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The Relationship among Cardiovascular Risk Factors, Diet Patterns, Alcohol Consumption, and Ethnicity among Women Aged 50 Years and Older

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Abstract

Background—Cardiovascular disease (CVD) is the leading cause of death among women of all races and ethnicities. The risk of developing the disease is greater in postmenopausal women.

Objective—The purpose of this study was to use cluster analysis to examine diet patterns and to examine the association between diet patterns and the presence of major cardiovascular disease risk factors.

Design—Data from the cross-sectional National Health and Nutrition Examination Survey (NHANES) 2001–2002 were used.

Subjects/setting—Women aged 50 years and older were included (n=1,313).

Main outcome measures—The following major CVD risk factors were examined: being overweight or obese (body mass index >24.9), having elevated systolic blood pressure (>120 mm Hg), and having low levels of high-density lipoprotein cholesterol (<50 mg/dL [<1.30 mmol/L]). Dietary patterns were derived by cluster analysis using data from a 24-hour dietary recall.

Statistical analyses performed—Odds Ratios (ORs) and 95% confidence intervals (CIs) were calculated using logistic regression to determine the probability of having a risk factor according to diet pattern while accounting for race/ethnicity, physical activity, age, and smoking.

Results—Cluster analysis generated six nonoverlapping diet patterns labeled: Pasta and Yellow Vegetables; Sweets; Beef, Starches, Fruits, and Milk; Frozen Meals, Burritos, and Pizza; Meat Dishes; and Soft Drinks and Poultry. The majority of the women were grouped in the Sweets diet pattern. Factors associated with adequate levels of high-density lipoprotein cholesterol included being non-Hispanic African American (OR 0.59, 95% CI 0.44 to 0.81; $P<0.0001$), alcohol consumption (OR 0.76, 95% CI 0.69 to 0.84; $P<0.0001$), and being assigned to the Sweets diet pattern (OR 0.27, 95% CI 0.14 to 0.50; $P<0.0001$) or Meat dishes diet pattern (OR 0.94, 95% CI 0.54 to 1.65; $P<0.0075$). The Sweets pattern was also associated with having normal systolic blood pressure levels (OR 0.51, 95% CI 0.34 to 0.76; $P<0.0001$). Individuals grouped in the Beef, Starches, and Milk diet pattern were more likely to have an adequate body mass index (OR 0.42, 95% CI 0.23 to 0.77; $P<0.0032$).

Conclusions—Significant associations between dietary patterns and major CVD risk factors were observed. Food and nutrition professionals can use this information to assess unhealthful food choices observed in the dietary patterns to guide nutrition recommendations and help reduce the incidence of CVD risk factors. Future research should aim to evaluate dietary intake via complementary methods (ie, dietary patterns and nutrient assessment) to better understand diet–disease relationships.

Cardiovascular disease (CVD) is the leading cause of death for men and women of all races and ethnicities in the United States (1). Mortality rates from CVD, however, differ in accordance with race and ethnicity. More African-American women die from CVD than do whites and Hispanics (2). The prevalence of the major CVD risk factors such as obesity, elevated cholesterol levels, and high blood pressure also differ significantly among men and women of different race and ethnic backgrounds. For example, Hispanic and white women have a higher rate of hypercholesterolemia whereas African-American women have higher obesity rates (2).

Several public health initiatives and education campaigns incorporating dietary modifications have been designed to reduce the presence of the major CVD risk factors in the population. For example, specific dietary interventions known as therapeutic lifestyle changes established by the National Cholesterol Education Program include the following recommendations: consumption of high-fiber foods (25 to 30 g/day), inclusion of n-3 fatty acids, consumption of <30% of total energy from fat, consumption of low-saturated-fat foods (<7% of total energy), and adequate energy intake for body weight and physical activity (3). The effectiveness of therapeutic lifestyle changes to reduce CVD risk factors were reported after 12 weeks of intervention among adult men and women (4).

For postmenopausal women, whether the discontinuation in menses is natural or induced, the risk for CVD is greater due to increased low-density lipoprotein (LDL) cholesterol levels, hormonal changes, and age (5). Postmenopausal women are also more likely to gain weight after menopause due to metabolic changes (6) and inactivity, and are also more likely to experience an increase in blood lipid levels (7).

Besides following a healthful diet and being physically active, moderate alcohol consumption, defined as one standard drink per day (14 g alcohol) for women (8), is associated with reduced CVD risk primarily through its antiatherogenic effect through an increase in high-density lipoprotein (HDL) cholesterol levels and decreasing LDL levels (9,10). Among postmenopausal women, moderate alcohol consumption is also beneficial, through its positive action in increasing HDL levels and decreasing LDL levels. There is evidence that this effect may be less significant in younger women (11).

The purpose of our study was to use cluster analysis to examine diet patterns and to examine the association between diet patterns and the following major CVD risk factors: being overweight or obese (body mass index [BMI; calculated as kg/m^2] >24.9), having elevated systolic blood pressure (SBP) (>120 mm Hg), and having low HDL cholesterol levels of <50 mg/dL (<1.30 mmol/L) among a national representative sample of women aged 50 years and older. Race and ethnicity, alcohol consumption, physical activity, and age were also examined to account for the moderating effect of these variables on the presence of CVD risk factors.

MATERIALS AND METHODS

Description of Sample

Data were taken from the National Health and Nutrition Examination Health Survey (NHANES) 2001–2002, conducted by the National Center for Health Statistics of the Centers for Disease Control and Prevention. This ongoing national survey is a cross-sectional study

that uses a multistage stratified probability sampling technique to select participants. Participants in the NHANES surveys undergo a variety of interviews and examinations. The interviewers utilize structured questionnaires to collect data on diet, alcohol consumption, and other health behaviors. The examinations include biochemical analysis and anthropometric measures. The main objective of NHANES is to monitor the health of the noninstitutionalized civilian US population.

A total of 11,039 people were interviewed and 10,477 people participated in the examinations at mobile examination centers between January 2001 and December 2002 (12). From the total preliminary sample, women aged 50 years and older who successfully completed both the interviews and examinations were selected. The resulting sample size for our study is $n=1,313$.

MEASURES

Diet Patterns

Cluster analysis to derive diet patterns involved multiple steps of preparation, using data from the 24-hour recall component of the NHANES survey. In NHANES, the five-step multiple-pass method developed by the US Department of Agriculture is used to conduct the 24-hour recall (13). The protocol and a detailed description of the method are described in the interviewer's manual from the National Center for Health Statistics (14).

The analysis is dependent on the food groups that were entered into cluster analysis. Hence, different food groups may yield different diet patterns or clusters. In this case, food groups were chosen to maintain uniformity with the NHANES data in which food groups were already created according to similarities in nutrient content. For example, one of the food groups in NHANES is the citrus fruits group, which includes oranges, grapefruits, and citrus juices. When the frequency of each food group within the sample was examined, nine food groups that had $<0.1\%$ were dropped from the data. These food groups were: lamb, veal, and carcass meats; egg substitutes; frozen plate meals with eggs as main ingredient; seeds and seed mixtures; flour and dry mixes; meat substitutes from cereal protein; vegetables with meat; poultry and fish; and oils. Forty food groups were used for subsequent analysis and their descriptions are provided in the Figure.

The values for each food group in the NHANES dataset represent the number of grams each individual consumed from that food group. To standardize these values, each food group was converted to kilocalories divided by the total energy intake of each individual (ie, percent energy contribution of a food group according to total energy intake). Thus, values for each food group represent the energy contributed by each food group based on the total daily energy intake of each participant. This method for deriving diet patterns to assess dietary intake has been described in detail in a recent review by Newby and colleagues (15).

The clusters were generated by using K-means procedure, which identifies distinct non-overlapping groups, based on Euclidian distances (straight-line distance). The number of clusters derived from the analysis is defined a priori, also referred to as cluster solutions. Each cluster solution was evaluated according to the degree of separation between clusters using an F statistic (16). Cluster solutions of four to seven clusters were evaluated and the six-cluster solution showed the best proportion of number of cases in each cluster and separation between them.

Alcohol Consumption

In NHANES, alcohol consumption is measured through a series of questions that cover lifetime and recent (past 12 months) quantity and frequency of alcohol use for individuals aged 20 years and older. For this study, responses to the frequency of alcohol use in the past 12 months were

converted to frequency per week and this new variable was then multiplied by the average number of drinks per day on drinking days to produce a quantity/frequency estimate of weekly drinking (17).

Race/Ethnicity

Data on race/ethnicity in NHANES were obtained by self-report and based on these self-reports, participants were classified as Non-Hispanic whites, Non-Hispanic African Americans, Hispanics, and others. The others category included individuals from races other than the aforementioned, and individuals who self-reported as multiracial.

Cardiovascular Risk Factors

Biochemical parameters of CVD risk factors analyzed in this study included serum HDL cholesterol, LDL cholesterol, homocysteine, and folate levels. The definition of each biochemical parameter as a risk factor was based on the evidence-based guidelines for CVD prevention in women (7). Other risk factors examined included SBP by standard measurement (18), BMI derived from height and weight measures, self-reported physical activity, and smoking. Smoking risk was considered in cases where participants reported they smoked cigarettes every day. Physical activity risk or risk of being physically inactive was determined when participants indicated their usual daily activities were characterized by sitting and that they did not walk very much. Each cardiovascular risk factor was converted into dichotomous variables (categorical) indicating their presence or absence.

DATA ANALYSIS

Data preparation and descriptive statistics were carried out using the Statistical Package for the Social Sciences software (version 13.0, 2005, SPSS Inc, Chicago, IL). Other statistical analyses, which included logistic regression and cross tabulations, were done using SAS Proc Survey Procedures (version 9.1.3, 2004, SAS Institute Inc, Cary, NC) that calculate standard errors of the parameter estimates corrected for the complex probability sampling used in NHANES. Statistical significance was set at $P < 0.05$ (two-tail) for all tests.

Cluster solutions were examined according to their composition of selected nutrients. Clusters were compared for the following: total energy; percent energy from carbohydrates, protein, and fat; mean values for fiber; polyunsaturated fats:saturated fats ratio; n-3 fatty acids ratio (n-3:n-6); and other vitamins and minerals. Mean nutrient intakes for each cluster were adjusted for age and total energy intake using the standard multivariate approach (19). Differences between mean nutrient values across clusters were examined by analysis of variance (using a type 3 sum of squares for unbalanced cells). Comparisons between each diet pattern across race/ethnicity categories were assessed using contingency analysis.

Logistic regression was used to determine the odds of having two or more risk factors or presence of specific cardiovascular risk factors based on race/ethnicity, dietary patterns, and alcohol use while controlling for smoking and physical activity. Examination of the data indicated that there were no members of the others category who reported having no cardiovascular risks. Adjustments to the data were made to improve the statistical model. The others race/ethnic category was excluded from the model because there were 45 cases, a sample size that was not adequate for inclusion in a multivariable model. For the logistic regression analyses Proc SurveyLogistic was used to report adjusted odds ratios (ORs) and corresponding Taylor Series confidence intervals (CIs).

RESULTS

The mean age of participants was 68.29 ± 11.1 years. However, NHANES grouped participants older than age 85 years together in one category. Characteristics of the sample are shown in Table 1.

Diet Patterns

Six distinct nonoverlapping clusters or diet patterns among women aged 50 years or older were identified. The clusters were named according to the foods that contributed the greatest amount of energy as compared to the other clusters. The six clusters were named: Pasta and Yellow Vegetables; Sweets; Beef, Starches, Fruits, and Milk; Frozen Meals, Burritos, and Pizza; Meat Dishes; and Soft Drinks and Poultry. Percent energy contribution of selected food groups used to derive the clusters is presented in Table 2. The values in the table for each food group represent the amount of energy from the food group divided by the total energy for the day.

The Sweets cluster had the greatest energy contribution from cookies, cakes, pies, and pastries. However, the energy contribution of sugars and sweets in this cluster is less when compared to the other clusters (Table 2). The sugars and sweets food group included food items such as honey, molasses, and jelly preserves. Hence, the designation of the Sweets cluster refers to the consumption of foods high in sugar as opposed to the use of sugar or other sweeteners added to foods.

Evaluating the Cluster Solution

In predicting the cluster membership, a discriminant analysis was done based on the nutrient density variables used in the cluster solution (20). The level of agreement was 95.8%.

Nutrient Composition of Diet Patterns

Each diet pattern was examined in terms of the nutrient composition of selected macro- and micronutrients. The nutrients used to evaluate the nutritional composition of each cluster included those that have been implicated in CVD, such as total fat intake, polyunsaturated fat:saturated fat ratio, n-3 fatty acids, alcohol consumption, and total energy. Table 3 provides the nutrient composition within and between individual clusters and identifies significantly greater mean nutrients in each cluster.

For between-cluster comparisons, all nutrient values were significantly different while adjusting for total energy intake using a multivariate approach (19). Relative to the other clusters, the Sweets cluster had the greatest mean consumption of alcohol (6.66 g). The Soft Drinks and Poultry cluster showed the greatest amount of carbohydrates (59.66% of total energy) and lower nutrient intakes relative to the other clusters. Polyunsaturated fats:saturated fats ratio was greatest in the Pasta and Yellow Vegetables and the Sweets diet patterns. None of the nutrients were in significantly greater amounts for the Beef, Starches, Fruits, and Milk cluster. Nevertheless, this diet pattern showed the greatest variability of foods consumed, including fruits, vegetables, and dairy. As expected, the dietary pattern named Pasta and Yellow Vegetables had the greatest mean value for β -carotene (3.22 mg) and folic acid (186.54 μ g). Fiber intake was <20 g in all clusters and similar ratios of n-3:n-6 fatty acids were observed across clusters.

Diet Patterns According to Race/Ethnicity

Cross tabulations to examine the dietary patterns across race/ethnicity categories showed significant associations (data not shown). The majority of Hispanics were in the Beef, Starches, Fruits, and Milk cluster (27.7%). Non-Hispanic whites were more likely to fall into the Beef,

Starches, Fruits, and Milk cluster (32.6%). The majority of Non-Hispanic African Americans fell into the Sweets (29.3%) diet pattern.

CVD Risk Factors

Only 5% of women aged 50 years and older had no CVD risk factors. The majority (37.3%) had at least two risk factors and Non-Hispanic African Americans (13.3%) followed by non-Hispanic whites (9.7%) were more likely to have four risk factors or more. More than half of participants (73.2%) were overweight or obese as defined by BMI classification (21) and these had SBP above the optimal considered for women (>120 mm Hg) (7). Hispanics were more likely to have low HDL cholesterol levels (38.8%).

Alcohol Consumption and Race/Ethnic Categories

Average alcohol consumption for all women aged 50 years and older was 1.04 drinks per day, which is considered moderate alcohol consumption. Across race/ethnicity categories, significant differences were observed. Non-Hispanic whites reported the greatest alcohol consumption (1.17 ± 3.5 drinks/day) followed by Hispanics (0.95 ± 3.9 drink/day), Non-Hispanic African Americans (0.54 ± 2.0 drink/day) and others (0.16 ± 0.68 drink/day).

Association of Diet Patterns with CVD Risk Factors

Three separate logistic regression models were fitted. The models assessed the probability of being overweight or obese, having low HDL cholesterol levels of <50 mg/dL (<1.30 mmol/L), and having elevated SBP (>120 mm Hg). The reference category for the dietary patterns was the Soft Drinks and Poultry pattern; therefore, ORs are based on comparisons to this diet pattern. Each of the three models was statistically significant at $P < 0.0001$.

BMI Risk

If a woman was overweight or obese as measured by BMI then she was less likely to use alcohol (OR 0.83, 95% CI 0.78 to 0.89; $P < 0.0001$) less likely to be in the Beef, Starches, Fruits, and Milk diet pattern group (OR 0.42, 95% CI 0.23 to 0.77; $P < 0.0032$), and less likely to be physically active (OR 0.46, 95% CI 0.29 to 0.73; $P = 0.0011$) when compared to women who were not overweight or obese. Those who were overweight or obese were more likely to report smoking (OR 1.74, 95% CI 1.19 to 2.55; $P < 0.0043$) than women who were not overweight or obese.

HDL Cholesterol Risk

Protective factors for HDL risk included being Non-Hispanic African American (OR 0.59, 95% CI 0.44 to 0.81; $P < 0.0001$), being physically active (OR 0.71, 95% CI 0.52 to 0.98; $P = 0.0351$), being a nonsmoker (OR 0.614, 95% CI 0.446 to 0.846; $P = 0.0028$), alcohol consumption (OR 0.760, 95% CI 0.689 to 0.839; $P < 0.0001$), and being assigned to the Sweets diet pattern (OR 0.268, 95% CI 0.144 to 0.498; $P < 0.0001$) or Meat Dishes diet pattern (OR 0.941, 95% CI 0.539 to 1.646; $P < 0.0075$) relative to those in the Soft Drinks and Poultry diet pattern. In contrast, those with HDL cholesterol risk were more likely to be Hispanic.

SBP Risk

Women with elevated SBP were more likely to drink alcohol (OR 1.11, 95% CI 1.02 to 1.20; $P < 0.0001$) and be physically inactive (OR 1.83, 95% CI 1.27 to 2.63; $P = 0.0012$), and less likely to be in the Sweets diet pattern (OR 0.51, 95% CI 0.34 to 0.76; $P < 0.001$).

DISCUSSION

We assessed diet patterns and the presence of specific CVD risk factors among a national representative sample of women aged 50 years and older.

The diet pattern analysis evaluated dietary intake not by its nutrient composition but by the consumption of particular food groups. Cluster analysis to derive dietary patterns is gaining popularity in research studies. A recent review identified 35 studies using cluster analysis to evaluate food intake since 1980 (15). These methods may help avoid issues of colinearity between nutrients (15) that can confound diet–disease relationships. Grouping individuals according to the foods they consume may also facilitate the recognition of unhealthful food choices that will inevitably affect the nutrient content of the diet and the presence of CVD risk factors.

The diet patterns derived in this study indicate that women aged 50 years and older consume an average of 1,366 to 1,670 kcal/day. Consumption of fiber and n-3 fatty acids was inadequate in all diet patterns, based on the guidelines for CVD prevention (3). The diet pattern with the lowest mean energy intake was the Beef, Starches, Fruits, and Milk cluster, which was also associated with the lowest probability of being overweight or obese. This pattern is characterized by consumption of a variety of foods, including fruits, legumes, vegetables, meats, and dairy and conforms more closely to the 2005 US Dietary Guidelines (22) relative to the other patterns. Yet it showed significant associations with only one of the major CVD risk factors examined in this study; that is, being overweight or obese in the expected direction.

The Sweets dietary pattern consisted of 32% of the total sample followed by the Beef, Starches, Fruits, and Milk diet pattern (29%). A similar study (23) also reported a “Sweets” diet pattern derived from cluster analysis among a sample of adult men and women. Interestingly it was also the cluster in that study where most of the study participants were grouped.

In our study, the Sweets diet pattern also showed the most significant associations to HDL and SBP risk as a protective factor. It is noteworthy that those who did not have HDL risk were also more likely to be Non-Hispanic African Americans and they were more likely to be classified in the Sweets diet pattern. Thus, the association of the Sweets pattern to the absence of HDL risk may be partly due to the lower risk for HDL levels below the recommended among non-Hispanic African Americans in this diet pattern. The mean amount of alcohol in the Sweets pattern was 6.66 g, which represents approximately half a standard drink. Even though this may not be a considerable amount of alcohol consumption to exert an influence on HDL cholesterol levels, it is possible that the alcohol content of the diet may also be partially responsible for its association with optimal HDL cholesterol levels because, as expected, the moderate alcohol consumption reported by participants was also a protective factor for HDL risk.

In contrast, the Sweets pattern also showed a protective effect on SBP risk that cannot be explained by the lifestyle factors included in this study nor by age or race and ethnic category.

Recent studies continue to confirm the importance of fiber intake and other nutrients to achieve a decrease in cholesterol level, triglyceride level, and body weight, all of which contribute to CVD risk (24,25). Nevertheless, a recent clinical trial among postmenopausal women did not find a significant change in incidence of coronary heart events and very mild decrease in CVD risk factors after 8 years of dietary intervention to reduce fat intake and increase fruit and vegetable consumption (26). These studies reflect the complexity of dietary intake and diet–disease associations, as well as the difficulties of dietary assessment in nutritional epidemiology. Compared to dietary intake, these studies highlight the overarching role other lifestyle factors may have on health.

Our results indicate there are significant associations between diet patterns and CVD risk factors even though they were limited to 1 day of dietary data among a multiethnic population of women aged 50 years and older. The uncharacteristic protective effect of a diet characterized by a large amount of its energy from desserts or pastries may be explained by the consumption of other nutrient sources, lifestyle factors not considered in this study, or even genetic factors. Taking into account the limitations of empirically defined diet patterns, the assessment of diet intake using different methods seems essential to thoroughly describe the complex association between diet and disease. Thus, the results from this study also support the importance of assessing different aspects of dietary intake (ie, food sources) combined with lifestyle factors to explain its association with CVD risk factors.

The CVD risk factors assessed for this study indicate that women aged 50 years and older would benefit from CVD prevention interventions that target lifestyle changes such as increased physical activity to increase HDL cholesterol levels and lower BMI. Dietary interventions to increase consumption of fruits and vegetables, milk and milk products, and polyunsaturated fats among postmenopausal women continue to be necessary. According to the diet patterns derived from this study among women aged 50 years and older, high-fiber foods and n-3 fatty acids food sources must also be increased to conform to recommendations of a heart-healthy diet.

LIMITATIONS

A number of limitations in this study warrant discussion. The cross-sectional design of NHANES allows only 1 day of measurement for dietary intake, which is known to have day-to-day variability and may affect the reliability of the estimates of usual nutrient intakes (27). However, when the aim is to examine the usual dietary intake of groups rather than individuals, 1 day of dietary intake data with appropriate adjustments is adequate (19).

It is important to consider that CVD risk factors can have greater or lesser impact on the actual development of CVD disease that is not being evaluated in this study. Thus, the mere presence or absence of a particular risk factor and its association to dietary patterns do not necessarily indicate causation of CVD.

Socioeconomic status or education, which are known to influence several of the known CVD risk factors (28), were not taken into account and these factors may explain the differences in CVD risk between race/ethnic groups.

CONCLUSIONS

Although other studies have used empirically derived methods to define diet patterns and their association to CVD risk factors, this study focused on women aged 50 years and older who are at greater risk for CVD disease compared to younger women. The results from this study support the use of cluster analysis to assess dietary intake, as evidenced by the significant associations with selected CVD risk factors. Findings indicate the importance of evaluating the role of lifestyle factors and the influence of dietary intake on disease prevention. Future research should aim to evaluate dietary intake via complementary methods (ie, food and nutrient assessment) to identify the most influential interventions that can be addressed in public health campaigns aimed to reduce the development of CVD among women.

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Food group	Foods included
Alcoholic beverages	Beers and ales, cordials and liqueurs, cocktails, wines, distilled liquors
Beef	Beef steak, beef oxtails, neckbones, short ribs, head, beef roasts, stew meat, corned beef, beef brisket, sandwich steaks
Cakes, cookies, pies, pastries	Cakes, cookies, pies, cobblers, pastries, Danish, breakfast pastries, granola bars, coffee cake
Carob products	Carob powder, chips, syrup
Cereals	Ready-to-eat cereals
Cheeses	Natural cheese, cottage cheese, cream cheese, processed cheese and cheese spreads, imitation cheeses, cheese mixtures, cheese soups
Citrus fruits, juices	Citrus fruits and juices
Crackers and salty snacks from grain products	Crackers, sweet crackers, low sodium crackers, non-sweet crackers, salty snacks
Creams and cream substitutes	Sweet dairy cream, cream substitutes, sour cream
Dark-green vegetables	Leafy vegetables, nonleafy vegetables, vegetable soups
Deep-yellow vegetables	Carrots, pumpkin, squash, sweet potatoes, vegetable soups
Dried fruits	Berries, mixtures of dried fruits, mixtures of fruits with nonfruit items
Egg mixtures	Egg dishes, egg sandwiches, egg soups, meringues
Eggs	Chicken eggs, other poultry eggs
Fats	Table fats, cooking fats, other fats
Fish and shellfish	Finfish, other seafood, shellfish
Frozen and shelf-stable plate meals and soups	Frozen and shelf-stable plate meals with meat, poultry or fish, soups, broths, extracts from meat, poultry
Fruit juices and nectars	Excludes citrus fruits, nectars
Grain mixtures	Frozen plate meals or soups with grain as major ingredient
Legumes	Beans, peas, lentils, soybean derived products, meat substitutes from legume protein
Meat, poultry, fish with nonmeat items	Meat, poultry, fish in: gravy sauce, with starch item, with starch item and vegetable, with vegetables. Meat, poultry, fish in sandwich.
Milk and milk drinks	Fluid milk, yogurt, flavored milk, milk-based meal replacements, dry milk,
Milk desserts, sauces, gravies	Frozen milk desserts, pudding, custards and other milk desserts, white sauces and milk gravies
Non-alcoholic beverages	Coffee, tea, soft drinks, fruit-flavored drinks, beverages, nonalcoholic beers, wines and cocktails
Nuts, nut butters, and nut mixtures	Nuts, nut butters, nut butter sandwiches, coconut beverages, nut mixtures
Oils	Vegetable oils
Organ meats	Liver, hearts, kidney, sweetbreads, brains, tongue, other variety meats, frankfurters, sausages, luncheon meats, potted meat, spreads
Other vegetables	Raw, cooked, cooked with sauces, casseroles, olives, pickles, relishes, vegetable soups
Pancakes, waffles, French toast, and other grain products	Pancakes, waffles, French toast, crepes, flour-water patties, flour-milk patties, rice flour cakes, funnel cakes
Pastas, cooked cereals, rice	Pastas, cooked cereals, rice
Pork	Ground, pork chops, pork steaks, ham, roasts, Canadian bacon, bacon, salt pork, other pork items
Poultry	Chicken, turkey, duck, other poultry
Quick breads	Biscuits, cornbread, other muffins
Salad dressings	Regular, low-calorie and reduced calorie salad dressings
Sugars and sweets	Syrups, honey, molasses, sweet toppings, jellies, jams, preserves, gelatin desserts, ices, popsicles, candies, chewing gums, sugar replacements
Tomatoes and mixtures	Raw, cooked, in sauces, soups
White potatoes and Puerto Rican starchy vegetables	White potatoes (baked, boiled, creamed, scalloped, fried, mashed, stuffed, puffs, chips, sticks), potato salad, potato soups, Puerto Rican starchy vegetables (eg, sweet potato, tannier)
Yeast breads, rolls	Breads, white rolls, whole-wheat bread, cracked-wheat bread, rye bread, multigrain bread, cottonseed bread, other breads

Figure 1.

Food groups entered into cluster analysis from the National Health and Nutrition Examination Survey food coding scheme in a study to examine the association between diet patterns and the presence of major cardiovascular disease risk factors.

Table 1

Sample characteristics of women aged 50 years and older who participated in the National Health and Nutrition Examination Survey 2001–2002 (n=1,313) and whose dietary data were studied to examine the association between diet patterns and the presence of major cardiovascular disease risk factors

Characteristic	Mean $\pm$ standard deviation (unless specified)	Recommended values ^a
Age (y)	68.3 $\pm$ 11.1	NA ^b
Body mass index	28.7 $\pm$ 6.4	<24.9
Total cholesterol (mg/dL ^c)	217.9 $\pm$ 39.4	<130 mg/dL ^c
HDL ^d cholesterol (mg/dL ^c)	59.3 $\pm$ 17.4	>50 mg/dL ^c
RBC ^e folate (ng/mL ^f)	352.9 $\pm$ 150.5	<102.6 ng/mL ^f
Homocysteine (mg/L ^g)	1.28 $\pm$ 0.9	>2.03 mg/L
Systolic blood pressure (mm Hg)	142.9 $\pm$ 25.8	<120 mm Hg
Alcohol consumption (drinks/day)	1.0 $\pm$ 3.3	1 drink/day
Non-Hispanic whites (n)	809	NA
Non-Hispanic African Americans (n)	223	NA
Hispanics (n)	236	NA
Others (n)	45	NA

^aSource: reference 7.

^bNA=not applicable.

^cTo convert mg/dL cholesterol to mmol/L, multiply mg/dL by 0.0259. To convert mmol/L cholesterol to mg/dL, multiply mmol/L by 38.7. Cholesterol of 193 mg/dL=5.00 mmol/L.

^dHDL=high-density lipoprotein.

^eRBC=red blood cell.

^fTo convert ng/mL folate to nmol/L, multiply mg/dL by 2.266. To convert nmol/L cholesterol to ng/mL, multiply nmol/L by 0.44. Folate of 352 ng/mL=797 nmol/L.

^gTo convert mg/L homocysteine to μ mol/L, multiply mg/L by 7.397. Homocysteine of 1.28 mg/L=9.47 μ mol/L.

Percent energy contribution^a of selected food groups across diet patterns derived by cluster analysis among women aged 50 years and older who provided dietary data through the National Health and Nutrition Examination Survey 2001–2002 (n=1,313)

Table 2

Food or food group ^b	Diet Pattern Group (Clusters)					
	Pasta and yellow vegetables (n=95)	Sweets (n=433)	Beef, starches, fruits, and milk (n=377)	Frozen meals, burritos, and pizza (n=167)	Meat (not beef or pork) dishes (n=131)	Soft drinks and poultry (n=110)
Pork	1.56	0.67	1.93	0.83	0.68	1.31
Yeast bread, rolls	6.20	1.83	14.23	7.02	7.05	7.70
Cakes, cookies, pies, pastries	1.99	7.73	3.76	4.86	5.02	3.82
Other fruits	4.20	1.58	6.18	4.23	3.94	2.08
Other vegetables	3.26	1.42	3.83	2.67	2.52	2.77
Fats	0.52	0.71	1.92	1.23	1.08	1.11
Sugars and sweets	2.27	1.46	4.05	3.16	3.56	3.75
Nonalcoholic beverages	4.45	1.95	4.28	4.39	6.79	23.93
Milk and milk drinks	5.60	1.43	9.17	5.14	4.59	2.28
Grain mixtures, frozen plate meals, soups	1.28	0.77	0.94	28.20	1.23	1.55
Citrus fruits, juices	2.53	1.14	2.32	2.26	1.55	0.68
White potatoes and Puerto Rican starchy vegetables	1.91	1.72	5.45	2.00	3.19	4.38
Deep-yellow vegetables	1.49	0.30	0.56	0.29	0.20	0.30
Salad dressings	1.60	0.79	2.29	2.07	1.88	2.29
Cheeses	1.47	1.04	2.81	1.53	1.56	1.04
Organ meats, sausages and lunch meats	1.56	0.98	2.53	1.52	1.25	2.02
Milk desserts, sauces, gravies	1.54	1.50	2.17	1.93	3.33	3.38
Cereals, not cooked	2.14	0.98	4.82	2.47	2.82	1.53

Food or food group ^b	Diet Pattern Group (Clusters)					
	Pasta and yellow vegetables (n=95)	Sweets (n=433)	Beef, starches, fruits, and milk (n=377)	Frozen meals, burritos, and pizza (n=167)	Meat (not beef or pork) dishes (n=131)	Soft drinks and poultry (n=110)
Poultry, fish with non-meat items	4.54	0.73	1.08	1.76	29.34	2.48
Beef	1.56	0.68	3.90	1.37	0.45	3.09
Pastas, cooked cereals, rice	24.33	0.65	1.35	1.46	3.45	1.77
Dark-green vegetables	1.18	0.27	0.39	0.53	0.14	0.54
Poultry	4.14	1.41	3.53	1.89	1.00	7.56

^aPercent energy contribution=energy from food group divided by total energy intake×100.

^bColumns do not add up to 100 because not all food groups are shown in the Table.

Table 3

Nutrient composition of each diet pattern derived by cluster analysis, among women aged 50 years and older who provided dietary data in the National Health and Nutrition Examination Survey 2001–2002 (n=1,313) for a study to examine the association between diet patterns and the presence of major cardiovascular disease risk factors

	Diet Pattern					
	Pasta and yellow vegetables	Sweets	Beef, starches, fruits, milk	Frozen meals, burritos, pizza	Meat dishes	Soft drinks, poultry
Total energy (kcal)	1,538	1,644	1,366	1,670	1,495	1,584
Carbohydrates (%)	55.15	49.81	52.14	51.63	50.58	59.66*
Protein (%)	15.52	14.53	17.10	15.13	17.33*	13.51
Fat (%)	30.12	35.54*	32.77	33.85	33.61	28.63
Fat (g)	54.16	65.54*	50.56	63.45	56.21	50.57
P:S ratio ^a	0.96	0.96	0.69	0.69	0.85	0.88
n-3/n-6 fatty acids	0.35	0.37*	0.34	0.36	0.35	0.35
Alcohol (g) ^b	2.27	6.61*	1.68	4.13	1.55	0.99
Fiber (g)	14.68	14.11	13.72	15.44*	12.38	12.72
β-carotene (mg)	3.22*	2.87	2.06	2.26	1.31	2.47
Ascorbic acid (mg)	83.74	93.82	81.02	108.24*	75.76	97.00
Vitamin E (mg)	6.46*	6.15	4.94	6.25	4.75	4.87
Folic acid (μg)	186.54*	125.10	167.22	162.77	148.76	126.48
Calcium (mg)	667.11	551.80	666.80	760.17*	547.89	448.37
Iron (mg)	13.46*	12.04	12.49	12.65	11.79	10.96
Selenium (μg)	91.50*	77.19	76.24	81.54	80.45	73.01
Zinc (mg)	8.40	7.61	9.06	8.69	9.81*	7.67

^a P:S ratio=polysaturated fat to saturated fat ratio.

^b Median values given for alcohol.

* P<0.05 based on cross-cluster comparisons using *F* tests.