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Dietary patterns among overweight and obese African-American women living in the rural South

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Abstract

Introduction—Obesity and chronic diseases disproportionately affect African-American women in the rural South (US), and may be influenced by adherence to a typical Southern-style diet. There is a need to examine dietary patterns of this population, and to determine if consumption of nutritionally rich foods like nuts is associated with consumption of other nutritious foods. The objectives of this study were to identify: (1) Dietary patterns of overweight/obese African-

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Compliance with Ethical Standards

Conflicts of Interest: SS, SJ, BB, TLC, PCL, and MLB declare that they have no conflicts of interest.

Research involving Human Participants: All procedures performed in this study involving human participants were in accordance with the ethical standards of the Institutional Review Board and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was obtained from all individual participants included in the study.

American women in the rural South; (2) The role that nuts play in the diet; (3) Adherence to federal food group recommendations across dietary patterns.

Methods—Secondary data analysis of two baseline 24-hour dietary recalls was performed on 383 overweight/obese African-American women enrolled in a weight loss intervention in Alabama and Mississippi between 2011–2013. Cluster analysis identified dietary patterns. T-tests and chi-square tests tested demographic and dietary differences across clusters. The proportion of women in each cluster who met federal recommendations for fruit, vegetable, nuts, added sugar, and sodium intake was calculated.

Results—Two dietary patterns were found. Nut intake frequency was higher in Cluster 2 ($P < .001$), which was characterized by a higher intake frequency of fruits and vegetables, but high mean daily intake of added sugar (12.26 ± 7.67 tsp) and sodium (2800 ± 881 mg). Ninety-two percent of participants in this cluster consumed red/processed meats daily.

Conclusion—Even among women in this population who consume a more plant-based dietary pattern containing nuts, there is still a need to decrease intake of added sugar, sodium, and red meat.

Keywords

diet patterns; nuts; African-American; women; rural health

Introduction

Obesity and dietary patterns

Obesity continues to be a problem throughout the United States, and disproportionately affects rural residents (40%), African-Americans living in the Southeast (Alabama, 42%; Mississippi, 43%), and African-American women (60%) [1–3]. Four out of five African-American women are either overweight or obese [4]. African-American women are even more obese (57%) than African-American men (38%), and African-American women in the South are more vulnerable to obesity than other ethnic groups in other parts of the country [5]. Obesity contributes to a myriad of chronic diseases, including certain cancers (eg, endometrial, breast, colon) [6]. Death rates for obesity-related cancers are higher for African-Americans than for Whites [7]. Since diet is linked to obesity, it is important to identify potential dietary factors that may predispose vulnerable populations like African-American women in the rural South to obesity and its related chronic conditions.

Health benefits of diets rich in nuts

A diet that includes nuts can positively affect health by increasing diet quality, facilitating a healthy weight status, and decreasing obesity-related disease risks like coronary heart disease [8–11]. Nut consumption facilitates a healthy weight status by increasing satiety and substituting for less nutritious, high calorie foods in the diet [8]. Further, although nuts are energy-dense, their absorption in the body is inefficient, with up to 18% being excreted in the stool [8]. Nuts also contain a variety of vitamins, minerals, unsaturated fats, and polyphenols with antioxidant capacity which provide additional protection against chronic diseases [8, 9]. Dietary patterns that include nuts (eg Mediterranean, prudent dietary patterns)

generally result in a lower risk of hypertension, stroke, atherosclerosis, and cancer [12–16]. The 2015 United States Department of Agriculture (USDA) Dietary Guidelines for Americans recommends following a dietary pattern that emphasizes vegetables, fruits, and nuts, and limiting red/processed meats and high sugar foods and beverages [17].

Although foods like nuts can positively impact health, in recent years, the need to focus on the overall diet rather than on isolated foods and nutrients has become more apparent. King et al acknowledged the need for future research to examine nut consumption in the context of diet patterns in various populations in order to better make dietary recommendations [18]. Since the synergistic effects of foods are more potent in affecting health than a single food item alone [19, 20], the health benefits of nut consumption may either be amplified or diminished due to interactions with other food items in the diet.

Dietary patterns among African-Americans in the rural Southeastern region of the United States

The typical Southern-style diet among African-Americans in the rural Southeastern region of the United States increases obesity and chronic disease risks, being characterized by a high intake of fried and salty foods, sugar-sweetened beverages, and red and processed meats [21, 22]. Red and processed meats in particular increase both obesity and cancer risks [23–25], and a diet high in added sugars and sodium can increase risk for obesity and obesity-related chronic diseases [26–29]. On the other hand, obesity and cancer-protective plant foods like sweet potato, black-eyed peas, turnip greens, and collard greens are also staples in the diet [30–32]. Tree nuts and peanuts are abundant in the South and may also form parts of popular cuisine [33–35]. In fact, Alabama ranks 8th in pecan production in the nation, and 72% of all U.S. produced peanuts are produced in the Southeast (Georgia, Mississippi, Alabama, and Florida)[33, 35]. Nuts may therefore be widely available to residents in the rural South. Since its consumption is associated with positive health outcomes, the inclusion of nuts in the overall diet is important to identify, particularly in this population. However, it is unknown if nut consumption is associated with a higher intake of other beneficial foods, or if it is associated with a typical Southern-style dietary pattern. In other dietary patterns that contain nuts (eg Mediterranean, prudent diets), nut consumption is associated with a higher intake of other beneficial foods like fruits and vegetables, and little to no intake of less beneficial foods like red and processed meats [13–16]. An association between nut consumption and the consumption of foods that increase disease risk may impede the health benefits of nut intake in this population.

The primary objective of this study was therefore to identify dietary patterns among overweight and obese African-American women living in the rural Southeastern region of the United States, and to examine nut intake across dietary patterns. Because little is still known about dietary patterns in this population, we assumed the null hypothesis, that there would be no difference in nut intake across dietary patterns, even in a pattern that includes more plant-based foods. A secondary objective was to examine difference in adherence to federal recommendations for select food groups (fruits, vegetables, and nuts) and food components (added sugars and sodium) across dietary patterns. Since African-Americans

tend to exhibit low adherence to federal dietary recommendations [36], we hypothesized that there would be low adherence to these recommendations.

Materials and Methods

The present study utilized data from an existing study by the Deep South Network for Cancer Control (DSN). DSN is an academic-community partnership that seeks to eliminate cancer disparities in Alabama and Mississippi through collaboration among academic professionals, community liaisons, community leaders, and lay volunteers. Demographic and dietary data were obtained from 383 African-American women who enrolled in a weight loss intervention through DSN between January 2011 and September 2013 [37, 38].

Participants lived in one of eight rural counties in the Alabama Black Belt or the Mississippi Delta (four counties in each state). Participants from all counties received community strategies for weight loss, but only four of the counties (two in each state) also received community strategies for weight loss [37, 38]. The research protocol was approved by the Institutional Review Board at the University, and all participants provided written informed consent.

Participants were recruited by trained staff who lived in each county. Those who met inclusion criteria self-identified as African-American, aged 30 to 70 years, and were overweight (BMI 25 – 29.9 kg/m²) or obese (BMI ≥ 30 kg/m²) at baseline [6]. Those excluded reported smoking cigarettes, history of weight loss surgery, eating disorder, recent cardiac event, or mobility impairment. Women with elevated measured fasting blood sugar (>126 mg/dL) or blood pressure (systolic >160 mmHg or diastolic >100 mmHg) at baseline were also excluded. Overall, the study enrolled 409 participants, and 383 enrolled women provided two baseline dietary recalls (one weekend and one weekday). Sensitivity analysis revealed significant dietary differences between unenrolled and enrolled women; therefore, the present analysis includes only data from the 383 enrolled women who provided two baseline dietary recalls.

Anthropometric data

At baseline, height and weight were measured by trained staff using a portable stadiometer (SECA 2-in-1 Model #8761321004). Height was measured to the nearest 0.1cm and weight to the nearest 0.1kg with light clothing and without shoes. BMI was calculated from height and weight measurements.

Demographic data

Participants completed a demographic questionnaire that provided information regarding age, income, and education level.

Dietary measures

The web-based Automated Self-Administered 24-hour recall (ASA24) system from the National Cancer Institute (NCI) was used to assess dietary intake [39]. ASA24 uses the Automated Multi-pass Method that probes users multiple times in order to capture all foods

eaten, including those commonly overlooked [39]. Two recalls have been suggested for this population in previous dietary assessments [36], and were used in the present study. Rather than using the self-administered protocol, trained staff members interviewed participants and entered the information in to ASA24 as the participant was guided through the recall to account for issues pertaining to limited internet accessibility or low literacy level. Data were retrieved from the ASA24 researcher website. The ASA24 database was combined with the MyPyramid Equivalents Database (MPED) from United States Department of Agriculture (USDA) to categorize foods into food groups and food components, as illustrated in Figure 1 [40].

Grouping and categorizing foods

Using the combined database, foods were further grouped into non-overlapping categories based on the ASA24 descriptions of foods and meals eaten. The process of identifying food categories for the dietary pattern analysis was based partly on use of food groups provided by MPED and ASA24, and partly on a procedure of identifying other food categories. ASA24 provided descriptions of all food items, including meats, dairy, eggs, grains, fruits, vegetables, sugars, fats, nuts, beverages, and snacks. In order to observe differences in dietary patterns and to capture important food categories for this population, we further identified dessert foods, fried foods, sugar-sweetened beverages, fast foods (including convenience foods), as well as salads and low-fat dairy (including vegetarian substitutes) based on participant description of food items, as recorded in ASA24. For example, foods described as burgers, fries, Chinese food, and pizza were placed in the “Fast Food” category. The “Dessert” category included any description of cakes, cookies, pies, and other sweetened foods. The “Low-fat Dairy” category included all descriptions of skim or low-fat milk, cheese, yogurt, and vegetarian substitutes (e.g., vegetarian mayonnaise, non-dairy cheese). Descriptions for each of the food categories that were used to identify dietary patterns are reported in Figure 1. These food categories were used to identify distinct dietary patterns using variable clustering, and then women were placed into clusters based on similar dietary patterns, as described below.

Statistical analysis

Variable Clustering / Ward’s Clustering procedure—Dietary patterns for this study were identified with Cluster Analysis, using a combination of Variable Clustering and Ward’s Clustering Procedure. Cluster analysis is an exploratory statistical procedure in which variables in a dataset are assembled into groups based on similarities [41]. When used to assess dietary intake data, cluster analysis separates participants into clusters of similar diet patterns, commonly based on similar patterns of food or food group consumption [41, 42]. Cluster analysis has been shown to have high reliability and internal stability [41, 42].

Food consumption patterns were first identified using Variable Clustering, which is a multivariate technique that groups variables (in this case, food groups) based on the degree of correlation among them (i.e., similarities in frequency of intake). In the multi-step clustering process, all variables begin in a single cluster, and are split and assigned to new clusters using a variable clustering algorithm. The algorithm creates smaller clusters based on the principal components (food item(s) eaten most frequently) of each cluster. Food items

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were assigned to clusters based on their correlation with the principal components in each cluster [42, 43]. The optimal number of clusters for variables was based on a scree plot, which stopped splitting variables when eigenvalues were less than 1. Using this method, 10 clusters of food groups were identified (Figure 2). The proportion of variation explained using this variable clustering technique was 49%.

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Next, a hierarchical cluster analysis (Ward's clustering procedure) [41, 42, 44] was used to assign participants into similar dietary patterns. Hierarchical clustering is the ideal clustering procedure used for datasets that contain up to a few hundred variables and similar subjects [45, 46]. This method was chosen instead of the k-means clustering procedure, which is generally recommended for much larger datasets [47]. Participants were then assigned to clusters based on similar frequency of intake of each food group, such that each participant fell into only one cluster. The number of clusters of women was chosen based on the recommendation of between 2 and 6 as the optimal number of dietary patterns in cluster analysis [41]. Cluster stability was confirmed with a follow-up discriminant analysis [48], which was performed on 2–6 cluster solutions using the 10 dietary patterns in all 383 women. This approach confirmed that 89% of the sample was correctly clustered using the 2-cluster approach. Although all of the cluster solutions were stable (between 83% and 89% correct cluster assignments), cluster stability decreased with increasing number of clusters; therefore, we opted for the 2-cluster approach since it was the most stable.

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Once clusters of food categories were identified and participants assigned to a given cluster, we compared the demographic characteristics of each cluster. After applying the Johnson SI transformation for BMI, we used t-tests to assess cluster differences for mean age, BMI, and food intake frequency, and chi-square tests to assess education and income level differences. Results for each demographic variable were also tested against a regression model that was fully adjusted for the remaining demographic variables (including BMI, age, income, and education).

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We further identified the likelihood of participants in each cluster meeting the federal recommendations for daily intake of fruit, vegetable, nuts, added sugar, and sodium through chi-square tests. MPED was used to calculate the differences between clusters for mean daily consumption of fruits, vegetables, nuts, red and processed meats, added sugar, and sodium. Nut intake was calculated in ounce equivalents, where half-ounce of nuts (including peanuts and seeds) is defined as nutritionally equivalent to one ounce of lean meat. Descriptions of these food categories are reported in Figure 3. The following reference standards for adult females were used to assess daily adherence to federal dietary recommendations : 1.5 cups of fruit, 2.5 cups of vegetables (31 to 50 years of age) or 2 cups (> 50 years of age), 1.5 ounces of nuts, less than 6 teaspoons of added sugar, and less than 1500 mg of sodium for African-Americans [17, 49, 50]. JMP Pro 12 statistical software was used for all tests [51], and P-values of .05 were considered statistically significant.

Results

Dietary patterns

Based on the variable clustering technique, 10 different clusters of food groups were identified among our sample of 383 women (Figure 2). Nut intake was highly correlated with intake of added sugar, tea/coffee, full-fat dairy and mayonnaise, and grain, and was assigned to the Added Sugar group.

We further identified two distinct clusters of women with similar intake patterns of the 10 clusters of food groups. Among our participants, Cluster 1 was characterized by a higher frequency of intake for cereals, fast food / fried foods, and desserts. Cluster 2 was characterized by a higher frequency of intake for salads, water, whole grains, potatoes, added sugars, and alcohol. Nuts were consumed more frequently in Cluster 2.

The demographic characteristics of participants by cluster are reported in Table 1. Although participants in each cluster were similar with regard to income ($\chi^2=8.3$, $P = 0.20$) and education level ($\chi^2=4.1$, $P = .25$), those from Cluster 2 were older ($P < .001$), and had lower BMI values, although this was only mildly significant ($P = .06$). When total kilocalories consumed and other demographic variables were adjusted for, the relationship between cluster assignment and age persisted ($P < .001$), but not cluster assignment and BMI ($P = .34$). There was also no difference in likelihood of being overweight vs. obese between the two clusters ($P = .35$). Cluster 2 participants were more likely to be over 50 years old than those in Cluster 1 ($\chi^2=20.3$, $P < .001$).

Dietary patterns

There were statistically significant differences in the daily intake frequency of 9 of the 10 food groups between clusters (Table 2). Nut intake frequency was significantly higher in Cluster 2 ($P < .001$), and participants in this cluster also had the highest intake frequency of fruits, vegetables, salads, and water ($P < .001$ for all). However, they also had higher intake frequencies of red meats and added sugars ($P < .001$ for both). Participants in Cluster 1 had the highest intake frequency of fast food, dessert foods, and sugar sweetened beverages ($P = .004$, $P = .03$, $P = .001$, respectively). The clusters were similar with regard to frequency of consumption of processed meats, salty snacks, and legumes ($P = .72$, $P = .11$, and $P = .25$, respectively).

Adherence to federal recommendations of food groups and components

There was no difference in total kilocalorie consumption between the two clusters ($P = .87$). When adjusting for total kilocalories consumed (mean intake per 1000 kcal), BMI, age, education, and income, participants in Cluster 2 had significantly higher mean daily intakes of nuts than participants in Cluster 1 ($P = .001$). However, there was no difference in likelihood of meeting recommendations for daily nut, fruit, vegetable, or added sugar intake among participants in Clusters 1 and 2 (Table 3). Further, participants in Cluster 2 were less likely to meet recommendations for daily sodium intake than participants in Cluster 1 (Table 3). Participants in both clusters consumed more than two times the recommended daily limit for added sugars, and almost two times the recommendation for sodium intake for African-

Americans (Cluster 1: added sugar, 14.10 ± 9.50 tsp and sodium, 2713 ± 1118 mg; Cluster 2: added sugar, 12.26 ± 7.67 tsp and sodium, 2800 ± 881 mg).

Demographic predictors of dietary habits

In the adjusted regression analysis, the relationship between demographic variables and nuts, fruits, vegetables, red and processed meats, added sugars, and sodium was identified. Age was consistently a strong predictor of healthier food choices in the models. Age was positively associated with mean daily nut, fruit, and vegetable intake ($P = .05$, $P = .001$, and $P = .002$), and negatively associated with added sugar intake ($P = .009$). Age was also negatively associated with BMI ($P = .002$). Participants over 50 had lower BMI values than those 50 and under ($P < .001$), although this association was more significant in Cluster 1 ($P < .001$) than in Cluster 2 ($P = .06$). BMI was negatively associated with mean daily added sugar intake ($P = .01$), and education level was positively associated with nut intake ($P = .002$) and vegetable intake ($P = .04$).

Discussion

It is important to identify dietary patterns among populations that are disproportionately affected with chronic diseases in order to observe the interrelationship between food items that have health benefits and those that do not. The aim of our study was to observe whether or not consumption of nutritionally rich food items like nuts is associated with a greater consumption of other beneficial foods. The present study identified two distinct dietary patterns among overweight and obese African American women in rural Alabama and Mississippi. Nut intake frequency was higher in Cluster 2, which also contained a higher intake frequency of fruits and vegetables. The identification of this pattern suggests a trend toward consumption of nutritionally rich foods by women in a culture that is traditionally characterized by unhealthy dietary practices.

Yet, although there was a cluster that contained nutritionally rich and protective foods, few of the participants in this cluster adhered to federal recommendations for daily fruit, vegetable, and nut intake. This finding is consistent with what has been noted in other studies, where African-American women generally fail to meet federal dietary recommendations [36]. However, given that there was no significant difference in BMI across clusters, it is possible that the obesity-protective effects of nuts and other foods contained in this cluster may not be seen because of failure to meet dietary recommendations.

Additionally, participants in Cluster 2 consumed approximately two times the recommended limit for daily added sugar, and were less likely to meet federal daily limits for sodium intake than participants in Cluster 1. A diet high in added sugar and sodium has been linked to obesity, and a high sodium diet is particularly detrimental for African-Americans who are predisposed to hypertension and insulin resistance [26–29, 52, 53]. Thus, even though healthy eating behaviors were identified among women in this sample, little fruit and vegetable consumption, coupled with high added sugar and sodium intake, may predispose women to obesity and its related chronic diseases.

Red and processed meat intake was also high among participants in this study. Mean intake of red meat was similar between clusters. Eighty-eight percent of participants in Cluster 1 and 92% of participants in Cluster 2 consumed red and/or processed meat over the two-day recall period. Previous findings show that red and processed meats constitute a major part of the traditional diets of African-Americans in the South [21]. Such dietary choices could negate the synergistic benefits seen in other diets that include nuts, fruits, and vegetables. Although nut consumption provides weight and cancer-protective benefits, consumption of red and processed meats is associated with both weight gain and cancer [16, 24, 25, 54, 55]. It has been suggested that part of the weight stabilizing benefits seen in nut consumption come from the substitution of energy-dense foods with nuts, which provide a satiating effect [11]. If nut consumers eat similar amounts of red meat as non-consumers, such benefits may not be seen.

Within African-American communities, there may be a perception that healthful eating means giving up traditional ways of cooking and eating [56]. Additionally, common beliefs such as that a meal must have meat in order to be complete [56] may serve as a further barrier to more plant-based diets. These beliefs may represent challenges for those who seek to transform their diets to include more nutrient-rich foods.

Another finding of interest in our study was that age continued to be a strong predictor of diet choices and BMI, even apart from cluster assignment. Older participants tended to weigh less and select healthier food choices than younger participants. This finding may be due, at least in part, to previous research that has highlighted that older African-Americans tend to be motivated to eat healthier due to disease onset [56]. As they age, African-Americans may only begin selecting nutritious foods when they see adverse effects in their health [56]. Still, traditionally “Southern” foods may continue to be part of their diets, even in small ways, because of deep cultural influences. This may explain why even in Cluster 2, which contained more plant-based foods, red meats and added sugars were still eaten frequently.

Future dietary interventions in this community should focus on increasing intake of plant foods like nuts, fruits, and vegetables. Interventions should encourage community members, including those who follow a more plant-based diet, to substitute red and processed meats for leaner meats and other forms of protein, and to reduce added sugars and sodium intake. Adherence to these recommendations may decrease the prevalence of obesity and its related chronic diseases among African-American women living in the rural South.

Strengths and limitations

The use of a 24-hour recall to assess dietary intake may be limited in accuracy, relative to more direct measures of dietary intake, such as doubly labeled water. However, such measurements were infeasible due to our large sample size. Further, the software used to assess dietary intake was a strength of our study. Two recalls were conducted, and ASA24 uses the Automated Multi-pass Method, which probes users multiple times for foods they may easily forget.

This study utilized a large sample size, and participants were homogeneous in race, weight status, geographic location, and gender. Therefore, results provide a deeper understanding of the context of nut intake among overweight and obese African-American women in the South. Caution should be used when generalizing the findings to women of other races, age groups, and regions of the country.

Conclusion

Our study identified two distinct dietary patterns among overweight and obese African-American women in the rural South. Even in the cluster that contained higher intake frequency of plant-based foods, participants did not meet recommendations for fruit, vegetable, nut, added sugar, and sodium intake. Most of the participants in this cluster also consumed red and processed meats. Nutrition education strategies in this community should affirm healthy eating trends, while encouraging increased intake of nuts, fruits, and vegetables, and decreased intake of added sugars, sodium, and red and processed meats.

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Food grouping	Food items included
1. Alcohol	Beer, wine, and distilled spirits
2. Cheese	Hard natural cheese, soft cheese, processed cheese, and cheese products
3. Cold cereals*	Cold breakfast cereals and cereal bars
4. Desserts*	Cakes, candy, pies, sweet rolls, ice-cream/frozen desserts, muffins, pastries, cookies, donuts, puddings, fondants
5. Eggs	Lean meat from chicken eggs or other poultry eggs; egg dishes
6. Fast food*	Fast food items and convenience foods including: beef, pork, or chicken burgers, pizza, Chinese food, burritos, tacos, and fajitas, fries, egg/sausage/cheese sandwiches, frozen meals
7. Fats/oils	Margarine, butter, or a blend of butter and margarine, coconut or palm oils
8. Full-fat dairy	Whole milk, yogurt, cream, and mayonnaise
9. Fish	Cooked lean meat from fish, including finfish, shellfish, and other seafood
10. Fried foods*	Fried breads, potatoes (not French fries), rice, vegetables, eggs, chicken, fish, red meat, and organ meat
11. Fruit	Fruit in forms other than juice, including citrus, non-citrus, and other fruit
12. Grains*	Grains and grain dishes, including bread, rice, and pasta dishes
13. Greens	Turnip greens, collard greens, mustard greens
14. Legumes	Dried beans and peas, and legume dishes
15. Low-fat dairy*	Low-fat milk, yogurt, and mayonnaise; fat-free cream and butter; egg whites; vegetarian dairy, mayonnaise, and meat substitutes
16. Nuts	Lean meat from tree nuts, nut butters, peanuts, and seeds

17. Potatoes	White potato in various forms such as baked, boiled, mashed potato, or potato salad
18. Poultry	Cooked lean meat from chicken, turkey, duck, and other poultry; poultry dishes
19. Processed meat	Cooked lean meat from franks, sausages, and luncheon meats; processed meat dishes
20. Red meat	Cooked lean meat from beef, pork, veal, lamb, and game; red meat dishes
21. Salads	Green leafy salads; salad dressings
22. Salty snacks*	Potato chips, other chips, pretzels, popcorn
23. Sauces/* condiments	Sauces and condiments, including, but not limited to: salsa, ketchup, barbeque sauce, vinegar, dips, soy sauce
24. Soups*	Vegetable and meat based soups and broths
25. Sugar-sweetened beverages*	Beverages sweetened with sugar, including fruit and vegetable juices and drinks, energy drinks, sweetened teas and coffee, sweetened milk beverages, sodas
26. Added sugars	Added sugars from white sugar, brown sugar, raw sugar, corn syrup, corn syrup solids, high fructose corn syrup, malt syrup, maple syrup, pancake syrup, fructose sweetener, liquid fructose, honey, molasses, anhydrous dextrose, crystal dextrose, and dextrin
27. Tea/coffee*	Hot beverages including herbal and fruit teas, hot chocolate, and coffee
28. Vegetables	All vegetables except potato, greens, and salads; vegetable dishes
29. Water*	Water from bottled, tap, and spring sources
30. Whole grain*	Brown rice, oatmeal, grits, wheat germ

Fig. 1.

Thirty food categories were used to identify dietary patterns for 383 overweight and obese African-American women in rural Alabama and Mississippi. Foods were grouped based MPED food groups and ASA24 food descriptions.

* These food items were grouped into categories based on ASA24 food descriptions.

Food grouping	Food items included in cluster
(Principal foods)	
1. Salads	Salads; vegetables; cheese; eggs
2. Added sugars	Added sugars; tea and coffee; full-fat dairy; nuts; grains
3. Cold cereals	Cold cereals; low-fat dairy; fish
4. Fast food	Fast foods; fried foods; sauces
5. Water	Water; Fruit
6. Salty snacks	Salty snacks; processed meats; beans
7. Whole grain	Whole grains; discretionary fats and oils
8. Potato	Potatoes; red meat; soups
9. Alcohol	Alcohol; poultry
10. Desserts	Desserts; sugar-sweetened beverages

Fig. 2.

Ten non-overlapping dietary patterns were identified for two clusters of 383 overweight and obese African-American women in rural Alabama and Mississippi based on 30 food categories. Participants were assigned to clusters based on frequency of consumption of food categories.

MyPyramid	
Equivalents	
Database (MPED)	Description of food items
Food grouping	
1. Total fruit	Fruit from any source, including, but not limited to, whole fruit, fruit juice, and fruit pies and/or cakes. Measured in cups.
2. Total vegetable	Vegetables from various sources, including dark green vegetables, orange vegetables, tomatoes (including tomato-based sauces), potatoes, starchy vegetables and other vegetables. Measured in cups.
3. Nuts	Tree nuts, seeds, and peanuts. Measured in ounce equivalents.
4. Red meat	Beef, lamb, veal, pork, and game. Measured in ounces.
5. Processed meat	Cooked meat from frankfurters, sausages, and luncheon meats. Measured in ounces.
6. Added sugars	White sugar, brown sugar, raw sugar, corn syrup, corn syrup solids, high fructose corn syrup, malt syrup, maple syrup, pancake syrup, fructose sweetener, liquid fructose, honey, molasses, anhydrous dextrose, crystal dextrose, and dextrin. Measured in teaspoons.

Fig. 3.
Description of six USDA food groups used to examine adherence to federal recommendations among 383 overweight and obese African-American women in rural Alabama and Mississippi.

Table 1

Demographic characteristics of 383 overweight and obese African-American women living in rural Alabama and Mississippi (2011–2013) by cluster^a

Demographic variable	Cluster 1 (n=249)	Cluster 2 (n=134)
	Mean (SD)	Mean (SD)
Age, years	44.9 (9.5)	49.9 (10.2) ^{b*}
BMI, kg/m ²	39.1 (7.8)	37.8 (8.7)
BMI Category	n (%)^c	n (%)
Overweight (25 – 29.9 kg/m ²)	19 (8)	14 (10)
Obese (≥ 30 kg/m ²)	230 (92)	120 (90)
Income	n (%)^c	n (%)
< \$10,000	52 (21)	22 (16)
\$10,000–\$19,999	59 (24)	28 (21)
\$20,000–\$29,999	49 (20)	31 (23)
\$30,000–\$39,999	31 (12)	26 (19)
\$40,000–\$49,999	26 (10)	6 (4)
\$50,000 or more	23 (9)	13 (10)
Don't know/unsure	7 (3)	4 (3)
N missing	2 (1)	4 (3)
Education	n (%)^c	n (%)
Less than High School	11 (4)	11 (8)
High School graduate/GED	81 (33)	48 (36)
Some post High School	49 (20)	22 (16)
College graduate or more	106 (43)	47 (35)
Not applicable	0 (0)	1 (1)
N missing	2 (1)	5 (4)

^a Participants were assigned to clusters based on similar frequency of intake of food groups, such that each participant data fell into only one cluster.

^b Difference in age between Clusters 1 and 2: t-ratio=4.75;

* P-value < .001

^c Percentages may not total 100 due to rounding

Table 2

Non-overlapping food categories with similar intake frequency over two days in two clusters of 383 overweight and obese African-American women in rural Alabama and Mississippi, 2011–2013^a

Food groups	Frequency of consumption		P-value
	Cluster 1 (n=249) Mean $\pm$ SD	Cluster 2 (n=134) Mean $\pm$ SD	
1. Salads	3.35 $\pm$ 2.95	5.55 $\pm$ 4.27	< .001
2. Added sugars	4.61 $\pm$ 2.92	7.11 $\pm$ 3.82	< .001
3. Cold cereals	1.47 $\pm$ 1.64	0.78 $\pm$ 0.96	< .001
4. Fast food / fried foods	2.45 $\pm$ 2.00	1.86 $\pm$ 1.51	.003
5. Water	4.95 $\pm$ 2.72	6.73 $\pm$ 3.71	< .001
6. Salty snacks	1.68 $\pm$ 1.33	1.59 $\pm$ 1.19	0.52
7. Whole grains	0.37 $\pm$ 0.58	1.54 $\pm$ 1.30	< .001
8. Potato	1.31 $\pm$ 1.13	1.79 $\pm$ 1.33	< .001
9. Alcohol	1.39 $\pm$ 1.11	1.83 $\pm$ 1.43	.001
10. Desserts	4.06 $\pm$ 2.34	3.19 $\pm$ 2.01	< .001

^a Means that are significantly higher are in bold

Table 3

Difference in likelihood of meeting daily federal recommendations for food groups and components in two clusters of 383 overweight and obese African-American women in rural Alabama and Mississippi, 2011–2013

Food group/food component	Participants who met federal recommendations		P-value
	Cluster 1 (n=249) n (%)	Cluster 2 (n=134) n (%)	
Fruits, cups	45 (18)	32 (24)	.18
Vegetables, cups	34 (14)	26 (20)	.14
Nuts, oz	11 (4)	12 (9)	.07
Added sugars, tsp	44 (18)	27 (20)	.55
Sodium, mg	30 (12)	6 (4)	.02