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Adherence to the DASH Diet is Inversely Associated with Incidence of Type 2 Diabetes: The Insulin Resistance Atherosclerosis Study

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Objective: The Dietary Approaches to Stop Hypertension (DASH) diet has been promoted widely, yet little is known about its impact on type 2 diabetes mellitus (T2DM).

Research Design and Methods: We evaluated the association of DASH diet with incidence of T2DM among 862 participants of the Insulin Resistance Atherosclerosis Study who completed a 1-year food frequency questionnaire at baseline. T2DM odds ratios (OR) were estimated at tertiles (T) of the DASH score.

Results: An inverse association was observed in Whites (T2 vs. T1: OR=0.66, 95%CI 0.29-1.48) which became significant for the most extreme contrast (T3 vs. T1: OR=0.31, 95% CI 0.13-0.75) adjusting for covariates No association was observed in Blacks or Hispanics (T2 vs. T1: OR=1.16 95%CI 0.61-2.18; T3 vs. T1 OR=1.34, 95%CI 0.70-2.58).

Conclusion: Adherence to the DASH dietary pattern, which is rich in vegetables, fruit, and low-fat dairy products, may have the potential to prevent type 2 diabetes.

The effectiveness of dietary and lifestyle modification approaches in the prevention of type 2 diabetes mellitus (T2DM) is well recognized. The American Diabetes Association Nutritional Recommendations emphasize moderate weight loss via modification of energy and fat intake and physical activity for primary prevention among high risk individuals, but do not make specific recommendations regarding a dietary pattern (1). The Dietary Approaches to Stop Hypertension (DASH) trial demonstrated that a dietary pattern rich in vegetables, fruit, and low-fat dairy products can reduce blood pressure (2) and has been promoted widely (3,4). To the best of our knowledge, the DASH dietary pattern has not been evaluated with respect to potential influence on diabetes development. Thus, the aim of our study was to evaluate the impact of adherence to the DASH diet on risk of T2DM in the multi-ethnic Insulin Resistance Atherosclerosis Study (IRAS).

RESEARCH DESIGN AND METHODS

Study design details have been published (5). Between 1992 and 1994, 1,624 participants were recruited at four clinical centers, aiming for equal representation across glucose tolerance status (normal; impaired glucose tolerance; non–insulin taking type 2 diabetes mellitus); ethnicity (Black, Hispanic, and non-Hispanic white); gender; and age (40–49 years, 50–59 years, 60–69 years). Of 1,087 persons with normal or impaired glucose tolerance at baseline, 906 (83%) returned to 5-year-follow-up, among whom 148 type 2 diabetes cases developed. Low educational attainment was associated with reduced follow-up, which somewhat limits generalizability. Analyses included 862 participants with complete data on exposure, outcome and key covariates. Data completeness was unrelated to demographic variables except study center.

At baseline, habitual dietary intake was assessed by using a one-year, semi-quantitative 114-item food frequency interview ascertaining both frequency and serving size. We created 33 food groups based on similarities in food and nutrient composition (6) which were collapsed to create 8 DASH food groups (grains, vegetables, fruits, dairy, meat, nuts/seeds/legumes, fats/oils, and sweets). Adherence to the DASH diet was assessed with an index variable (7). We additionally distinguished whole grain and low fat dairy to address the qualitative DASH goals. For each food group, a maximum score of 10 was assigned if the recommended intake was met, while lower intakes were scored proportionately. If lower intakes were recommended, reverse scoring was applied, and a score of 0 was applied to intakes ≥200% the upper recommendation. The resulting 8 component scores were summed to create the overall DASH adherence score (range 0 to 80) (7).

Anthropometric measures were taken in a standardized manner following protocol. A 12-sample, insulin enhanced, frequently sampled intravenous glucose tolerance test was conducted and insulin sensitivity (S_I) and acute insulin response (AIR) assessed using minimal model analysis. AIR was calculated based on insulin levels through the eight-minute blood samples prior to insulin infusion.

At 5-year follow-up, individuals who met WHO criteria for diabetes on their oral glucose tolerance test or who were taking hypoglycemic medication not previously reported at baseline were considered having incident T2DM.

Multiple logistic regression analysis was used to assess the relationship between DASH diet and risk of T2DM. Parameter estimates and 95% confidence intervals were estimated for DASH tertiles. The test for trend across tertiles used the resulting p-value from the Type III analysis of effects based on the Wald Chi-squared test. Previous cross-sectional analysis have indicated a significant interaction between DASH adherence and race with respect to baseline BMI and waist (8), hence models were additionally stratified by race/ethnicity into white vs. minority (Blacks and Hispanics) and a DASH score by minority race interaction tested.

RESULTS

The mean food group intake by DASH tertile is shown for descriptive purposes. The DASH score was associated with age, race/ethnicity, smoking, physical activity and educational attainment (data not shown).

In the total study population, we initially observed a weak, inverse association of the DASH index with incident T2DM adjusting for age, sex, race/center, diabetes status, family history, education, smoking, energy intake, and expenditure. Further adjustment for BMI had little impact. However, upon stratification by race/ethnicity, a strong inverse association of DASH score with T2DM was observed in Whites (T3 vs. T1: OR=0.31, 95% CI 0.13-0.75), but not in Blacks or Hispanics. The interaction between DASH and minority race was statistically significant (p= 0.02) in the fully adjusted model. Adjustment for insulin sensitivity and secretion strengthened the association in the total population and in Whites but had no impact in minorities. Adjustment for baseline glucose did not alter the findings (data not shown).

CONCLUSIONS

Intervention studies have shown that in addition to a blood pressure lowering effect (2), the DASH diet has beneficial effects on total and LDL cholesterol (9), insulin sensitivity (10), and weight management (11). To date, however, findings from observational studies have not been encouraging (12), suggesting that very high adherence levels might be needed to produce an impact and that those may be achievable only in intervention settings. However, in the free-living IRAS population, higher adherence to the DASH dietary pattern was associated with markedly reduced odds of T2DM among White participants. No association was observed in Blacks or Hispanics, possibly because of the key limitation of our study, the relatively small sample size. Additionally, differential accuracy of diet assessment may play a role. Therefore, replication of our study findings in a larger cohort is needed.

The composition of the DASH diet pattern with its emphasis on vegetables, fruit, and low-fat dairy products, nuts, seeds, and whole grains, and its limits on meat, poultry, eggs, fats and oils certainly makes this a likely candidate for diabetes prevention. Our findings are consistent with other epidemiologic research suggesting a beneficial effect of increased dairy (13), whole grain (14), and nuts (15) on diabetes risk. Unlike previous research, the magnitude of our results is noteworthy with an OR of 0.25 in the highest adherence tertile compared to the lowest. In conclusion, our results suggest that adherence to the DASH dietary pattern, which is based on a priori defined amounts of specific food groups, may have the potential to prevent diabetes.

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Table 1 Food group intake (mean and standard deviation) and odds of type 2 diabetes mellitus by tertile of DASH dietary pattern score

			Tertiles of DASH score			
			1	2	3	
DASH score			38.4 (5.3)	49.5 (2.5)	60.2 (4.5)	
Food group (serving/day)						
Total grains *			2.6 (1.5)	2.9 (1.5)	3.3 (1.4)	
High fiber grains †			0.5 (0.6)	0.8 (0.7)	1.2 (0.8)	
Vegetables ‡			2.5 (1.5)	3.3 (1.8)	4.1 (1.6)	
Fruit §			1.3 (1.1)	2.3 (1.6)	3.3 (1.6)	
Total dairy ‖			0.9 (0.6)	1.0 (0.7)	1.2 (0.8)	
Low-fat dairy ¶			0.1 (0.2)	0.2 (0.3)	0.4 (0.4)	
Meat, poultry, eggs, fish #			2.0 (1.2)	1.7 (1.0)	1.7 (0.9)	
Nuts, seeds, dried beans **			2.2 (2.7)	3.0 (3.3)	3.9 (2.9)	
Fats & oils ††			1.8 (1.4)	1.6 (1.0)	1.4 (0.9)	
Sweets ‡‡			11.0 (8.6)	7.5 (6.4)	5.6 (6.1)	
Total population	n/N	β (p-value)	OR	OR (95% CI)	OR (95% CI)	P for trend
Model 1 §§	141/864	-0.032 (0.77)	1.00	0.86 (0.54, 1.38)	0.73 (0.45, 1.21)	0.47
Model 2 ‖‖	141/862	-0.002 (0.98)	1.00	0.94 (0.58, 1.52)	0.78 (0.47, 1.29)	0.60
Model 3 ¶¶	129/822	-0.066 (0.58)	1.00	0.88 (0.51, 1.51)	0.64 (0.37, 1.13)	0.29
Whites						
Model 1 §§	54/347	-0.429 (0.02)	1.00	0.53 (0.24, 1.15)	0.25 (0.11, 0.61)	<0.01
Model 2 ‖‖	54/346	-0.349 (0.07)	1.00	0.66 (0.29, 1.48)	0.31 (0.13, 0.75)	0.03
Model 3 ¶¶	49/327	-0.414 (0.05)	1.00	0.77 (0.31, 1.90)	0.25 (0.09, 0.67)	0.02
Blacks/Hispanics						
Model 1 §§	87/517	0.176 (0.20)	1.00	1.11 (0.59, 2.07)	1.34 (0.70, 2.55)	0.67
Model 2 ‖‖	87/516	0.183 (0.19)	1.00	1.16 (0.61, 2.18)	1.34 (0.70, 2.58)	0.68
Model 3 ¶¶	80/495	0.075 (0.63)	1.00	0.90 (0.45, 1.80)	0.96 (0.46, 1.97)	0.95

*Total Grains: High fiber dark bread and cereal, low fiber bread and cereal, salty snacks, rice, pasta

†Whole grains: High fiber dark bread and cereal

[‡]Vegetables: Tomato vegetables, cruciferous vegetables, other vegetables, potatoes, fries
[§]Fruit: Fruit and fruit juices
[‖]Total dairy: Milk, yogurt, cottage cheese, cheese, ice cream
[¶]Low fat dairy: Milk and yogurt up to 2% fat
[#]Meat, poultry, eggs, fish: All meats including processed meats, poultry, eggs, fish and shellfish
**Nuts, seeds and dried beans: Nuts, seeds, dried beans, tofu
[††]Fat and oils: Fats, oils, salad dressing, gravies, creamer
[‡‡]Sweets: Sweets including chocolate, regular soft drinks, pastry
[§§]Model 1 adjusts for age, sex, race/ethnicity/clinic, glucose tolerance status, family history of diabetes, education, smoking status, energy intake, energy expenditure
[‖‖]Model 2 adjusts for covariates contained in Model 1 plus baseline BMI
[¶¶]Model 3 adjusts for covariates contained in Model 2 plus baseline insulin sensitivity and secretion.
n Number of cases
N Population at risk
β Change per 10 unit increase in DASH score