mexico men and women for whom broth with noodles or rice was the top contributor (6.0% and 7.5% respectively). Among AfAm, seven of the top ten contributors were poultry products. Red meat was reported most commonly among Latinos (12.2–23.5%) and the least among AfAm (2.5–3.3%). Fish was one of the ten major sources of total meat among AfAm, NH, JpAm, Latino-US and Caucasians, however, it was not among the top ten for Latino-Mexico individuals.

Table 3 presents the top ten types of red meat consumed in each ethnic-sex group. Lean beef steak/roast was the top contributor to red meat consumption among AfAm, Caucasians and Latinos (9.3–14.3%) and it contributed to a lesser degree among JpAm and NH (5.4–9.0%).

The primary source of red meat among JpAm men and NH was stew/curry with beef/lamb (10.5–13.1%). Stir-fried beef or pork with vegetables was the top red meat source only for JpAm women (14.5%). Meat burritos appeared in the top ten lists only for Latinos who also consumed chili in significant amounts.

Contribution of meat to nutrient intakes

Among the top ten foods, meats contributed about 20% or more to vitamin B-12 intake. Fish was the second highest contributor to vitamin B-12 intake in all ethnic-sex groups, except in Latino-Mexico men and women and Caucasian women among whom fish appeared in third and fourth place. Similarly, liver ranked among the top three contributors for AfAm, NH, Latino-US and Latino-Mexico women. Beef and lamb were also notable contributors to vitamin B-12 intake, usually ranking between third and fifth place. However, cereals (11.7–25.5%) were the single top contributor to vitamin B-12 intake in each ethnic-sex group (Table 4).

Among the ten major dietary sources of daily iron intake, the contribution of meat varied between 4.3% in Caucasian women and 14.2% in NH men (Table 5). By comparison, the contribution of cereals to total daily iron intake ranged from 13.8% in Latino-Mexico men to 30.8% in Latino-Mexico women. Cereals were followed by rice and bread, except among AfAm women and Caucasian men, for whom, pasta (with tomato sauce/cheese) and for Latino-Mexico women beans followed cereals and bread. Overall, beans contributed 1.9–3.5% to total daily iron intake for most ethnic-sex groups, except for JpAm and NH where beans did not appear among the top ten contributors to iron intake.

Cereals were also the top contributor to total daily zinc intakes across all ethnic-sex groups (8.6–20.6%), except for JpAm men for whom rice was the highest contributor (14.6%) (Table 6). However, within the top ten dietary zinc sources (which accounted for 50.7–59.9% of dietary zinc), the contribution of meat ranged from 11.1% in Caucasian women to 29.3% in NH men. Burgers, meatballs and meat patties were the third major contributor to total daily zinc intake only for AfAm men and NH women, whereas, beef and lamb or bread was the third top source of zinc intake for all the other ethnic-sex groups. Interestingly, wine was the second top contributor to zinc for Caucasian women (5.9%) and it was also one of the major dietary sources of zinc for AfAm women, Latino-Mexico and Caucasian, with a contribution ranging from 2.7% to 4.1%.

DISCUSSION

The present study examined sources of meat consumption and their respective contributions to selected mineral and vitamin intakes among the five main ethnic/racial groups in the U.S. The results indicate clear variability in major meat sources and their contributions to vitamin B-12, iron and zinc intakes by ethnicity and gender. Variations could be attributed to different geographical and cultural influences (Carrera *et al.*, 2007; Talegawkar *et al.*, 2008). For example, in this study, fish was one of the ten major sources of total meat among Latino-US, however, it was not among the top ten for Latino-Mexico. This underscores the importance of investigating dietary patterns in each ethnic group in the etiology of chronic diseases.

In the present study, the contribution of poultry exceeded that of red meat and fish among all ethnic/racial groups, except for Latino-Mexico men. It has been reported that the consumption of red meat decreased from 1980 to 2004, while the intake of poultry increased in the U.S. (Ward, 2010) and similar trends were observed in the U.K. (Prynne *et al.*, 2009). Several factors could have been responsible for these changing trends. Substitution of poultry for red meat may be related to increased perception of saturated fat content of red meat as unhealthy since the late 1970s (Eckel *et al.*, 2009). Over the past decade, the U.S. government has promoted healthier eating and food manufacturers have responded by providing foods, new or reformulated, with added healthy attributes and claims. Further, consumer awareness of basic food components increased after the passage of the 1990 Nutritional Label and Education Act (NLEA) (Yen *et al.*, 2008).

In all ethnic-sex groups, the three red meats, beef, lamb and pork, were consumed in comparable amounts, which was similar to findings from NHANES based on a sample of 15,006 U.S. adults (Wang & Beydoun, 2009). While red meat is a good source of high-quality protein and other essential nutrients, studies have found correlations to several health risks, including shorter life span and a higher risk of cardiovascular diseases, diabetes and cancer (Vang *et al.*, 2008; Halkjaer *et al.*, 2009; Lee *et al.*, 2009; Sinha *et al.*, 2009; Wang & Beydoun, 2009; Erber *et al.*, 2010). These associations could be attributable to several meat components, such as carcinogens formed in meat when cooked at a high temperature, as well as red meat's high energy and saturated fat content (Tasevska *et al.*, 2009; Wang & Beydoun, 2009). In another MEC study, red meat was a major source of energy, fat and saturated fat intake for AfAm but not other ethnic/racial groups (S. Sharma, L.R. Wilkens, L. Shen & L.N. Kolonel, unpublished data).

As a result of these health concerns, limited consumption of red meat is recommended to reduce risk of obesity, cancer and other chronic diseases (Popkin, 2009; Ford *et al.*, 2009). However, lean red meat could be a healthy alternative since it is low in saturated fat, and it is also a good source of protein, omega-3 fatty acids, vitamin B12, niacin, zinc and iron (Li *et al.*, 2005; Symons *et al.*, 2009; Welch *et al.*, 2009). Evidence suggests that lean red meat alternatives have important roles in the prevention and management of chronic diseases, including heart health, cancer and weight management (Hodgson *et al.*, 2006; McAfee *et al.*, 2010). In our study, contributions of lean red meats among the top ten varied from 9.1% to 20.4% of total red meat intake among ethnic-sex groups, and lean beef was the top red meat source among all groups, except for NH and JpAm. These findings underscore the need for a culturally appropriate nutrition education programs promoting healthy lifestyle choices to reduce the burden of chronic diseases in these populations.

Meats contributed significantly to zinc and vitamin B-12 intakes, and to a lesser extent to iron intakes. Other studies have demonstrated a high contribution of meats to iron, zinc and vitamin B-12 intakes (Cosgrove *et al.*, 2005a; 2005b; Welch *et al.*, 2009). However, in the present study, the contribution of meats to iron was lower than the contribution of cereals, rice, bread, or pastas for all ethnic-sex groups, which may be in part due to mandatory fortification of cereal and grain foods (WHO *et al.*, 2009; Beinner *et al.*, 2010; Tripathi *et al.*, 2010). Despite this finding, it is important to consider that the bioavailability of heme iron from red meat is far greater than of non-heme iron (Clark, 2008).

Analyses of the National Health and Nutrition Examination Survey (NHANES) database have highlighted areas of public health concern with regard to micronutrient status of the general U.S. population. NHANES (1999–2000) data suggested that iron intakes were generally low in females of childbearing age and young children (McClung *et al.*, 2006). The prevalence of iron deficiency is greater in non-Hispanic black and Mexican-American females (19–22%) than in non-Hispanic white females (10%) (McClung *et al.*, 2006). An analysis of NHANES III data found that 35%–45% of adults aged 60 years or older had zinc intakes below the estimated average requirement (Ervin & Kennedy-Stephenson, 2002). Meat consumption and certain minerals, including iron and zinc, have been identified as topics of interest in the etiology of certain chronic diseases including cancer, CVD, diabetes, and osteoporosis (Halkjaer *et al.*, 2009; Yamaguchi, 2009; Welch *et al.*, 2009; Chua *et al.*, 2010). Results from this paper may potentially be used to help alleviate some of these concerns through the development of food-based dietary guidelines, especially for high risk ethnic minorities. For example, recommendations for increased consumption of lean red meat and poultry could help to reduce chronic disease risks, increase iron, zinc and vitamin B-12 intakes, and is very likely to result in a diet with better nutrient quality.

Thus, understanding the associations between dietary patterns and chronic disease are important for identifying strategies to decrease chronic disease incidence, especially among different ethnic groups. Comparable and detailed information on foods contributing to meat and selected nutrient intake among the five main ethnic/racial groups in the U.S. is useful for conducting and interpreting the results of epidemiological dietary studies. One of the strengths of this paper is the use of a QFFQ developed and validated for the multiethnic population to assure standardized data collection among the five ethnic/racial groups. A standardized food grouping methodology of meats and their subgroups was used and based on the national recommendations. Furthermore, the large multiethnic sample makes it possible to study how meat consumption patterns vary between these groups. Limitations of this study include recall bias. Also, measurement error is known to be higher with FFQs compared to other methods (Ranka *et al.*, 2008). Another limitation is that the data available for the present study were collected over 15 years ago. If dietary patterns have changed over time, this may have impacted the generalisability of these results to the current populations. Thus, more recent data would be useful to determine if changes ethnic-specific changes in the dietary patterns have occurred over time.

In conclusion, the present study indicates that variability exists among major sources of meat and their contributions to vitamin B-12, iron and zinc intakes among ethnic-sex groups, which are important considerations in studies of diet and chronic disease risk. While poultry was the most commonly consumed meat source among most ethnic-sex groups, red meat was also a major source consumed, but varied by ethnic/racial group. This study adds to the limited literature on sources of meats and nutrients among different ethnic groups particularly minorities. It serves as a basis for nutrition researchers and dietitians to make culturally appropriate recommendations to improve dietary quality, for future research investigating the association between meat intake and chronic disease and for the development of food-based dietary guidelines, especially for high risk ethnic minorities.

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References

Allen LH. To what extent can food-based approaches improve micronutrient status? Asia Pac J Clin Nutr. 2008; 17:103–105. [PubMed: 18296313]

American Cancer Society. Cancer Facts & Figures. 2008 Available at: http://our.cancer.org/downloads/STT/2008CAFFfinalsecured.pdf.

Atkins, RC. Atkins for Life: The complete controlled carb program for permanent weight loss and good Health. New York, NY: St Martins Press; 2004.

Beinner MA, Velasquez-Meléndez G, Pessoa MC, Greiner T. Iron-fortified rice is as efficacious as supplemental iron drops in infants and young children. J Nutr. 2010; 140:49–53. [PubMed: 19889805]

Carrera PM, Gao X, Tucker KL. A study of dietary patterns in the Mexican-American population and their association with obesity. J Am Diet Assoc. 2007; 107:1735–1742. [PubMed: 17904933]

Chua AC, Klopcic B, Lawrance IC, Olynyk JK, Trinder D. Iron: an emerging factor in colorectal carcinogenesis. World J Gastroenterol. 2010; 16:663–672. [PubMed: 20135713]

Clark SF. Iron deficiency anemia. Nutr Clin Pract. 2008; 23:128–141. [PubMed: 18390780]

Cosgrove M, Flynn A, Kiely M. Impact of disaggregation of composite foods on estimates of intakes of meat and meat products in Irish adults. Public Health Nutr. 2005a; 8:327–337. [PubMed: 15918931]

Cosgrove M, Flynn A, Kiely M. Consumption of red meat, white meat and processed meat in Irish adults in relation to dietary quality. Br J Nutr. 2005b; 93:933–942. [PubMed: 16022764]

Eckel RH, Kris-Etherton P, Lichtenstein AH, Wylie-Rosett J, Groom A, Stitzel KF, et al. Americans' awareness, knowledge, and behaviors regarding fats: 2006–2007. J Am Diet Assoc. 2009; 109:288–296. [PubMed: 19167956]

Erber E, Hopping BN, Grandinetti A, Park SY, Kolonel LN, Maskarinec G. Dietary patterns and risk for diabetes: the multiethnic cohort. Diabetes Care. 2010; 33:532–538. [PubMed: 20007939]

Ervin RB, Kennedy-Stephenson J. Mineral intakes of elderly adult supplement and non-supplement users in the third national health and nutrition examination survey. J Nutr. 2002; 132:3422–3427. [PubMed: 12421862]

Ford ES, Bergmann MM, Kröger J, Schienkiewitz A, Weikert C, Boeing H. Healthy living is the best revenge: findings from the European prospective investigation into cancer and nutrition-potsdam study. Arch Intern Med. 2009; 169:1355–1362. [PubMed: 19667296]

Gardner CD, Kiazand A, Alhassan S, Kim S, Stafford RS, Balise RR, et al. Comparison of the Atkins, Zone, Ornish, and LEARN diets for change in weight and related risk factors among overweight premenopausal women: the A to Z weight loss study: a randomized trial. JAMA. 2007; 297:969–977. [PubMed: 17341711]

Halkjaer J, Olsen A, Bjerregaard LJ, Deharveng G, Tjønneland A, Welch AA, et al. Intake of total, animal and plant proteins, and their food sources in 10 countries in the European prospective Investigation into cancer and nutrition. Eur J Clin Nutr. 2009; 63(Suppl. 4):S16–S36. [PubMed: 19888272]

Hodgson JM, Burke V, Beilin LJ, Puddey IB. Partial substitution of carbohydrate intake with protein intake from lean red meat lowers blood pressure in hypertensive persons. Am J Clin Nutr. 2006; 83:780–787. [PubMed: 16600928]

Kolonel LN, Henderson BE, Hankin JH, Nomura AM, Wilkens LR, Pike MC, et al. A multiethnic cohort in Hawaii and Los Angeles: baseline characteristics. Am J Epidemiol. 2000; 151:346–357. [PubMed: 10695593]

Lee SA, Shu XO, Yang G, Li H, Gao YT, Zheng W. Animal origin foods and colorectal cancer risk: a report from the Shanghai Women's Health Study. Nutr Cancer. 2009; 61:194–205. [PubMed: 19235035]

Leitzmann C. Vegetarian diets: what are the advantages? Forum Nutr. 2005; 57:147–156. [PubMed: 15702597]

Li D, Siriamornpun S, Wahlqvist ML, Mann NJ, Sinclair AJ. Lean meat and heart health. Asia Pac J Clin Nutr. 2005; 14:113–119. [PubMed: 15927927]

Lobo JC, Torres JP, Fouque D, et al. Zinc deficiency in chronic kidney disease: Is there a relationship with adipose tissue and atherosclerosis? Biol Trace Elem Res. 2010; 135:16–21. [PubMed: 19760368]

McAfee AJ, McSorley EM, Cuskelly GJ, Moss BW, Wallace JM, Bonham MP, et al. Fearon AM. Red meat consumption: an overview of the risks and benefits. Meat Sci. 2010; 84:1–13. [PubMed: 20374748]

McClung JP, Marchitelli LJ, Friedl KE, Young AJ. Prevalence of iron deficiency and iron deficiency anemia among three populations of female military personnel in the US Army. J Am Coll Nutr. 2006; 25:64–69. [PubMed: 16522934]

Mozaffarian D. Fish, mercury, selenium and cardiovascular risk: current evidence and unanswered questions. Int J Environ Res Public Health. 2009; 6:1894–1916. [PubMed: 19578467]

National Center for Health Statistics. Health, United States, 2008. 2009. Available at: http://www.cdc.gov/nchs/data/hus/hus08.pdf

Popkin BM. Reducing meat consumption has multiple benefits for the world's health. Arch Intern Med. 2009; 169:543–545. [PubMed: 19307515]

Pot GK, Majsak-Newman G, Geelen A, Harvey LJ, Nagengast FM, Witteman BJ, et al. Fish consumption and markers of colorectal cancer risk: a multicenter randomized controlled trial. Am J Clin Nutr. 2009; 90:354–361. [PubMed: 19553301]

Prasad AS. Zinc: role in immunity, oxidative stress and chronic inflammation. Curr Opin Clin Nutr Metab Care. 2009; 12:646–652. [PubMed: 19710611]

Prynne CJ, Wagemakers JJ, Stephen AM, Wadsworth ME. Meat consumption after disaggregation of meat dishes in a cohort of British adults in 1989 and 1999 in relation to diet quality. Eur J Clin Nutr. 2009; 63:660–666. [PubMed: 18285805]

Ranka S, Gee JM, Biro L, Brett G, Saha S, Kroon P, et al. Development of a food frequency questionnaire for the assessment of quercetin and naringenin intake. Eur J Clin Nutr. 2008; 62:1131–1138. [PubMed: 17538531]

Sharma S, Murphy S, Wilkens L. Extending a multiethnic food composition table to include standardized food group servings. J Food Compost Anal. 2003; 104:485–495.

Sharma S, Murphy S, Wilkens L. Adherence to the food guide pyramid recommendations among African Americans and Latinos: results from the Multiethnic Cohort. J Am Diet Assoc. 2004; 104:1873–1877. [PubMed: 15565084]

Sinha R, Cross AJ, Graubard BI, Leitzmann MF, Schatzkin A. Meat intake and mortality: a prospective study of over half a million people. Arch Intern Med. 2009; 169:562–571. [PubMed: 19307518]

Stram DO, Hankin JH, Wilkens LR, Henderson B, Kolonel LN. Calibration of the dietary questionnaire for a multiethnic cohort in Hawaii and Los Angeles. Am J Epidemiol. 2000; 151:358–370. [PubMed: 10695594]

Symons TB, Sheffield-Moore M, Wolfe RR, Paddon-Jones D. A moderate serving of high-quality protein maximally stimulates skeletal muscle protein synthesis in young and elderly subjects. J Am Diet Assoc. 2009; 109:1582–1586. [PubMed: 19699838]

Talegawkar SA, Johnson EJ, Carithers TC, Taylor HA Jr, Bogle ML, Tucker KL. Serum carotenoid and tocopherol concentrations vary by dietary pattern among African Americans. J Am Diet Assoc. 2008; 108:2013–2020. [PubMed: 19027404]

Tasevska N, Sinha R, Kipnis V, Subar AF, Leitzmann MF, Hollenbeck AR, et al. A prospective study of meat, cooking methods, meat mutagens, heme iron, and lung cancer risks. Am J Clin Nutr. 2009; 89:1884–1894. [PubMed: 19369370]

Tripathi B, Platel K. Finger millet (Eleucine coracana) flour as a vehicle for fortification with zinc. J Trace Elem Med Biol. 2010; 24:46–51. [PubMed: 20122580]

US Department of Agriculture, Economic Research Service. [Accessed January 15, 2010] Data: food consumption (per capita) data system. 2010. Available at; http://www.ers.usda.gov/Data/FoodConsumption

Vaes BL, Lute C, Blom HJ, Bravenboer N, de Vries TJ, Everts V, et al. Vitamin B (12) deficiency stimulates osteoclastogenesis via increased homocysteine and methylmalonic acid. Calcif Tissue Int. 2009; 84:413–422. [PubMed: 19363664]

Vang A, Singh PN, Lee JW, Haddad EH, Brinegar CH. Meats, processed meats, obesity, weight gain and occurrence of diabetes among adults: findings from Adventist Health Studies. Ann Nutr Metab. 2008; 52:96–104. [PubMed: 18349528]

Wang Y, Beydoun MA. Meat consumption is associated with obesity and central obesity among US adults. Int J Obes. 2009; 33:621–628.

Wang Y, Beydoun MA, Caballero B, Gary TL, Lawrence R. Trends and correlates in meat consumption patterns in the US adult population. Public Health Nutr. 2010:1–13. [PubMed: 20015421]

Ward CE. Twenty-Five year meat consumption and price trends. 2006 Available at; http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-2859/AGEC-603web.pdf.

Welch AA, Fransen H, Jenab M, Boutron-Ruault MC, Tumino R, Agnoli C, et al. Variation in intakes of calcium, phosphorus, magnesium, iron and potassium in 10 countries in the European Prospective Investigation into Cancer and Nutrition study. Eur J Clin Nutr. 2009; 63(Suppl. 4):S101–S121. [PubMed: 19888269]

WHO, FAO, UNICEF, GAIN, MI, FFI. Meeting Report: Interim Consensus Statement. Geneva: WHO; 2009. Recommendations on wheat and maize flour fortification.

Yamaguchi M. Role of nutritional zinc in the prevention of osteoporosis. Mol Cell Biochem. 2009; 338:241–254. [PubMed: 20035439]

Yen ST, Lin BH, Davis CG. Consumer knowledge and meat consumption at home and away from home. Food Policy. 2008; 33:31–39.

Table 1

Characteristics of the participants by ethnicity and gender

	African Americans	Native Hawaiians	Japanese Americans	Latino-Mexico	Latinos-US	Caucasians
Men						
n	11,722	5,979	25,893	10,180	10,613	21,933
Age (years)	62 ± 8.9	57 ± 8.7	61 ± 9.2	59 ± 7.7	61 ± 7.6	59 ± 9.1
Body Mass Index (kg/m^2)	26.7 ± 4.3	28.5 ± 5.1	24.7 ± 3.3	26.7 ± 3.7	26.7 ± 4.1	26.0 ± 4.0
Energy (kcal/day)	$2,194 \pm 1,166$	$2,760 \pm 1,311$	$2,255 \pm 833$	$2,716 \pm 1,401$	$2,468 \pm 1,261$	$2,283 \pm 899$
Women						
n	20,130	7,650	25,355	10,903	11,255	25,303
Age	61 ± 9.0	56 ± 8.7	61 ± 8.9	58 ± 7.6	60 ± 7.9	59 ± 9.0
Body Mass Index (kg/m^2)	28.4 ± 5.8	28.0 ± 6.1	23.1 ± 3.8	27.0 ± 4.8	27.6 ± 5.4	25.2 ± 5.2
Energy (kcal/day)	$1,879 \pm 993$	$2,370 \pm 1,263$	$1,808 \pm 678$	$2,316 \pm 1,238$	$2,056 \pm 1,104$	$1,805 \pm 703$

Table 2

Top ten sources of meat and relative contributions (%) to total meat consumption by ethnicity and gender

	African Americans		Native Hawaiians		Japanese Americans		Latino-Mexico		Latino-US		Caucasians	
	Food items	%	Foods items	%	Foods items	%	Foods items	%	Foods items	%	Foods items	%
Men	Chicken wings (with skin)	5.3	Canned tuna fish	5.0	Baked/broiled/raw fish	5.4	Broth with noodles or rice	6.0	Roasted/baked chicken *	5.2	Roasted/baked chicken *	7.3
	Chicken wings *	4.7	Baked/broiled/raw fish	4.6	Stew /curry (with beef/lamb)	4.8	Mexican meat soup or stew	4.5	Beef steak/roast (lean only)	4.9	Beef steak/roast (lean only)	4.6
	Roasted/baked chicken *	4.6	Stew/curry (with beef/lamb)	4.5	Canned tuna fish	4.5	Beef steak/Roast (lean only)	4.2	Chili	4.7	Canned tuna fish	4.3
	Roasted/baked chicken (with skin)	4.4	Broth with noodles or rice	3.9	Stir-fried beef/ pork **	4.1	Arroz Con Pollo	4.0	Mexican meat soup or stew	3.8	Baked/broiled/raw fish	4.1
	Fried chicken (with skin)	4.2	Stir-fried beef/ pork **	3.6	Stir-fried chicken **	4.0	Chili	3.9	Meat burritos	3.8	Roasted/baked chicken (with skin)	3.4
	Beef steak/roast (lean only)	3.3	Stir-fried chicken **	3.3	Broth with noodles or rice	4.0	Roasted/baked chicken *	3.9	Broth with noodles or rice	3.5	Broth with noodles or rice	3.0
	Broth with noodles or rice	3.2	Fried fish	3.0	Fried fish	4.0	Dried bean or pea soup	3.8	Chicken wings *	3.1	Turkey *	2.9
	Chicken/turkey hot dogs	3.1	Roasted/baked chicken *	3.0	Roasted/baked chicken *	3.7	Stew/curry (with beef/lamb)	3.6	Chicken/turkey hot dogs	2.9	Chicken/turkey hot dogs	2.8
	Fried chicken *	2.9	Fried chicken (with skin)	2.9	Fried chicken *	3.3	Stir-fried beef / pork **	3.5	Canned tuna fish	2.7	Stew/curry (with beef/lamb)	2.8
	Canned tuna fish	2.6	Roasted/baked chicken (with skin)	2.6	Fried chicken (with skin)	2.9	Fried chicken *	3.5	Fried chicken *	2.7	Fried chicken *	2.6
Total (%)		**38.3**		**36.3**		**40.7**		**40.9**		**37.3**		**37.8**
Women	Chicken wings *	7.2	Canned tuna fish	5.4	Roasted/baked chicken *	6.2	Broth with noodles or rice	7.5	Roasted/baked chicken *	8.1	Roasted/baked chicken *	12.2
	Roasted/baked chicken *	7.0	Baked/broiled/raw fish	4.3	Stir-fried chicken **	5.5	Roasted/baked chicken *	5.9	Chicken wings *	5.3	Canned tuna fish	5.0
	Chicken wings (with skin)	6.8	Roasted/baked chicken *	4.2	Baked/broiled/raw fish	5.3	Mexican meat soup or stew	4.3	Chili	4.5	Beef steak/roast – (lean only)	4.7
	Roasted/baked Chicken (with skin)	5.7	Broth with noodles or rice	4.2	Stir-fried beef/pork **	4.9	Arroz Con Pollo	4.3	Beef steak/roast (lean only)	4.4	Baked/broiled/raw Fish	4.3
	Fried chicken (with skin)	3.7	Stew/curry (with beef/lamb)	3.9	Canned tuna fish	4.8	Chicken wings *	4.2	Mexican meat soup or	4.2	Turkey *	4.0

	African Americans		Native Hawaiians		Japanese Americans		Latino-Mexico		Latino-US		Caucasians	
	Food items	%	Foods items	%	Foods items	%	Foods items	%	Foods items	%	Foods items	%
	Broth with noodles or rice	3.1	Stir-fried beef/pork **	3.9	Broth with noodles or rice	4.7	Dried bean or pea soup	4.0	Broth with noodles or Rice stew	3.8	Roasted/baked chicken (with skin)	3.4
	Canned tuna fish	3.1	Stir-fried chicken **	3.6	Stew/curry (with beef/lamb)	4.1	Beef steak/roast (lean only)	3.9	Canned tuna fish	3.4	Chicken wings *	3.2
	Turkey (no skin)	3.1	Chicken wings *	3.2	Fried fish	3.8	Fried chicken *	3.9	Meat burritos	3.0	Broth with noodles or rice	3.1
	Fried chicken *	2.7	Fried fish	2.8	Fried chicken *	3.6	Stir-fried chicken **	3.7	Fried chicken *	2.9	Stir-fried chicken **	2.9
	Beef steak/roast (lean only)	2.5	Meat loaf/ meatballs/patties	2.7	Chicken wings *	3.6	Tomato or vegetables soup	3.5	Arroz Con Pollo	2.8	Meat loaf/meatballs/ patties	2.6
Total (%)		44.9		38.2		46.5		45.2		42.4		45.4

*
without skin;

**
including vegetables

Table 3

Top ten sources of red meat and relative contributions (%) to total red meat consumption by ethnicity and gender

	African Americans		Native Hawaiians		Japanese Americans		Latino-Mexico		Latino-US		Caucasians	
	Food items	%	Foods items	%	Foods items	%	Foods items	%	Foods items	%	Foods items	%
Men	Beef steak/roast (lean only)	9.8	Stew/Curry (with beef/lamb)	11.5	Stew/Curry (with beef/lamb)	13.1	Beef steak/roast (lean only)	10.4	Beef steak/roast (lean only)	11.9	Beef steak/roast (lean only)	12.2
	Meatloaf/Meat-balls/Patties	6.5	Stir-Fried Beef/pork*	9.2	Stir-fried beef/pork*	11.3	Chili	9.5	Chili	11.1	Stew/Curry-with beef/lamb	7.4
	Spareribs	5.6	Beef steak/roast (regular)	6.3	Beef steak/roast (lean only)	7.8	Stew/Curry (with beef/Lamb)	8.9	Meat burritos	7.0	Meat loaf/Meat-balls/Patties	6.6
	Pork chops/Roast (lean only)	5.4	Meat loaf/Meat-balls/Patties	6.1	Meat loaf/Meat-balls/Patties	6.1	Stir-fried beef/Pork*	8.8	Tacos/Tostadas (beef/pork)	5.3	Stir-fried beef/ pork*	6.3
	Stew/Curry (with beef/lamb)	5.4	Beef steak/roast - lean only	5.4	Beef steak/roast (Regular)	4.6	Dried bean or pea soup	6.1	Pork chops/roast-lean only	5.1	Beef steak/roast (regular)	5.7
	Stir-fried beef/ pork*	4.4	Pork chops/ roasts (regular)	4.5	Hamburgers	4.1	Meat burritos	5.7	Stir-fried beef/pork/ vegetables	5.0	Hamburgers	5.1
	Beef steak/roast (regular)	4.4	Spareribs	4.1	Spareribs	4.1	Tacos/Tostadas (beef/pork)	5.1	Meat loaf/Meat-balls/Patties	5.0	Chili	5.0
	Hamburgers	4.1	Pork and greens or laulaus	3.8	Pork chops/ roasts - lean only	4.0	Beef steak/roast (regular)	4.8	Beef steak/roast (regular)	4.8	Pork Chops/roast (lean only)	4.9
	Chili	3.9	Pork chops/Roast - lean only	3.7	Chili	3.7	Meat loaf/Meat-balls/Patties	3.7	Stew/Curry(with beef/Lamb)	3.6	Cheeseburgers	3.2
	Pork and Greens or Laulaus	3.3	Chili	3.6	Corned beef - lean only	3.3	Pork chops/roast-(lean only)	3.3	Hamburgers	3.4	Spareribs	3.0
Total (%)		**52.8**		**58.2**		**62.1**		**66.3**		**63.1**		**59.4**
Women	Beef steak/roast (lean only)	9.3	Stew/Curry (with beef/lamb)	10.5	Stir-fried beef/ pork*	14.5	Beef Steak/roast (lean only)	11.3	Beef steak/roast (lean only)	12.0	Beef steak/roast (lean only)	14.3
	Meat loaf/Meat-balls/Patties	7.6	Stir-fried beef/ pork*	10.4	Stew/Curry (with beef/lamb)	12.1	Chili	9.2	Chili	12.0	Meat loaf/Meat-balls/Patties	8.0
	Spareribs	5.5	Meat loaf/Meat-balls/Patties	7.2	Beef steak/roast (lean only)	9.0	Stir-fried beef/ pork*	8.3	Meat burritos	6.2	Stir-fried beef/ pork*	7.1
	Pork chops/ Roast (lean only)	5.4	Beef steak/roast (lean only)	6.0	Meat loaf/Meat-balls/Patties	7.1	Stew/Curry (with beef/lamb)	7.8	Meat loaf/Meat-balls/Patties	6.2	Stew/Curry (with beef/lamb)	6.5
	Stir-fried Beef/ pork*	5.1	Beef steak/roast (regular)	4.4	Pork chops/ roasts (lean only)	4.6	Dried bean or pea soup	7.3	Tacos/Tostadas (beef/pork)	6.1	Pork chops/roast (lean only)	6.1

African Americans		Native Hawaiians		Japanese Americans		Latino-Mexico		Latino-US		Caucasians	
Food items	%	Foods items	%	Foods items	%	Foods items	%	Foods items	%	Foods items	%
Stew/Curry (with beef/lamb)	4.7	Pork chops/ roasts (lean only)	4.4	Spareribs	3.8	Tacos/Tosdadas (beef/pork)	5.4	Stir-fried Beef/pork *	5.6	Chili	4.7
Pork and greens or laulaus	4.5	Pork and greens or laulaus	3.9	Corned beef (lean only)	3.5	Meat loaf/Meat-balls/Patties	5.1	Pork chops/roasts (lean only)	5.5	Hamburgers	3.8
Tacos/Tosdadas (beef/pork)	4.2	Spareribs	3.9	Chow mein/Chow fun/Yakisoba	3.2	Tomato or vegetable soup	4.3	Stew/Curry(with beef/lamb)	4.0	Taco/Tostadas (beef/pork)	3.8
Chili	3.7	Chili	3.5	Chili	3.2	Meat burritos	4.1	Beef steak/roast (regular)	3.6	Beef steak/ roast (regular)	3.8
Beef steak/roast (regular)	3.4	Hamburgers	3.4	Hamburgers	2.7	Beef steak/roast (regular)	4.0	Mexican meat soup or stew	3.3	Spaghetti/Ravioli/ Lasagna	3.8
Total (%)	53.4		57.6		63.7		66.8		64.5		61.9

*
including vegetables

Table 4

Top ten food sources and relative contributions (%) to daily vitamin B-12 intakes by ethnicity and gender

	African Americans Food items	%	Native Hawaiians Foods items	%	Japanese Americans Foods items	%	Latino-Mexico Foods items	%	Latino-US Foods items	%	Caucasians Foods items	%
Men	cereals	21.1	cereals	14.6	cereals	17.1	cereals	11.7	cereals	17.1	cereals	20.3
	fish	7.7	fish	12.9	fish	14.2	beef & lamb	9.3	fish	9.3	fish	7.6
	liver	6.7	liver	6.5	beef & lamb	6.2	fish	7.6	liver	6.3	pasta with TS or cheese	7.5
	burg. MB / patties	6.6	beef & lamb	6.3	burg. MB / patties	5.9	veg. soups	5.5	beef & lamb	6.2	burg. MB / patties	6.0
	veg. soups	5.3	burg. MB / patties	6.2	shrimp/shellfish	5.1	low-fat milk	5.2	burg. MB / patties	5.2	beef & lamb	5.3
	pasta with TS or cheese	5.2	shrimp/ shellfish	5.0	veg. soups	4.7	burg. MB / patties	4.9	pasta with TS or cheese	5.1	veg. soups	4.7
	beef & lamb	4.6	veg. soups	4.5	pasta with TS or cheese	4.1	liver	4.4	veg. soups	4.8	low-fat milk	4.7
	shrimp/ shellfish	4.5	pasta with TS or cheese	4.1	liver	3.8	meat soups/stew	3.8	shrimp/shellfish	4.3	liver	4.2
	low-fat milk	3.7	low-fat milk	3.4	nonfat milk	3.3	pasta with TS or cheese	3.3	low-fat milk	4.2	nonfat milk	3.7
	HD-spam - bologna-other	2.8	HD-spam-bologna-other	3.1	meat soups/stew	3.2	taco salad	3.2	HD-spam - bologna	4.2	shrimp/shellfish	3.6
Total (%)		68.2		66.6		67.6		61.3		65.4		67.6
Women	cereals	23.2	cereals	16.6	cereals	19.5	cereals	25.5	cereals	19.7	cereals	21.6
	fish	8.8	fish	11.8	fish	13.3	low-fat milk	5.8	fish	8.9	pasta with TS or cheese	7.8
	liver	7.6	liver	7.6	nonfat milk	6.1	liver	5.8	liver	6.2	fish	7.5
	pasta with TS or cheese	5.4	burg. MB / patties	5.8	burg. MB / patties	5.0	fish	4.9	pasta with TS or cheese	6.0	nonfat milk	6.0
	low-fat milk	4.5	beef & lamb	5.0	beef & lamb	4.9	burg. MB / patties	4.7	veg. soups	4.9	low-fat milk	5.2
	burg. MB / patties	4.3	pasta with TS or cheese	4.7	pasta with TS or cheese	4.2	nonfat milk	4.6	burg. MB / patties	4.9	burg. MB / patties	4.4
	beef & lamb	3.9	veg. soups	4.5	veg. soups	4.2	pasta with TS or cheese	4.4	beef & lamb	4.9	beef & lamb	4.2
	shrimp/ shellfish	3.6	shrimp/shellfish	4.2	shrimp/shellfish	4.0	beef & lamb	4.3	low-fat milk	4.2	liver	4.0

African Americans		Native Hawaiians		Japanese Americans		Latino-Mexico		Latino-US		Caucasians	
Food items	**%**	**Foods items**	**%**	**Foods items**	**%**	**Foods items**	**%**	**Foods items**	**%**	**Foods items**	**%**
veg. soups	3.1	low-fat milk	4.1	low-fat milk	3.9	veg. soups	4.1	shrimp/shellfish	3.7	veg. soups	3.9
yogurt	3.1	nonfat milk	3.3	stir-fried MT & Veg	3.0	yogurt	3.0	nonfat milk	3.4	yogurt	3.5
Total (%)	**67.5**		**67.6**		**68.5**		**67.1**		**66.8**		**68.1**

TS=Tomato sauce; MB=meat ball; Veg=vegetables; MT=meat; HD=hot dog; burg.=burgers

Table 5

Top ten food sources and relative contributions (%) to daily iron intakes by ethnicity and gender

	African Americans		Native Hawaiians		Japanese Americans		Latino-Mexico		Latino-US		Caucasians	
	Food items	%	Foods items	%	Foods items	%	Foods items	%	Foods items	%	Foods items	%
Men	cereals	26.0	cereals	20.1	cereals	21.1	cereals	13.8	cereals	22.1	cereals	26.8
	bread	9.7	bread	8.9	rice	11.0	bread	13.4	bread	9.3	bread	9.8
	rice	3.6	rice	7.7	bread	8.1	rice	4.2	rice	6.9	pasta with TS or cheese	5.0
	burg. MB / patties	3.6	burg. MB / patties	3.4	burg. MB / patties	2.8	muffins/ dough-nuts	3.6	pasta with TS or cheese	3.5	burg. MB / patties	3.2
	pasta with TS or cheese	3.5	pasta with TS or cheese	2.7	pasta with TS or cheese	2.7	beans	3.5	burg. MB /patties	3.3	rice	2.9
	chicken/turkeys	3.3	chicken/turkeys	2.4	chicken/ turkeys	2.6	taco salad	3.3	chicken/turkeys	2.6	chicken/turkeys	2.2
	beans	2.6	stir-fried MT & Veg	2.2	stir-fried MT & Veg	2.6	meat burritos	2.9	beans	2.2	beans	2.0
	veg. soups	1.7	beef & lamb	2.2	fish	2.1	beef & lamb	2.8	beef & lamb	2.1	beef & lamb	1.8
	crackers/ chips/ popcorn	1.6	fish	2.1	meat soups/stew	1.9	pasta with TS or cheese	2.7	stir-fried MT & Veg	1.9	crackers/ chips/popcorn	1.6
	beef & lamb	1.5	meat soups/stew	1.9	beef & lamb	1.9	burg. MB / patties	1.9	meat soups/stew	1.8	veg. soups	1.6
Total (%)		57.1		53.6		56.8		52.7		55.7		56.9
Women	cereals	26.4	cereals	22.5	cereals	22.6	cereals	30.8	cereals	24.3	cereals	26.6
	bread	9.0	bread	9.3	bread	9.3	bread	6.9	bread	10.1	bread	11.0
	pasta with TS or cheese	4.1	rice	5.3	rice	8.3	beans	3.4	rice	5.2	pasta with TS or cheese	5.1
	chicken/ turkeys	3.1	pasta with TS or cheese	3.2	pasta with TS or cheese	3.0	pasta with TS or cheese	3.2	pasta with TS or cheese	3.8	rice	2.2
	beans	2.5	burg. MB / patties	3.0	stir-fried MT & Veg	2.7	rice	2.6	chicken/turkeys	2.4	chicken/turkeys	2.2
	rice	2.4	chicken/turkeys	2.2	dark greens	2.5	chicken/turkeys	2.5	burg. MB / patties	2.3	burg. MB / patties	2.1
	crackers/ chips/ popcorn	2.4	stir-fried MT & Veg	2.2	chicken/turkeys	2.2	fortified diet beverages	2.2	stir-fried MT & Veg	2.2	dark greens	2.0
	burg. MB / patties	2.1	dark greens	2.0	burg. MB / patties	2.1	burg. MB / patties	2.1	beans	2.2	beans	1.9
	dark greens	2.0	fish	1.9	tofu	1.8	veg. soups	1.9	dark greens	1.9	crackers and pretzels	1.7

	African Americans		Native Hawaiians		Japanese Americans		Latino-Mexico		Latino-US		Caucasians	
	Food items	%	Foods items	%	Foods items	%	Foods items	%	Foods items	%	Foods items	%
	stir-fried MT & Veg	1.8	beef & lamb	1.7	fish	1.7	pizza	1.9	veg. soups	1.8	crackers/chips/popcorn	1.6
Total (%)	55.8		53.3		56.2		57.5		56.2		56.4	

TS=Tomato sauce; MB=meat ball; Veg=vegetables; MT=meat; burg.=burger.

Table 6

Top ten food sources and relative contributions (%) to daily zinc intakes by ethnicity and gender

	African Americans	%	Native Hawaiians	%	Japanese Americans	%	Latino-Mexico	%	Latino-US	%	Caucasians	%
Men	cereals	17.4	cereals	12.7	rice	14.6	cereals	8.6	cereals	14.0	cereals	17.0
	chicken/turkeys	5.7	rice	9.9	cereals	13.1	beef & lamb	7.0	rice	8.8	burg. MB / patties	5.1
	burg. MB / patties	5.5	beef & lamb	5.7	beef & lamb	4.9	bread	5.9	beef & lamb	5.3	bread	4.9
	bread	5.3	burg. MB / patties	5.3	chicken/turkeys	4.5	taco salad	5.3	burg. MB / patties	5.1	beef & lamb	4.7
	rice	5.0	bread	4.4	burg. MB / patties	4.4	meat soups/stew	5.2	chicken/turkeys	4.5	pasta with TS or cheese	4.1
	beef & lamb	3.9	meat soups/stew	4.2	meat soups/stew	4.4	rice	4.4	bread	4.5	chicken/turkeys	4.1
	pork & ham	3.2	chicken/ turkeys	4.1	bread	4.1	wine	4.1	meat soups/stew	3.9	rice	3.9
	shrimp/shellfish	3.1	pork & ham	3.4	stir-fried MT & Veg	3.6	meat burritos	3.8	pork & ham	3.0	wine	3.8
	pasta with TS or cheese	3.0	shrimp/shellfish	3.4	shrimp/shellfish	3.6	chicken/turkeys	3.7	shrimp/shellfish	2.9	shrimp/ shellfish	2.4
	meat soups/stew	2.2	stir-fried MT & Veg	3.2	pork & ham	2.7	burg. MB / patties	3.6	pasta with TS or cheese	2.8	pork & ham	2.4
Total (%)		51.2		56.3		59.9		51.6		54.8		52.4
Women	cereals	18.3	cereals	14.6	cereals	14.6	cereals	20.6	cereals	15.8	cereals	17.3
	chicken/turkeys	5.9	rice	7.2	rice	12.1	chicken/turkeys	4.8	rice	6.8	wine	5.9
	bread	4.9	burg. MB / patties	4.9	bread	5.1	bread	3.8	bread	5.3	bread	5.7
	pasta with TS or chee	3.6	bread	4.8	chicken/turkeys	4.4	burg. MB / patties	3.7	chicken/turkeys	4.5	pasta with TS or cheese	4.3
	rice	3.5	beef & lamb	4.5	stir-fried MT & Veg	4.1	beef & lamb	3.5	beef & lamb	4.0	chicken/turkeys	4.2
	burg. MB / patties	3.5	chicken/turkeys	4.1	beef & lamb	3.7	wine	3.3	burg. MB / patties	3.9	burg. MB / patties	3.5
	crackers/chips/ popcorn	3.3	meat soups/stew	3.4	burg. MB / patties	3.6	rice	2.9	pasta with TS or cheese	3.2	beef & lamb	3.4
	beef & lamb	3.2	stir-fried MT & Veg	3.2	meat soups/stew	3.3	cheese	2.8	meat soups/stew	3.2	rice	3.2
	wine	2.7	shrimp/shellfish	2.9	shrimp/shellfish	2.8	pork & ham	2.7	stir-fried MT & Veg	3.2	cheese	2.6

African Americans		Native Hawaiians		Japanese Americans		Latino-Mexico		Latino-US		Caucasians	
Food items	%	Foods items	%	Foods items	%	Foods items	%	Foods items	%	Foods items	%
stir-fried MT & Veg	2.6	pork & ham	2.8	pasta with TS or cheese	2.5	pasta with TS or cheese	2.6	shrimp/shellfish	2.8	nonfat milk	2.4
Total (%)	**51.5**		**52.4**		**56.2**		**50.7**		**52.7**		**52.5**

TS=Tomato sauce; MB=meatball; Veg=vegetables; MT=meat; burg.=burger.