Dietary sources of five nutrients in ethnic groups represented in the Multiethnic Cohort

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Abstract

Data are limited on how dietary sources of energy and nutrient intakes differ among ethnic groups in the USA. The objective of the present study was to characterise dietary sources of energy, total fat, saturated fat, protein, dietary fibre and added sugar for five ethnic groups. A validated quantitative FFQ was used to collect dietary data from 186 916 men and women aged 45–75 years who were living in Hawaii and Los Angeles between 1993 and 1996. Participants represented five ethnic groups: African-American; Japanese-American; Native Hawaiian; Latino; Caucasian. The top ten dietary sources of energy contributed 36·2–49·6 % to total energy consumption, with rice and bread contributing the most (11·4–27·8 %) across all ethnic–sex groups. Major dietary sources of total fat were chicken/turkey dishes and butter among most groups. Ice cream, ice milk or frozen yogurt contributed 4·6–6·2 % to saturated fat intake across all ethnic–sex groups, except Latino-Mexico women. Chicken/turkey and bread were among the top dietary sources of protein (13·9–19·4 %). The top two sources of dietary fibre were bread and cereals (18·1–22 %) among all groups, except Latino-Mexico men. Regular sodas contributed the most to added sugar consumption. The present study provides, for the first time, data on the major dietary sources of energy, fat, saturated fat, protein, fibre and added sugar for these five ethnic groups in the USA. Such data are valuable for identifying target foods for nutritional intervention programmes and directing public health strategies aimed at reducing dietary risk factors for chronic disease.

Key words: Dietary sources: Nutrients: Ethnicity: Multiethnic Cohort

Cancer, CVD and diabetes ranked among the top ten causes of deaths in the USA in 2010[1]. Although chronic disease mortality has declined in recent years[2], widespread prevalence of these diseases remains a critical public health concern. While genetic susceptibility plays an important role in the development of chronic disease, modifiable factors, such as diet, are key determinants[3]. Mokdad *et al.*[3] attributed an estimated 400 000 deaths in the USA in 2000 to poor diet and physical inactivity and projected more than 500 000 deaths when the effects of overweight on mortality among the 1999–2000 estimates were realised. Substantial evidence supports that poor diet is a preventable risk factor for the development of numerous chronic diseases, and improving diet could result in a decrease in the incidence of and mortality from CVD, cancer and other diet-related chronic conditions[3–7].

The US Department of Agriculture (USDA), the American Heart Association, the National Cancer Institute and the American Diabetes Association advise the US population that meeting recommended nutrient intakes within energy requirements will help reduce the risk for a number of chronic diseases[8–12]. Jointly developed by the US Department of Health and Human Services and the USDA, the Dietary Guidelines for Americans 2010 suggest following a healthful diet by consuming foods to meet nutrient needs in accordance with the Institute of Medicine recommendations[9]. Furthermore, the dietary guidelines recommend to keep the total fat intake between 20 and 35 % of energy, consuming less than 10 % of energy from saturated fat, selecting lean meat and poultry, and choosing carbohydrates, such as fibre-rich fruits, vegetables and whole grains as part of a healthful diet[9].

To date, data are limited on dietary sources of energy, total fat, saturated fat, protein, dietary fibre and added sugar among minority ethnic/racial groups in the USA, including African-American, Native Hawaiian, Japanese-American and Latino. Such data are necessary to illustrate how dietary consumption patterns vary between ethnic/racial groups and how these

differences may be associated with chronic disease outcomes. Disproportionate rates of diet-related chronic diseases, such as obesity, are observed among minority ethnic/racial groups compared with Caucasian populations[13], yet few large-scale studies have been attempted to identify dietary sources of energy and nutrients among different ethnic/racial groups, particularly minorities, in the USA.

The aim of the present study was to characterise the major dietary sources of energy, total fat, saturated fat, dietary fibre and added sugar among the main ethnic/racial groups in the Multiethnic Cohort (MEC). The present results intend to highlight similarities and differences in the types of foods that are consumed as well as the percentage contribution of dietary sources to total energy and selected nutrients by comparing intakes across all ethnic–sex groups represented in the study population.

Methods

The MEC was established in Hawaii and Los Angeles County, California to investigate the associations between diet and cancer among five ethnic/racial groups in the USA: African-Americans (AfAm); Native Hawaiians (NH); Japanese-Americans (JpAm); Latinos (born in Mexico and Central/South America – Latino-Mexico; born in the USA – Latino-US); Caucasians. Study design, recruitment procedures and baseline characteristics have been reported elsewhere[14]. In brief, more than 215 000 men and women aged 45–75 years representing the five ethnic/racial groups were enrolled into the MEC study between 1993 and 1996. Ethnicity was self-defined.

Data were collected using a mailed self-administered questionnaire that was specifically developed for the MEC study[14]. The twenty-six-page questionnaire included a seventeen-page quantitative FFQ (QFFQ) that collected data on the consumption of more than 180 food items over the past year. The QFFQ was developed from 3 d measured dietary records from sixty men and sixty women of each of the five ethnic/racial groups[14,15]. Foods that contributed to more than 85 %

of the intake of fat, dietary fibre, vitamin A, carotenoids and vitamin C were listed on the QFFQ. Ethnic-specific foods were also included irrespective of their contribution to the diet. The QFFQ measured the amount of food consumed based on a choice of three portion sizes (represented in photographs) specific to each food item listed on the QFFQ and the usual intake frequency based on the categories ranging from 'never or hardly ever' to '2 or more times a day'. A sub-study was conducted to validate and calibrate the QFFQ using three repeated 24 h dietary recalls collected in each ethnic–sex group[15]. Average correlations for nutrient densities ranged from 0·57 to 0·74 across ethnic–sex strata, and those for specific nutrient groups were from 0·32 to 0·67 for proteins, 0·46 to 0·77 for total fat, 0·56 to 0·7 for saturated fats and 0·68 to 0·78 for fibre.

Energy and nutrient intakes were calculated based on all QFFQ items[16]; similar foods were combined to determine the percentage contribution of each source to the total daily intake of energy, total fat, saturated fat, protein, dietary fibre and added sugar. Participants excluded in the analysis were those with extreme mean energy intake (beyond 3 SD) and/or macronutrient intake (beyond 3·5 SD). As the focus of the present study was to examine nutrient sources among persons of different ethnicities, those who identified themselves being from a mixed ethnic background were also excluded. Latinos born in the Caribbean were also excluded due to the very small number of participants. A total of 186 916 participants were included in the present analysis.

The present study was conducted according to the guidelines laid down in the Declaration of Helsinki, and the protocol was approved by the Institutional Review Boards of the University of Hawaii and the University of Southern California.

Results

Table 1 displays the demographic information of the participants enrolled in the MEC. NH men and AfAm women had the highest average BMI among all ethnic–sex groups, while

Table 1. Demographic information, BMI and daily energy intake of the participants*
(Mean values and standard deviations)

	AfAm		NH		JpAm		Latinos-Mexico		Latinos-US		Caucasian	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Men												
n	11 722		5979		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
BMI (kg/m²)	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/d	2194	1166	2760	1311	2255	833	2716	1401	2468	1261	2283	899
kJ/d	9180	4879	11 548	5485	9435	3485	11 364	5862	10 326	5276	9552	3761
Women												
n	20 130		7650		25 355		10 903		11 255		25 303	
Age (years)	61	9·0	56	8·7	61	8·9	58	7·6	60	7·9	59	9·0
BMI (kg/m²)	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/d	1879	993	2370	1263	1808	678	2316	1238	2056	1104	1805	703
kJ/d	7892	4155	9916	5284	7565	2837	9690	5180	8602	4619	7552	2941

AfAm, African-American; NH, Native Hawaiian; JpAm, Japanese-American.
* Participants in the Multiethnic Cohort Study in Hawaii and Los Angeles.

Table 2. Ten major sources of 'energy' and the percentage (%) contribution of each item in each ethnic−sex group*

	AfAm		NH		JpAm		Latinos-Mexico		Latinos-US		Caucasian	
	Food items	% Contribution	Foods items	% Contribution	Foods items	% Contribution	Foods items	% Contribution	Foods items	% Contribution	Foods items	% Contribution
Men	Rice	8·1	Rice	15·8	Rice	22·9	Bread	9·0	Rice	14·4	Bread	6·5
	Bread	6·4	Bread	5·4	Bread	4·9	Rice	7·7	Bread	6·1	Rice	6·4
	Chicken or turkey dishes	4·6	Beer	4·4	Beer	4·4	Muffins or doughnuts	4·1	Beer	4·2	Pasta with tomato sauce or cheese	4·6
	Regular sodas	3·8	Regular sodas	3·3	Chicken or turkey dishes	3·3	Taco salad	3·9	Chicken or turkey dishes	3·5	Beer	4·5
	Pasta with tomato sauce or cheese	3·5	Chicken or turkey dishes	3·0	Fish	2·6	Cookies or cakes	3·3	Pasta with tomato sauce or cheese	3·1	Cereals	3·6
	Cereals	3·4	Fish	2·6	Cereals	2·6	Crackers, chips or popcorn	3·1	Regular sodas	2·8	Chicken or turkey dishes	2·9
	Orange, grapefruit or pomelo	3·1	Burgers, meatballs or patties	2·6	Regular sodas	2·3	Chicken or turkey dishes	2·9	Cereals	2·7	Crackers, chips or popcorn	2·8
	Beer	3·1	Cereals	2·3	Pasta with tomato sauce or cheese	2·3	Ice cream, ice milk or frozen yogurt	2·2	Burgers, meatballs or patties	2·6	Burgers, meatballs or patties	2·7
	Burgers, meatballs or patties	3·1	Pasta with tomato sauce or cheese	2·3	Orange, grapefruit or pomelo	2·2	Regular sodas	2·2	Ice cream, ice milk or frozen yogurt	2·1	Regular sodas	2·7
	Crackers, chips or popcorn	2·6	Ice cream, ice milk or frozen yogurt	2·1	Stir-fried meat and vegetables	2·1	Pasta with tomato sauce or cheese	2·2	Orange, grapefruit or pomelo	2·1	Ice cream, ice milk or frozen yogurt	2·4
Total (%)		41·7		43·8		49·6		40·6		43·6		39·1
Women	Bread	6·4	Rice	11·8	Rice	19·0	Rice	5·7	Rice	11·8	Bread	7·9
	Rice	6·0	Bread	6·2	Bread	6·2	Bread	5·7	Bread	7·2	Rice	5·3
	Chicken or turkey dishes	4·7	Pasta with tomato sauce or cheese	3·0	Cereals	3·3	Cereals	4·7	Pasta with tomato sauce or cheese	3·8	Pasta with tomato sauce or cheese	5·1
	Pasta with tomato sauce or cheese	4·4	Regular sodas	3·0	Orange, grapefruit or pomelo	3·2	Chicken or turkey dishes	3·8	Cereals	3·4	Cereals	3·9
	Crackers, chips or popcorn	4·0	Chicken or turkey dishes	3·0	Chicken or turkey dishes	3·0	Pasta with tomato sauce or cheese	3·5	Chicken or turkey dishes	3·4	Chicken or turkey dishes	2·9
	Cereals	3·8	Cereals	3·0	Pasta with tomato sauce or cheese	2·8	Bananas	3·4	Orange, grapefruit or pomelo	2·6	Crackers, chips or popcorn	2·9
	Orange, grapefruit or pomelo	3·0	Orange, grapefruit or pomelo	2·5	Stir-fried meat and vegetables	2·6	Orange, grapefruit or pomelo	3·1	Crackers, chips or popcorn	2·4	Orange, grapefruit or pomelo	2·7
	Ice cream, ice milk or frozen yogurt	2·5	Fish	2·5	Bananas	2·5	Pizza	2·2	Bananas	2·3	Bananas	2·4
	Cookies or cakes	2·3	Burgers, meatballs or patties	2·4	Fish	2·5	Low-fat milk	2·1	Regular sodas	2·3	Cookies or cakes	2·1
	Bananas	2·2	Crackers, chips or popcorn	2·0	Peanuts or other nuts	1·9	Muffins or doughnuts	2·0	Stir-fried meat and vegetables	2·0	Ice cream, ice milk or frozen yogurt	2·1
Total (%)		39·3		39·4		47·0		36·2		41·2		37·3

AfAm, African-American; NH, Native Hawaiian; JpAm, Japanese-American.
* Participants in the Multiethnic Cohort Study in Hawaii and Los Angeles.

NH men and NH women reported the highest mean daily energy intakes.

The top ten dietary sources of energy contributed from 36·2% (Latino-Mexico women) to 49·6% (JpAm men) to total energy intake (Table 2). Across all ethnic–sex groups, the dietary sources of energy intake were similar with rice and bread contributing most, ranging from 11·4% (Latino-Mexico women) to 27·8% (JpAm men). However, the percentages of contribution of each source varied among the ethnic–sex groups. Chicken/turkey dishes and pasta with tomato sauce or cheese were in the top ten list for all groups. Cereal was among the top contributors to energy for all ethnic–sex groups (2·3–4·7%), except Latino-Mexico men. Regular soda contributed between 2·2% (Latino-Mexico men) and 3·8% (AfAm men) to total energy intake. Interestingly, beer was a major source of energy intake among men of all ethnic/racial groups with the exception of Latino-Mexico; conversely, beer did not appear among the ten major sources of energy for women of any of the ethnic/racial groups.

The ten major dietary sources of fat are presented in Table 3 for all ethnic–sex groups. The top ten sources of total fat contributed 35·1% (Latino-Mexico women) to 43% (JpAm men) of total fat intake (Table 3). A top-three food source of fat across all ethnic–sex groups, chicken/turkey dishes, contributed from 4·1% (Caucasian women) to 7·4% (AfAm men) to total fat intake. Butter was a top-five food source among all groups except Latino-Mexico men, contributing between 3·6% (Latino-Mexico women) and 6·2% (NH women). Peanuts/other nuts also appeared among the top five major sources for men and women in four of the ethnic/racial groups (AfAm, NH, JpAm and Latino-US); the percentage contribution to total fat intake ranged from 4% for Latino-US men to 5·9% for JpAm men.

The sources of saturated fats are shown in Table 4. Ice cream, ice milk or frozen yogurt was among the top five contributors to total saturated fat intake for all groups, except Latino-Mexico women. Butter, likewise, was a significant food source of saturated fat for all but Latino-Mexico men, contributing from 4·4% among Latino-Mexico women to 7 and 7·2% for NH men and women, respectively.

Chicken/turkey dishes were a major contributor to total protein intake across all ethnic–sex groups, topping the list for men and women in four of the ethnic/racial groups (AfAm, NH, Latino-Mexico and Latino-US; Table 5). The first dietary source of protein for JpAm men and women was rice, contributing 12·7 and 10·4% to protein intake, respectively. Fish was also among the top five major sources in four ethnic/racial groups (AfAm, NH, JpAm and Latino-US); the percentage contribution varied from 4·8% for AfAm men to 7·7% for JpAm men. Bread contributed from 4·6% (Latino-Mexico women) to 7·6% (Latino-Mexico men) to total protein intake and also appeared among the top five sources across all ethnic–sex groups.

Bread and cereals were the top two food sources of dietary fibre among all groups, except Latino-Mexico men, for whom beans replaced cereals as the second highest contributor (Table 6). Together, bread and cereals accounted for 18·1% (NH women) to 22% (Caucasian men). Other important dietary sources of fibre were orange, grapefruit or pomelo across all ethnic–sex groups and bananas for men and women in all groups, except AfAm. Regular sodas were the top contributor to added sugar intake, ranging from 17·5% for JpAm women to 35·2% for Latino-Mexico men to total consumption (Table 7). The percentage contribution of regular sodas alone is greater than that of the other four major food sources combined for all groups except JpAm and Caucasian women. Other fruit juices/drinks were also a major source of added sugar across all ethnic–sex groups.

Discussion

The present study describes similarities and differences between ethnic/racial groups both in the types of foods that are consumed as well as the percentage contribution of these food sources to total energy and specific nutrient intake. In the present study population, we identified rice, bread, chicken/turkey dishes, sodas and pasta/tomato sauce dishes as the five major sources of energy. In contrast, Cotton *et al.*[17] identified 'yeast bread', 'beef', 'cakes/cookies/quick breads/doughnuts', 'soft drinks/soda' and 'milk' as the top five contributors to total energy intake among US adults from 1994 to 1996[18]. The differences may be attributed to several factors, including the use of different dietary assessment instruments and different sampling methodologies. Cotton *et al.* analysed 24 h dietary recalls collected as part of the Continuing Surveys of Food Intakes by Individuals (CSFII), whereas the present study utilised a validated QFFQ that was specifically developed to characterise the dietary consumption patterns of our multiethnic study population. Furthermore, the CSFII used personal weighting factors to compensate for demographic differences between the sampled population and the US population in order to obtain a nationally representative sample[18]. By contrast, the present study population comprises the diverse ethnic/racial groups of Hawaii and Los Angeles County, and requires no personal weighting factors to achieve the targeted population sample.

Consumption patterns in the USA have evolved as diverse population groups introduce new foods, novel products appear on the market, and diet trends emerge and fade. The US Department of Health and Human Services and the USDA Dietary Guidelines for Americans 2010 are designed to help Americans make better food choices to promote health and to reduce the risk for chronic diseases[9]. While the dietary guidelines contain technical information intended for policymakers, educators, dietitians and other health practitioners, the recommendations are ultimately targeted for the general public to embrace a healthier pattern of eating. The present findings, therefore, may serve to assist nutrition professionals in identifying foods for intervention and translating the dietary guidelines for practical application for specific ethnic/racial minority groups.

The percentage of the US population claiming minority racial or ethnic heritage is growing[19,20]. The US population is becoming increasingly diverse with the nation's minority

Table 3. Ten major sources of 'total fat' and the percentage (%) contribution of each item in each ethnic–sex group*

	AfAm		NH		JpAm		Latinos-Mexico		Latinos-US		Caucasian	
	Food items	% Contri-bution	Foods items	% Contri-bution	Foods items	% Contri-bution	Foods items	% Contri-bution	Foods items	% Contri-bution	Foods items	% Contri-bution
Men	Chicken or turkey dishes	7·4	Butter	5·8	Chicken or turkey dishes	6·0	Taco salad	5·8	Chicken or turkey dishes	5·8	Peanuts or other nuts	5·6
	Peanuts or other nuts	5·0	Chicken or turkey dishes	5·1	Peanuts or other nuts	5·9	Muffins or doughnuts	4·8	Butter	4·5	Pasta with tomato sauce or cheese	5·5
	Burgers, meatballs or patties	4·5	Peanuts or other nuts	4·5	Fish	4·8	Chicken or turkey dishes	4·6	Peanuts or other nuts	4·0	Butter	5·2
	Butter	4·5	Fish	4·3	Regular salad dressing	4·4	Crackers, chips or popcorn	4·4	Burgers, meatballs or patties	3·8	Chicken or turkey dishes	4·4
	Pasta with tomato sauce or cheese	4·3	Burgers, meatballs or patties	3·8	Butter	4·1	Bread	4·1	Pasta with tomato sauce or cheese	3·7	Burgers, meatballs or patties	3·9
	Pork and ham	3·7	Beef and lamb	3·7	Oil	4·0	Cookies or cakes	3·7	Spam or bologna	3·6	Crackers, chips or popcorn	3·7
	Spam or bologna	3·6	Spam or bologna	3·7	Stir-fried meat and vegetables	3·7	Beef and lamb	3·5	Beef and lamb	3·5	Salad dressing	3·7
	Crackers, chips or popcorn	3·4	Pork and ham	3·6	Spam or bologna	3·5	Cheese	3·4	Fish	3·4	Bread	3·2
	Bread	3·2	Oil	3·5	Burgers, meatballs or patties	3·4	Salad dressing	3·3	Pork and ham	3·2	Cheese	3·1
	Fish	2·9	Salad dressing	3·3	Beef and lamb	3·2	Butter	3·1	Bread	3·1	Ice cream	3·0
Total (%)		42·5		41·3		43·0		40·7		38·6		41·3
Women	Chicken or turkey dishes	7·3	Butter	6·2	Peanuts or other nuts	5·4	Chicken or turkey dishes	5·4	Butter	5·4	Pasta with tomato sauce or cheese	6·2
	Pasta with tomato sauce or cheese	5·2	Chicken or turkey dishes	4·7	Regular salad dressing	5·2	Pasta with tomato sauce or cheese	4·1	Chicken or turkey dishes	5·4	Butter	5·8
	Crackers, chips or popcorn	5·0	Fish	4·2	Chicken or turkey dishes	4·9	Butter	3·6	Pasta with tomato sauce or cheese	4·7	Peanuts or other nuts	4·5
	Peanuts or other nuts	4·8	Peanuts or other nuts	4·1	Butter	4·8	Regular salad dressing	3·5	Peanuts or other nuts	4·1	Chicken or turkey dishes	4·1
	Butter	4·7	Regular salad dressing	3·7	Fish	4·5	Taco salad	3·3	Bread	3·7	Bread	4·1
	Fish	3·2	Pasta with tomato sauce or cheese	3·6	Stir-fried meat and vegetables	4·5	Cheese	3·3	Fish	3·5	Salad dressing	4·0
	Bread	3·2	Burgers, meatballs or patties	3·5	Oil	4·0	Pork and ham	3·2	Stir-fried meat and vegetables	3·3	Crackers, chips or popcorn	3·9
	Ice cream	3·0	Oil	3·2	Pasta with tomato sauce or cheese	3·5	Pizza	3·0	Salad dressing	3·2	Cheese	3·6
	Stir-fried meat and vegetables	2·9	Bread	3·1	Bread	3·4	Burgers, meatballs or patties	3·0	Crackers, chips or popcorn	3·2	Fish	3·1
	Pork and ham	2·9	Spam or bologna	3·1	Rice	2·7	Bread	2·7	Burgers, meatballs or patties	2·8	Cookies or cakes	2·8
Total (%)		42·2		39·4		42·9		35·1		39·3		42·1

AfAm, African-American; NH, Native Hawaiian; JpAm, Japanese-American.
* Participants in the Multiethnic Cohort Study in Hawaii and Los Angeles.

Table 4. Ten major sources of 'saturated fat' and the percentage (%) contribution of each item in each ethnic−sex group*

	AfAm		NH		JpAm		Latinos-Mexico		Latinos-US		Caucasian	
	Food items	% Contribution	Foods items	% Contribution	Foods items	% Contribution	Foods items	% Contribution	Foods items	% Contribution	Foods items	% Contribution
Men	Ice cream, ice milk or frozen yogurt	5·9	Butter	7·0	Ice cream, ice milk or frozen yogurt	5·3	Cheese	6·9	Ice cream, ice milk or frozen yogurt	6·2	Pasta with tomato sauce or cheese	6·6
	Chicken or turkey dishes	5·8	Ice cream, ice milk or frozen yogurt	6·2	Chicken or turkey dishes	5·0	Taco salad	6·1	Butter	5·1	Cheese	6·5
	Burgers, meatballs or patties	5·7	Beef and lamb	5·0	Burgers, meatballs or patties	4·7	Ice cream, ice milk or frozen yogurt	5·7	Burgers, meatballs or patties	4·8	Ice cream, ice milk or frozen yogurt	6·2
	Pasta with tomato sauce or cheese	5·4	Burgers, meatballs or patties	4·9	Beef and lamb	4·7	Beef and lamb	4·5	Beef and lamb	4·6	Butter	5·8
	Butter	4·6	Spam or bologna	4·6	Spam or bologna	4·6	Muffins or doughnuts	3·9	Chicken or turkey dishes	4·5	Burgers, meatballs or patties	4·9
	Pork and ham	4·6	Pork and ham	4·4	Butter	4·5	Chicken or turkey dishes	3·3	Pasta with tomato sauce or cheese	4·5	Beef and lamb	3·5
	Cheese	4·5	Chicken or turkey dishes	4·0	Meat soups or stew	3·9	Cookies or cakes	3·3	Spam or bologna	4·4	Chicken or turkey dishes	3·4
	Spam or bologna	4·5	Pasta with tomato sauce or cheese	3·4	Pork and ham	3·8	Meat burritos	3·3	Cheese	4·2	Spam or bologna	3·3
	Beef and lamb	3·4	Meat soups or stew	3·2	Pasta with tomato sauce or cheese	3·7	Butter	3·2	Pork and ham	3·9	Low-fat milk	3·2
	Low-fat milk	2·6	Cheese	2·6	Stir-fried meat and vegetables	3·5	Crackers, chips or popcorn	3·2	Meat soups or stew	3·1	Pork and ham	2·9
Total (%)		47·0		45·3		43·7		43·4		45·3		46·3
Women	Pasta with tomato sauce or cheese	6·5	Butter	7·2	Butter	5·3	Cheese	6·8	Butter	6·0	Cheese	7·5
	Ice cream, ice milk or frozen yogurt	6·2	Ice cream, ice milk or frozen yogurt	5·1	Ice cream, ice milk or frozen yogurt	4·6	Low-fat milk	4·6	Pasta with tomato sauce or cheese	5·6	Pasta with tomato sauce or cheese	7·5
	Chicken or turkey dishes	5·8	Burgers, meatballs or patties	4·6	Chicken or turkey dishes	4·3	Pasta with tomato sauce or cheese	4·6	Cheese	5·1	Butter	6·7
	Butter	5·7	Pasta with tomato sauce or cheese	4·3	Pasta with tomato sauce or cheese	4·2	Butter	4·4	Ice cream, ice milk or frozen yogurt	4·7	Ice cream, ice milk or frozen yogurt	5·0
	Cheese	4·9	Beef and lamb	4·0	Stir-fried meat and vegetables	4·1	Chicken or turkey dishes	4·4	Chicken or turkey dishes	4·3	Low-fat milk	3·7
	Burgers, meatballs or patties	3·6	Spam or bologna	3·9	Burgers, meatballs or patties	3·7	Pizza	3·9	Burgers, meatballs or patties	3·7	Burgers, meatballs or patties	3·4
	Pork and ham	3·5	Chicken or turkey dishes	3·8	Spam or bologna	3·5	Pork and ham	3·8	Beef and lamb	3·4	Chicken or turkey dishes	3·4
	Low-fat milk	3·1	Pork and ham	3·7	Beef and lamb	3·5	Burgers, meatballs or patties	3·8	Pork and ham	3·4	Chocolate candy	3·1
	Crackers, chips or popcorn	3·1	Cheese	3·5	Peanuts or other nuts	3·1	Beef and lamb	3·5	Spam or bologna	3·2	Bread	2·9
	Chocolate candy	2·9	Low-fat milk	2·9	Meat soups or stew	3·1	Taco salad	3·5	Low-fat milk	2·9	Beef and lamb	2·7
Total (%)		45·3		43·0		39·4		43·3		42·3		45·9

AfAm, African-American; NH, Native Hawaiian; JpAm, Japanese-American.
* Participants in the Multiethnic Cohort Study in Hawaii and Los Angeles.

Table 5. Ten major sources of 'protein' and the percentage (%) contribution of each item in each ethnic−sex group*

	AfAm		NH		JpAm		Latinos-Mexico		Latinos-US		Caucasian	
	Food items	% Contribution	Foods items	% Contribution	Foods items	% Contribution	Foods items	% Contribution	Foods items	% Contribution	Foods items	% Contribution
Men	Chicken or turkey dishes	13·3	Chicken or turkey dishes	8·8	Rice	12·7	Chicken or turkey dishes	7·9	Chicken or turkey dishes	10·1	Chicken or turkey dishes	9·6
	Bread	6·1	Rice	8·8	Chicken or turkey dishes	9·8	Bread	7·6	Rice	7·9	Bread	6·1
	Burgers, meatballs or patties	5·1	Fish	7·5	Fish	7·7	Taco salad	6·9	Bread	5·6	Pasta with tomato sauce or cheese	6·0
	Fish	4·8	Bread	5·1	Bread	4·7	Beef and lamb	5·3	Fish	5·5	Fish	5·0
	Rice	4·5	Burgers, meatballs or patties	4·6	Stir-fried meat and vegetables	4·3	Rice	4·1	Burgers, meatballs or patties	4·6	Burgers, meatballs or patties	4·8
	Pasta with tomato sauce or cheese	4·4	Beef and lamb	4·6	Beef and lamb	4·0	Fish	4·0	Beef and lamb	4·3	Beef and lamb	3·8
	Pork and ham	4·3	Pork and ham	4·5	Burgers, meatballs or patties	3·8	Cheese	3·7	Pork and ham	4·0	Cheese	3·7
	Beef and lamb	3·2	Stir-fried meat and vegetables	3·7	Pork and ham	3·5	Meat soups or stew	3·6	Pasta with tomato sauce or cheese	3·9	Rice	3·6
	Cereals	2·9	Pasta with tomato sauce or cheese	3·0	Meat soups or stew	3·0	Burgers, meatballs or patties	3·2	Stir-fried meat and vegetables	3·2	Pork and ham	3·4
	Stir-fried meat and vegetables	2·3	Meat soups or stew	3·0	Pasta with tomato sauce or cheese	3·0	Meat burritos	3·0	Meat soups or stew	3·0	Cereals	3·0
Total (%)		50·9		53·6		56·5		49·3		52·1		49·0
Women	Chicken or turkey dishes	13·8	Chicken or turkey dishes	9·0	Rice	10·4	Chicken or turkey dishes	11·8	Chicken or turkey dishes	10·2	Chicken or turkey dishes	10·2
	Bread	5·8	Fish	6·9	Chicken or turkey dishes	9·6	Cheese	4·6	Bread	6·4	Bread	7·2
	Fish	5·2	Rice	6·4	Fish	6·9	Bread	4·6	Rice	6·2	Pasta with tomato sauce or cheese	6·3
	Pasta with tomato sauce or cheese	5·1	Bread	5·7	Bread	5·8	Pasta with tomato sauce or cheese	3·8	Fish	5·2	Fish	4·8
	Stir-fried meat and vegetables	3·4	Burgers, meatballs or patties	4·3	Stir-fried meat and vegetables	5·0	Cereals	3·7	Pasta with tomato sauce or cheese	4·5	Cheese	4·6
	Burgers, meatballs or patties	3·2	Stir-fried meat and vegetables	3·8	Pasta with tomato sauce or cheese	3·4	Pork and ham	3·7	Stir-fried meat and vegetables	3·9	Non-fat milk	3·5
	Rice	3·2	Beef and lamb	3·7	Beef and lamb	3·1	Low-fat milk	3·5	Burgers, meatballs or patties	3·5	Burgers, meatballs or patties	3·3
	Cereals	3·1	Pasta with tomato sauce or cheese	3·7	Burgers, meatballs or patties	3·1	Burgers, meatballs or patties	3·4	Beef and lamb	3·4	Cereals	3·2
	Pork and ham	3·1	Pork and ham	3·7	Broth with meat or noodles	3·0	Beef and lamb	3·1	Pork and ham	3·3	Low-fat milk	3·0
	Cheese	2·6	Broth with meat or noodles	2·9	Non-fat milk	2·9	Fish	3·0	Cheese	3·0	Rice	3·0
Total (%)		48·5		50·1		53·2		45·2		49·6		49·1

AfAm, African-American; NH, Native Hawaiian; JpAm, Japanese-American.
* Participants in the Multiethnic Cohort Study in Hawaii and Los Angeles.

Table 6. Ten major sources of 'dietary fibre' and the percentage (%) contribution of each item in each ethnic−sex group*

	AfAm		NH		JpAm		Latinos-Mexico		Latinos-US		Caucasian	
	Food items	% Contri-bution	Foods items	% Contri-bution	Foods items	% Contri-bution	Foods items	% Contri-bution	Foods items	% Contri-bution	Foods items	% Contri-bution
Men	Bread	10·7	Bread	10·0	Cereals	9·3	Bread	13·5	Bread	10·2	Cereals	11·4
	Cereals	10·5	Cereals	8·2	Bread	9·0	Beans	6·3	Cereals	8·9	Bread	10·6
	Orange, grapefruit or pomelo	6·9	Orange, grapefruit or pomelo	6·1	Rice	8·4	Orange, grapefruit or pomelo	5·6	Orange, grapefruit or pomelo	5·8	Crackers, chips or popcorn	5·0
	Crackers, chips or popcorn	4·8	Rice	5·6	Orange, grapefruit or pomelo	6·4	Cereals	5·6	Rice	5·3	Orange, grapefruit or pomelo	5·0
	Beans	4·8	Bananas	4·0	Bananas	4·7	Bananas	5·2	Bananas	4·3	Bananas	4·5
	Bananas	4·3	Tropical fruits	3·1	Tropical fruits	4·0	Crackers, chips or popcorn	4·1	Beans	4·3	Beans	3·7
	Apples or applesauce	3·4	Taro	2·9	Apples or apple-sauce	3·0	Apples or applesauce	3·6	Crackers, chips or popcorn	4·1	Pasta with tomato sauce or cheese	3·5
	Rice	3·0	Crackers, chips or popcorn	2·9	Peanuts or other nuts	2·9	Vegetable soups	3·2	Apples or apple-sauce	2·9	Apples or applesauce	3·4
	Other fruits	2·7	Peanuts or other nuts	2·5	Stir-fried meat and vegetables	2·7	Taco salad	3·1	Tropical fruits	2·6	Tropical fruits	2·8
	Broccoli or cauliflower	2·5	Beans	2·5	Dark greens	2·5	Green beans or peas	2·8	Vegetable soups	2·5	Peanuts or other nuts	2·8
Total (%)		53·6		47·8		52·9		53·0		50·9		52·7
Women	Cereals	10·3	Bread	9·7	Bread	9·3	Cereals	12·2	Bread	10·5	Bread	11·1
	Bread	8·9	Cereals	8·4	Cereals	8·9	Bread	8·0	Cereals	9·0	Cereals	10·4
	Crackers, chips or popcorn	6·6	Orange, grapefruit or pomelo	6·5	Orange, grapefruit or pomelo	7·7	Orange, grapefruit or pomelo	7·4	Orange, grapefruit or pomelo	5·7	Orange, grapefruit or pomelo	5·2
	Orange, grapefruit or pomelo	5·9	Bananas	4·5	Rice	6·2	Beans	6·9	Bananas	5·0	Bananas	4·9
	Apples or applesauce	4·4	Tropical fruits	3·9	Bananas	5·3	Bananas	6·3	Crackers, chips or popcorn	4·4	Crackers, chips, popcorn	4·7
	Beans	4·4	Crackers, chips or popcorn	3·6	Tropical fruits	5·1	Tropical fruits	4·7	Beans	3·9	Apples or applesauce	3·7
	Bananas	4·2	Rice	3·6	Apples or applesauce	3·5	Broccoli or cauliflower	2·9	Rice	3·6	Tropical fruits	3·6
	Broccoli or cauliflower	3·7	Taro	3·1	Other fruits	3·0	Other fruits	2·8	Tropical fruits	3·5	Beans	3·4
	Other fruits	3·2	Apples or applesauce	3·0	Carrots	3·0	Vegetable soups	2·7	Other fruits	3·1	Pasta with tomato sauce or cheese	3·3
	Tropical fruits	2·8	Other fruits	2·9	Dark greens	2·9	Apples or applesauce	2·6	Apples or applesauce	3·0	Carrots	3·3
Total (%)		54·4		49·2		54·9		56·5		51·7		53·6

AfAm, African-American; NH, Native Hawaiian; JpAm, Japanese-American.
*Participants in the Multiethnic Cohort Study in Hawaii and Los Angeles.

Table 7. Ten major sources of 'added sugar' and the percentage (%) contribution of each item in each ethnic−sex group*

	AfAm		NH		JpAm		Latinos-Mexico		Latinos-US		Caucasian	
	Food items	% Contri-bution	Foods items	% Contri-bution	Foods items	% Contri-bution	Foods items	% Contri-bution	Foods items	% Contri-bution	Foods items	% Contri-bution
Men	Regular sodas	31·8	Regular sodas	34·5	Regular sodas	28·4	Regular sodas	35·2	Regular sodas	28·7	Regular sodas	25·7
	Ice cream	6·4	Other fruit juices or drinks	7·9	Other fruit juices or drinks	6·9	Other fruit juices or drinks	3·9	Ice cream	6·1	Chocolate candy	5·8
	Cakes	4·8	Ice cream	5·5	Chocolate candy	4·9	Pancakes or French toast	3·9	Cookies or fruit bars	4·5	Other fruit juices or drinks	5·6
	Other fruit juices or drinks	4·7	Chocolate candy	4·4	Ice cream	4·9	Milkshakes or malts	3·9	Other fruit juices or drinks	4·4	Ice cream	5·5
	Pancakes or French toast	4·0	Pancakes or French toast	4·2	Pancakes or French toast	4·7	Ice cream	3·9	Pancakes or French toast	4·3	Cookies or fruit bars	5·0
	Cookies or fruit bars	4·0	Chocolate milk or cocoa	3·3	Cookies or fruit bars	3·3	Cappuccino	3·6	Sweet rolls or coffee cakes	4·1	Pancakes or French toast	4·2
	Chocolate candy	3·6	Cookies or fruit bars	2·7	Sugar	3·0	Cookies or fruit bars	3·4	Chocolate candy	4·1	Ice milk or frozen yogurt	3·9
	Ice milk or frozen yogurt	2·9	Cakes	2·3	Jam or jelly	2·9	Sugar	3·3	Sugar	2·9	Bran or high-fibre cereals	3·0
	Sweet rolls or coffee cakes	2·9	Sweet rolls or coffee cakes	2·2	Ice milk or frozen yogurt	2·7	Cakes	3·2	Cakes	2·9	Cakes	2·8
	Sugar	2·3	Sugar	2·1	Cakes	2·6	Chocolate milk or cocoa	3·2	Chocolate milk or cocoa	2·8	Chocolate milk or cocoa	2·6
Total (%)		67·4		69·1		64·3		67·5		64·8		64·1
Women	Regular sodas	29·3	Regular sodas	30·2	Regular sodas	17·5	Regular sodas	24·6	Regular sodas	25·1	Regular sodas	17·2
	Other fruit juices or drinks	6·4	Other fruit juices or drinks	9·1	Other fruit juices or drinks	9·0	Other fruit juices or drinks	6·3	Other fruit juices or drinks	6·1	Chocolate candy	7·5
	Ice cream	5·1	Chocolate candy	5·3	Chocolate candy	6·9	Cappuccino	4·7	Ice cream	4·8	Other fruit juices or drinks	6·5
	Cakes	4·5	Ice cream	4·2	Pancakes or French toast	4·5	Milkshakes or malts	4·1	Chocolate candy	4·5	Cookies or fruit bars	5·2
	Chocolate candy	4·5	Pancakes or French toast	4·0	Ice cream	3·9	Pancakes or French toast	3·9	Cookies or fruit bars	4·2	Ice milk or frozen yogurt	5·0
	Ice milk or frozen yogurt	3·8	Chocolate milk or cocoa	3·4	Cookies or fruit bars	3·8	Sugar	3·8	Pancakes or French toast	3·9	Ice cream	4·4
	Cookies or fruit bars	3·3	Ice milk or frozen yogurt	2·8	Jam or jelly	3·7	Ice cream	3·4	Sweet rolls or coffee cakes	3·7	Yogurt	4·1
	Pancakes or French toast	3·0	Cookies or fruit bars	2·6	Ice milk or frozen yogurt	3·3	Cookies or fruit bars	3·4	Ice milk or frozen yogurt	3·3	Pancakes or French toast	3·8
	Bran or high-fibre cereals	2·4	Cakes	2·3	Cakes	3·1	Chocolate milk or cocoa	3·1	Chocolate milk or cocoa	3·0	Bran or high-fibre cereals	3·2
	Chocolate milk or cocoa	2·3	Sweet rolls or coffee cakes	2·2	Bran or high-fibre cereals	2·6	Cakes	3·1	Cakes	2·8	Chocolate milk or cocoa	3·0
Total (%)		64·6		66·1		58·3		60·4		61·4		59·9

AfAm, African-American; NH, Native Hawaiian; JpAm, Japanese-American.
* Participants in the Multiethnic Cohort Study in Hawaii and Los Angeles.

population reaching 102·5 million in 2007, or 34% of the total[21]. It has been shown that ethnic/racial groups are adopting US dietary practices, which are typically high in fat and low in fruits and vegetables[22]. This trend is particularly alarming when observed in combination with other lifestyle changes, such as decreased physical activity, which may also increase the risk for chronic disease[4]. In the present study, we found that the Latino-US group identified different dietary sources of energy and other nutrients compared with the foods consumed by the Latino-Mexico group. For example, while peanuts/other nuts were a top contributor to total fat intake for Latino-US, peanuts/other nuts did not appear among the major sources for Latino-Mexico. Instead, taco salad was a top-ten contributor to total fat among Latino-Mexico compared with Latino-US, for whom taco salad was not an important source. Ethnic differences in dietary sources, as described in the present study, demonstrate a need to consider cultural identities and unique customs when formulating and conveying public health messages and developing and implementing nutrition education and intervention programmes aimed at improving food choices among diverse populations.

While numerous ethnic differences in major dietary sources of energy, total fat, saturated fat, protein, dietary fibre and added sugar have been noted between ethnic/racial groups, an appreciable similarity exists in dietary consumption patterns, consistent among all groups represented in the MEC. Some similarities would be expected, given that the MEC participants were recruited primarily from residents living in two specific geographic areas of the USA. Of note, regular sodas were the primary source of added sugar across all ethnic–sex groups. Combined, regular sodas and other fruit juices/drinks contribute up to almost 50% to total added sugar consumption. These findings present a tremendous opportunity for public health advocates to help reduce the intake of added sugar, specifically the consumption of sugar-sweetened beverages, which has been linked with an increased risk for a number of diet-related chronic diseases[23].

The strengths of the present study include the large sample size and the population-specific dietary assessment instrument used to collect data. The MEC QFFQ was specifically developed and validated to describe dietary consumption patterns for the five ethnic/racial groups represented in the present study population. The non-Caucasian sample sizes generated for the MEC are substantially larger than those that are available from other national surveys. The CSFII 1994–6 collected dietary intake data from 16 103 adults[18], which included AfAm and Latinos, but the samples were comparatively small. Furthermore, no national survey has sampled populations in Hawaii, a state that comprises a relatively large number of JpAm and NH. In addition, with the exception of a slightly higher education among cohort participants, baseline characteristics were comparable with census data, supporting the generalisability of these results to the larger US population[14].

Some limitations also warrant mention. Unfortunately, there were a relatively large number of exclusions due to missing data, and the proportion of excluded participants did vary somewhat for the different ethnic–sex groups, ranging from 15% in Caucasian and JpAm women, to only 2·5% for NH of both sexes. Although these differences do raise concern regarding introduction of selection bias, with the considerable sample sizes that were still maintained in these analyses, considerable dietary variation would have to have occurred in order to have an impact on these results. Recall bias is also a possible limitation; however, the QFFQ utilised in the MEC characterises total consumption relatively well as demonstrated in calibration and validation assessments[14,15]. Further, previous studies have demonstrated that FFQ are suitable tools for quantitative assessment of food and nutrient intake[24], although some have suggested that the validity may be higher among women[25], and could vary by food group[26]. Another limitation is the collection of data over 15 years ago, thus more recent data would be useful to determine whether changes in the dietary patterns of specific ethnic groups over time may have had an impact on the generalisability of these results to the current population. Nevertheless, no other study on the dietary sources exists for a large sample of the five main ethnic/racial groups in the USA.

Conclusions

The present study is the first to provide data on the major dietary sources of energy, total fat, saturated fat, protein, dietary fibre and added sugar across the main ethnic/racial minority groups in the USA. The present findings may be used to direct public health strategies and develop nutritional guidelines targeted for specific ethnic/racial populations. Continuing efforts to promote a healthful diet and improve food choices must bear special consideration of unique dietary needs distinct to each of these diverse population groups. The present dietary data are particularly valuable for identifying target foods for nutritional intervention programmes aimed at improving dietary adequacy and reducing the risk for chronic disease among the ethnic/racial populations represented in the MEC. Furthermore, these data will facilitate the ongoing investigation of diet–disease associations and observed health disparities among ethnic minority groups.

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