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Associations between diet quality scores and central obesity among adults in Puerto Rico

Emily Riseberg[1], **Martha Tamez**[2], **Katherine L. Tucker**[3], **Jose F. Rodriguez Orengo**[4,5], **Josiemer Mattei**[2]

[1]Department of Public Health and Community Medicine, Tufts University School of Medicine, Boston, MA, USA

[2]Department of Nutrition, Harvard T.H. Chan School of Public Health, Boston, MA, USA

[3]Department of Biomedical and Nutritional Sciences, Zuckerberg College of Health Sciences, University of Massachusetts Lowell, Lowell, MA, USA

[4]FDI Clinical Research, San Juan, Puerto Rico, USA

[5]Department of Biochemistry, School of Medicine, Medical Sciences Campus, University of Puerto Rico, San Juan, Puerto Rico, USA

Abstract

Background: Adults in Puerto Rico experience an excessive burden of central obesity. It remains unknown which dietary components are more strongly associated with central obesity in this high-risk group. We aimed to evaluate the relationship of the Mediterranean diet (MeDS) and Alternate Healthy Eating Index-2010 (AHEI) with central obesity in the Puerto Rico Assessment of Diet, Lifestyle and Diseases (PRADLAD) cross-sectional study.

Methodology: Data from PRADLAD participants (ages 30–75 y) were used (n=166). Dietary intake was assessed by food frequency questionnaire. The MeDS (9 components; range: 0 (lowest) to 9 (highest observance of a Mediterranean-like diet)) and AHEI (11 components; range: 0 (lowest) to 110 (highest diet quality)) were defined. Daily intake of foods and beverages within each MeDS component were ranked by contribution to total energy intake. Multivariable logistic regression was used to evaluate associations between MeDS and AHEI with central obesity (waist circumference >102cm males, >88cm females).

Results: Mean (SD) MeDS was 4.46 (1.77) and AHEI was 60.2 (11.1). Traditional foods representative of the MeDS included potatoes, root vegetables, fruit juice, avocados, bread, oatmeal, beans, chicken, seafood, low-fat milk, cheese, eggs, and beer. Adjusted odds ratios (OR)

*Correspondence: Josiemer Mattei, PhD, MPH, 665 Huntington Ave, Dept of Nutrition; Harvard Chan School, Boston MA 02115, Phone: 617-432-3017, jmattei@hsph.harvard.edu.

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and 95% confidence intervals (CI) of central obesity were 0.78 (0.63, 0.97) per unit increment of MeDS and 0.61 (0.42, 0.90) per 10-unit increment of AHEI.

Principal conclusions: Higher adherence to MeDS or AHEI was associated with lower central obesity in adults in Puerto Rico. Consuming traditional foods reflecting these dietary patterns (i.e.: Mediterranean-like) may reduce central obesity in high-risk populations.

Keywords

waist circumference; abdominal obesity; Mediterranean diet; Hispanics; Latinos

Background

Adults living in the island of Puerto Rico experience a high burden of cardiometabolic diseases. Puerto Ricans have high prevalence of cardiovascular risk factors, including obesity, type 2 diabetes, hypertension, and hyperlipidemia (1,2). In 2018, approximately 32.9% of Puerto Ricans were classified with obesity, and another 36.9% were overweight, according to the Behavioral Risk Factor and Surveillance System (BRFSS) (3). Central obesity, which is fat accumulated around the abdomen, is especially worrisome as it may contribute to chronic low-grade inflammation and is associated with metabolic syndrome (4,5). This excessive burden of obesity may contribute to higher mortality from cardiometabolic outcomes, such as diabetes complications, stroke, and ischemic heart disease (6).

Modifications to dietary intake can help to decrease the risk of cardiometabolic diseases (7–10). Various dietary scores and indexes, such as the Alternate Healthy Eating Index 2010 (AHEI) and Mediterranean diet score (MeDS), have been proposed to quantitatively assess diet quality in relation with disease outcomes (11–13). Adherence to both the AHEI and MeDS has been associated with a lower risk of cardiometabolic disease (14–16). An analysis within the Boston Puerto Rican Health Study (BPRHS), a longitudinal study of Puerto Rican adults residing in Boston, Massachusetts, found that the MeDS most accurately predicted lower waist circumference as well as other cardiovascular risk factors when compared with other dietary scores, such as AHEI (14). However, the MeDS has not yet been defined or studied within adult residents of Puerto Rico, who may have different dietary intakes from Puerto Ricans residing outside the island (14,17). One study of adults living in Puerto Rico found that only 2%, 20%, and 21% of participants met the recommended daily intake for fruit, vegetables, and whole grains, respectively (17).

Most analyses assessing the MeDS have studied participants from European, Mediterranean, or United States (mostly non-Hispanic white) cultures, with typically population-specific scores (18). A study among 23 different populations and their adherence to the Mediterranean Adequacy Index, another measure assessing Mediterranean diet adherence, found highest adherence to be in Greek and Italian men, and lowest adherence in Latinos (19). An additional analysis in a multi-ethnic cohort (55% Hispanic, 24% non-Hispanic black, 21% non-Hispanic white) found lower consumption of foods reflected in the Mediterranean diet than other European and American populations (20). Because the score is based on foods consumed in countries bordering the Mediterranean Sea, it may not capture intake of traditional Latino food preferences such as beans, root vegetables, and cooking oils (21).

Puerto Rican adults living in Puerto Rico have been found to have low diet quality (17). A typical Puerto Rican diet often includes high intake of sweets and desserts, rice, starches, and sugar-sweetened beverages, and low intake of fruit and vegetables (17), which contrasts with the high intake of whole-grain plant-based foods and healthy oils recommended by diet quality scores (21,22). Because these diet scores are currently not tailored toward the Puerto Rican diet, it is essential to determine which foods traditionally consumed in Puerto Rico may reflect the recommendations of a MeDS and to elucidate which diet score is more strongly associated with central obesity in this at-risk group. Thus, the objective of this study was to identify traditional Puerto Rican foods that contribute to the MeDS and to assess the relationship between the MeDS and AHEI and central obesity in adults living in Puerto Rico.

Methods

Participants

Data from the Puerto Rico Assessment of Diet, Lifestyle, and Diseases (PRADLAD), a cross-sectional survey, were used in this analysis. The methods for this study have been detailed elsewhere (23). Briefly, the study recruited a convenience sample of adults aged 30–75 y, living in the San Juan, Puerto Rico metropolitan area, through three partner clinics between July and November, 2015. Participants were eligible if they had been living in Puerto Rico at the time of recruitment and for at least 10 months prior to that date, and if they were able to answer questions without assistance. The Institutional Review Board (IRB) at Harvard T.H. Chan School of Public Health, Ponce Health Sciences University in PR, University of Massachusetts Lowell, and Northeastern University approved the study. All participants provided written informed consent.

Dietary Assessment and Diet Quality Scores

Dietary intake in the past 12 months was self-reported using a validated semi-quantitative food frequency questionnaire (FFQ) (24,25). This questionnaire was adapted for the Puerto Rican population from the National Cancer Institute Block format to include portion sizes, foods, and total nutrient intake appropriate for this population (25). The FFQ has been validated among Hispanic adults against plasma carotenoids (26), vitamin E (27), and vitamin B12 (28). The data from the FFQ were linked to the Minnesota Nutrient Data System (version 5.0_35) for food and nutrient analyses.

Diet quality was assessed using the MeDS and the AHEI. The MeDS was previously defined for Puerto Ricans (29), and includes 9 components: vegetables, fruits, whole grains, nuts and legumes, meat, fish, dairy, MUFA:SFA ratio, and alcohol. Dietary components (except alcohol) were scored using sex-specific population medians, adjusted for total energy with the residual method. Participants consuming less than the median for healthful components (i.e., vegetables, legumes, fruits, whole grains, MUFA: SFA ratio, and fish) were assigned a score of 0 (or above the median for unfavorable components, i.e., meat and dairy), and a score of 1 was assigned for the opposite. Alcohol consumption of ≤2 drinks/d men or ≤1drink/d women was assigned 1 point; a value of 0 was assigned for the opposite. The total MeDS was created by adding scores from the 9 components, resulting in a possible range of 0 to 9. Higher values indicate greater observance of a Mediterranean dietary pattern.

The AHEI is comprised of 11 components including vegetables without potatoes, fruit without juices, sugar-sweetened beverages and fruit juice, nuts and legumes, red/processed meat, whole grains, *trans* fatty acids, long-chain omega-3 fatty acids (EPA+DHA), polyunsaturated fatty acids, sodium, and alcohol (15). Participants were scored for each AHEI component from 0 (least healthy) to 10 (most healthy) continuously; intermediate levels were prorated. The scores of all components were summed for a total AHEI score ranging from 0 to 110. Higher values indicate higher diet quality.

Central Obesity

Waist circumference was measured by trained research assistants in duplicate at the midpoint between the lowest rib margin and the iliac crest (30). Measurements were rounded to the nearest millimeter and averaged. A third measurement was performed if the difference between the first two measurements was > 1 cm and the mean of the closest measurements was calculated. We defined central obesity based on the cutoff values recommended by the NCEP/ATP III (waist circumference >102 cm for males and >88 cm for females) (31).

Covariates

Questionnaires were administered by trained, bilingual research assistants using ‘Research Electronic Data Capture’ (REDCap) (32). The questionnaire captured demographic and socioeconomic characteristics (sex, age, ethnicity, education, income, marital status), medical history, and lifestyle behaviors (smoking, use of medications, physical activity). Physical activity was measured with a modified version of the Paffenbarger questionnaire in the Harvard Alumni Activity Survey (33), which has been previously utilized in the Boston Puerto Rican Health Study (34). Physical activity was transformed into a score calculated as the sum of hours spent on typical activities--heavy, moderate, light, or sedentary activity and sleeping--in one day, multiplied by weighted factors that represent the rate of oxygen consumption associated with each activity (34).

Statistical Methods

From the 380 participants in PRADLAD, we excluded those with missing dietary data (n=132). Participants with complete vs. missing dietary data were similar, except that fewer participants with completed FFQ (vs. not) were unemployed and reported having sleep difficulties (17). We further excluded those with missing waist circumference (n=45) or covariate measurements (n=37). Thus, the final sample size for this study was 166 participants. Sociodemographic and behavioral characteristics of participants above or below the median MeDS and AHEI score were contrasted using ANOVA for continuous variables and chi-square tests for categorical variables. Spearman’s correlation was used to determine the association between the MeDS and AHEI scores. Daily intake of food and beverage items in each of the MeDS components were ranked, based on their contribution to total energy intake using SAS PROC RANK among participants with dietary data (n=248). The ranking of foods and beverages contributing to total energy intake using the AHEI score has been reported elsewhere (17).

The association between MeDS and AHEI score and central obesity status was assessed using logistic regression adjusted for age, sex, ethnicity (Puerto Rican, Dominican, or other), smoking status (never, former, or current), physical activity score, education (<9th grade, 9th-12th grade, completed 12th grade or GED, some college/bachelor's degree, or some graduate school), income ($0-$10,000, $10,001-$20,000, or >$20,000), marital status (married/living with partner, divorced/separated/widowed, or single), currently using diabetes medication, and total energy intake (AHEI only). We computed odds ratios per 1 unit increase of MeDS and per 10 unit increase of AHEI. We also calculated z-scores for the MeDS and AHEI scores to attain comparable ranges, and ran logistic models using the calculated z scores for MeDS and AHEI as exposures. Additionally, we conducted a sensitivity analysis using the definition of central obesity (waist circumference >94 cm for males and >80 cm for females) based on International Diabetes Federation (IDF) guidelines (30), which contain a threshold lower than the NCEP/ATP III guidelines and were adapted to European and sub-Saharan African heritages.

In secondary analysis, we used linear mixed effects models to assess associations between the MeDS and AHEI score (per unit and using the z scores) and waist circumference as a continuous outcome. These models included the same covariates as the logistic models. Finally, we evaluated the association between each of the MeDS components and waist circumference and central obesity. All analyses were conducted using SAS version 9.4 (SAS Institute Inc, Cary, NC), and a P-value < 0.05 was considered statistically significant.

Results

Approximately 69% of the sample population was female, 62% had central obesity, and the mean (SD) age was 52 (12) y (Table 1). The median (range) value for the AHEI was 58.9 (38.2, 97.0) and for the MeDS was 4 (1, 9). Central obesity was more prevalent in those with MeDS below the median (P=0.02), and a higher proportion of participants above the median AHEI were never smokers (P=0.01). No other covariates differed significantly by AHEI or MeDS. The AHEI and MeDS were significantly correlated (ρ=0.64, P<0.0001). The mean (SD) of AHEI was 60.2 (11.1) and the MeDS was 4.46 (1.77) (Supplemental Table 1). Aside from alcohol, the mean values of MeDS components were generally close to 0.5. Mean values for AHEI components have been reported elsewhere (17).

A healthy MeDS consisted of approximately 4.5 and 4 servings of vegetables for men and women, respectively, 1.7 servings of fruits, and 0.5 servings of whole grains/d (Table 2). Consumed vegetables were mainly French fries/hash browns, sweet potatoes, yams, or coleslaw. Main sources of fruit were fruit juices and avocado. The top five contributors to meat consumption were chicken sandwich, Spam, ground turkey, ham, and breast chicken. Whole grains were primarily bread, cereal or granola bars, oatmeal, popcorn, and whole grain pasta, and these five foods represented 83% of total whole grain intake. Other dietary components, such as vegetables, fruit, and meat, had less than 50% of their total intake in the top five food items.

Both the MeDS and AHEI scores were inversely associated with central obesity under the NCEP criteria (Table 3). Each unit increment of MeDS was associated with 22% lower odds of central obesity (OR=0.78 95% CI=0.63, 0.97), and each 10-unit increment of AHEI was associated with 39% lower odds of central obesity after adjustment for confounders (OR=0.61, 95% CI=0.42, 0.90). In sensitivity analysis, only the AHEI was significantly associated with obesity under the IDF criteria, and the association was slightly attenuated than when we used the NCEP criteria. In secondary analysis, neither diet score was significantly associated with continuous waist circumference (Supplemental Table 2). Additionally, no individual MeDS dietary components were significantly associated with central obesity or waist circumference (Supplemental Table 3).

Discussion

We found that higher adherence to either the Mediterranean diet or the AHEI were inversely associated with central obesity, with the association slightly stronger for the AHEI than the MeDS. This is the first study to evaluate the adherence to a Mediterranean-like dietary pattern and its relation to central obesity in Puerto Rico. Results partly agree with a previous study conducted in the BPRHS, where both AHEI and MeDS were predictors of lower waist circumference and BMI after 2y, although the association with MeDS was stronger (14). One possible explanation for any discrepancies in magnitude of the reported associations is that the scoring methodology for MeDS was based on population-specific medians. As a result, a value of 0 for a specific food group in the BPRHS could be a value of 1 in PRADLAD due to differing medians in the two populations. Furthermore, specific foods representing the MeDS and their contribution to total energy intake differ between Puerto Ricans on the mainland vs. the island. Similar to this study, a previous analysis of top-ranking food items within the MeDS among Puerto Ricans in Boston found that these differed from the typical Mediterranean diet (14). While some foods were similar for Puerto Ricans in Boston vs. the island, distinctive foods were also noted for each location. For example, the top three vegetables in Boston were vegetables used in homemade soups, potatoes (boiled/baked), and iceberg lettuce. In this study, the top three vegetables were French fries or hash browns, sweet potatoes, and coleslaw. Additionally, avocado, a fruit not identified as frequently consumed in the Boston Puerto Rican cohort, was a top-ranking fruit contributing to energy intake in Puerto Rico. Further, peanuts and other nuts were represented in the nuts and legumes food group in Boston, but in Puerto Rico this group was only represented by varietals of beans. Some foods consumed by this population are intrinsic to Puerto Rico rather than Mediterranean countries, suggesting that the MeDS does not necessarily captures typical Mediterranean foods in Puerto Rico, and that they may best be described as Mediterranean-like.

The Mediterranean diet is traditionally characterized by high intake of vegetables, fruit, nuts and legumes, cereals, olive oil, and fish, as well as lower intake of dairy, meat, and poultry (21). However, the Mediterranean-like diet in Puerto Rico contains several unhealthy food items, in addition to the healthy food items identified (sweet potatoes, root vegetables, oatmeal, beans, seafood). For example, aside from avocados, the top contributing fruit in PRADLAD was juice, which tends to be high in sugars. Furthermore, French fries, coleslaw, Spam, and mayonnaise ranked highly in this study. A previous study in PRADLAD that focused on the AHEI also reported that sugary beverages, sweets and desserts, dairy, juices, and mixed dishes contributed heavily to total energy intake (17). Fruit and vegetables each contributed only approximately 4% of energy intake. Therefore, dietary interventions in Puerto Rico should reinforce traditional healthy foods while avoiding unhealthy commonly consumed foods to reduce central obesity.

While similarities in foods and nutrients exist between the populations in the two locations (such as high consumption of juices), the diets of mainland vs. island Puerto Ricans also differ in their observance to recommended guidelines. Contrasts between Puerto Ricans on the island vs. mainland showed that median vegetable intake was lower (1.6 servings/d for men and 1.5 servings/d for women) in the BPRHS than in PRADLAD (4.5 servings/d for men and 3.9 servings/d for women). The median cutoff of vegetable intake in PRADLAD was more than 50% higher than the recommended amount (2 servings/d) in both men and women but did not reach recommended levels for BPRHS. However, whole grain median intake for men and women in PRADLAD were 0.5 and 0.4 servings/d, respectively, whereas the recommended intake is 3 servings/d (35). These results suggest that dietary intervention or recommendations should be further tailored to the specific location (mainland vs. island) rather than to Puerto Ricans as a whole.

Although the overall diet score was significantly associated with central obesity, no significant associations were observed with individual MeDS components. This suggests that a holistic healthy diet is more important to sustain health than singling out individual food groups or nutrients. A multi-faceted interventional approach targeting varying aspects of ones' diet could help to reduce the burden of central obesity.

This study has some limitations. The cross-sectional nature of PRADLAD prevents causal inference; it is possible that participants with central obesity have improved their diet as an attempt to lose weight. Longitudinal studies in this population are essential to confirm our findings. The sample design limited the generalizability of our results. However, PRADLAD was conducted in three primary care clinics in San Juan, Puerto Rico to increase the socioeconomic representation of our sample. Additionally, the small sample size limits the statistical power of our analyses. However, the large number of demographic and lifestyle variables available in PRADLAD allowed for robust analysis. A larger study may be able to confirm the significant associations between the dietary scores and central obesity reported in this study. Finally, we used self-reported dietary data from an FFQ, and measurement error in the assessment of diet quality may have biased our results to the null.

Our study also has a number of strengths. This is the first study to create and evaluate a MeDS adapted to the island Puerto Rican diet. The methods and results from this study can be used for future dietary assessments and analyses in studies of Puerto Ricans living on the island, who are not often represented in epidemiological studies. The FFQ was administered by a trained interviewer in the participants' language of preference and has been validated for this population (23–25). Lastly, the use of two dietary scores that reflect the whole diet quality may convey stronger associations with disease outcomes than individual food or nutrient components (11).

In conclusion, this study found that higher adherence to either the Mediterranean diet or the dietary recommendations encompassed in the AHEI were inversely associated with central obesity. Thus, a healthful diet reflective of these recommendations could help to prevent central obesity in Puerto Ricans, although further research in this population is necessary to confirm these results. The ranking of foods contributing to the Mediterranean diet demonstrates that dietary components differ from the typical Mediterranean food components and that there are traditional foods and nutrients that could be improved in dietary interventions in this population.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations:

BPRHS	Boston Puerto Rican Health Study
PRADLAD	Puerto Rico Assessment of Diet, Lifestyle and Diseases
MeDS	Mediterranean diet score
AHEI	Alternate Healthy Eating Index
NCEP	National Cholesterol Education Program
IDF	International Diabetes Federation

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Table 1.

Demographic, socioeconomic, and lifestyle characteristics of adults living in Puerto Rico

	All	AHEI ≤ 58.9	AHEI > 58.9	p	MeDS ≤ 4	MeDS > 4	p
n	166	83	83		88	78	
Sex (%)				0.50			0.13
Female	68.7	71.1	33.7		73.9	62.8	
Male	31.3	28.9	66.3		26.1	37.2	
Age (years)	51.9 (11.6)	50.6 (12.1)	53.3 (10.9)	0.14	51.5 (11.9)	52.5 (11.2)	0.58
Education (%)				0.23			0.19
High school or less	84.6	88.4	81.1		88.3	80.3	
Some college or more	15.4	11.6	18.9		11.7	19.7	
Income (%)				0.98			0.66
$0–$10,000	56.0	56.6	55.4		59.1	52.6	
$10,001–$20,000	22.3	21.7	22.9		21.6	23.1	
≥ $20,001	21.7	21.7	21.7		19.3	24.4	
Smoker (%)				0.22			0.16
Never	71.1	69.9	72.3		65.9	76.9	
Former	11.5	8.4	14.5		11.4	11.5	
Current	17.5	21.7	13.3		22.7	11.5	
Alcohol Intake (%)				0.007 *			0.74
Never	53.0	60.2	45.8		54.6	51.3	
Former	19.3	9.6	28.9		17.1	21.8	
Current	27.7	30.1	25.3		28.4	26.9	
AHEI-2010 (score)	60.2 (11.1)	-	-		54.4 (8.8)	66.7 (10.0)	<0.0001 *
MeDS	4.46 (1.77)	3.08 (1.31)	5.76 (1.45)	<0.0001 *	-	-	
Physical activity (%)				0.13			0.72
Sedentary	42.8	50.6	34.9		45.5	39.7	
Light	31.9	27.7	36.1		29.6	34.6	
Moderate/vigorous	25.3	21.7	28.9		25.0	25.6	
Ethnicity (%)				0.31			0.20
Puerto Rican	79.5	84.3	74.7		84.1	74.4	
Dominican	17.5	13.3	21.7		12.5	23.1	
American/Other	3.0	2.4	3.6		3.4	2.6	
Central obesity (%)	62.1	67.5	56.6	0.15	70.5	52.6	0.02 *
Energy intake (kcal/day)	2160 (927)	2108 (978)	2211 (875)	0.47	2036 (954)	2299 (879)	0.07

* *P*<0.05

Data shown as % or mean (SD).

MeDS consists of nine components, each with a value of 0 (lower intake) or 1 (higher intake), compiling into a score of 0–9. AHEI consists of 11 components, each with a score of 0 (lowest intake) to 10 (highest intake), which are added to create a score ranging from 0 to 110.

Central obesity was defined according to the NCEP criteria as having a waist circumference >102 cm for males and >88 cm for females.(31)

Values were contrasted by the medians for AHEI (48.9) and MeDS (4).

Table 2.

Population-based energy-adjusted sex-specific median values of each Mediterranean diet score component, and ranking based on their contribution to energy intake[1]

Dietary components	Median cutoff for Mediterranean diet score: Men	Median cutoff for Mediterranean diet score: Women	Top 5 foods contributing to energy intake within the food or nutrient group	Contribution to energy to the food or nutrient group, %
Vegetables, servings/d	4.47	3.93	French fries or hash browns; Sweet potatoes, yams; Coleslaw; Baked potato; Root crops (e.g., cassava, ñame, yautia)	41.8
Fruits, servings/d	1.67	1.66	Grape juice; Orange juice; Avocado; Apple juice; and Other 100% fruit juices and/or blends	47.6
Whole grains, g/d	0.47	0.44	Sliced or baked bread; Cereal or granola bars; Oatmeal (plain or flavored); Popcorn; Whole grain pasta (e.g., spaghetti, macaroni, linguini)	82.6
Nuts and legumes, servings/d	0.70	0.77	Pinto beans; White beans; Kidney beans; Black beans; Lima beans	52.7
Meat, servings/d	1.57	1.4	Chicken sandwich; Spam; Ground turkey; Ham; Breast chicken	26.2
Fish, servings/d	0.23	0.26	Fish sandwich; Clams; Tuna salad; Scallops; Shrimp	63.6
Dairy, servings/d	1.53	1.57	2% reduced-fat milk; 1% reduced-fat milk; skim milk; flavored skim milk; flavored 1% reduced-fat milk	93.5
MUFA:SFA ratio	1.12	1.14	Cheddar cheese; Eggs; French fries; Chocolate; Mayonnaise	8.9
Alcohol, drinks/d	≤2	≤1	Beer; Light beer; Rum; Vodka; Whiskey	70.4

PRADLAD: Puerto Rico Assessment of Diet, Lifestyle and Diseases; MUFA: Monounsaturated fatty acids; SFA: Saturated fatty acids

[1]The definition used to create the Mediterranean diet score was based on Ye et. al. (2013).(29) Except for alcohol that used pre-defined cutoffs, a score of 0 was assigned to participants consuming below the median for healthful components (or above the median for meat and dairy), and 1 point was assigned for the opposite. The added components equaled a range of 0–9; higher values indicate greater observance of a Mediterranean pattern.

Table 3.

Associations between the Mediterranean Diet Score and Alternate Healthy Eating Index and central obesity

	Central obesity (NCEP criteria)		Central obesity (IDF criteria)	
	OR	**95% CI**	**OR**	**95% CI**
MeDS, one-unit increase				
Age-adjusted	0.88	(0.75, 1.03)	0.89	(0.75, 1.07)
Fully adjusted	0.78 *	(0.63, 0.97)	0.82	(0.64, 1.06)
AHEI, 10-unit increase				
Age-adjusted	0.82	(0.63, 1.07)	0.82	(0.61, 1.11)
Fully adjusted	0.61 *	(0.42, 0.90)	0.64 *	(0.41, 0.99)
MeDS, z score				
Age-adjusted	0.79	(0.59, 1.05)	0.82	(0.59, 1.13)
Fully adjusted	0.64 *	(0.43, 0.95)	0.70	(0.45, 1.10)
AHEI, z score				
Age-adjusted	0.80	(0.59, 1.08)	0.80	(0.57, 1.13)
Fully adjusted	0.57 *	(0.37, 0.89)	0.60 *	(0.37, 0.99)

* $p<0.05$

The NCEP criteria for central obesity is waist circumference >102 cm for males and >88 cm for females.(31) The IDF criteria for central obesity is waist circumference >94 cm for makes and >80 cm for females.(30)

MeDS consists of nine components, each with a value of 0 (lower intake) or 1 (higher intake), compiling into a score of 0–9. AHEI consists of 11 components, each with a score of 0 (lowest intake) to 10 (highest intake), which are added to create a score ranging from 0 to 110.

Associations were assessed using logistic regression models with covariates: sex, age, smoking status, physical activity score, education, income status, marriage status, diabetes status, and ethnicity. The ORs reflect the odds per one-unit increase of MeDS and 10-unit increase of AHEI.