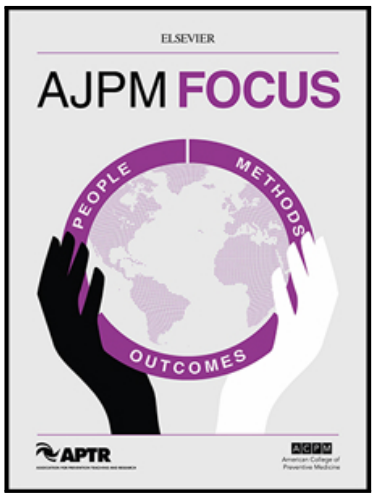

Concordance between DASH diet and coronary artery calcification: Results from the Mediators of Atherosclerosis in South Asians Living in America (MASALA) prospective cohort study

Bridget Murphy Hussain , Andrea L. Deierlein , Sameera A. Talegawkar , Alka M. Kanaya , Joyce A. O'Connor , Meghana D. Gadgil , Yong Lin , Niyati Parekh

PII: S2773-0654(24)00106-8
DOI: https://doi.org/10.1016/j.focus.2024.100288
Reference: FOCUS 100288

To appear in: *AJPM Focus*

Received date: 21 May 2024
Revised date: 2 October 2024
Accepted date: 5 October 2024

Please cite this article as: Bridget Murphy Hussain , Andrea L. Deierlein , Sameera A. Talegawkar , Alka M. Kanaya , Joyce A. O'Connor , Meghana D. Gadgil , Yong Lin , Niyati Parekh , Concordance between DASH diet and coronary artery calcification: Results from the Mediators of Atherosclerosis in South Asians Living in America (MASALA) prospective cohort study, *AJPM Focus* (2024), doi: https://doi.org/10.1016/j.focus.2024.100288

Highlights:

- DASH diet intake may reduce risk of severe CAC score among South Asians
- Men may particularly benefit from DASH diet adherence.
- DASH diet may reduce risk of early predictors of ASCVD risk among South Asians

Concordance between DASH diet and coronary artery calcification: Results from the Mediators of Atherosclerosis in South Asians Living in America (MASALA) prospective cohort study

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CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

ACKNOWLEDGEMENTS

The authors thank the other investigators, the staff, and the participants of the MASALA study for their valuable contributions. **Funding**: Research reported in this publication was supported by the National Heart, Lung, and Blood Institute of the National Institutes of Health under Award Number F31HL162504.The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. The project described was supported by Grant Number R01HL093009 from the National Heart, Lung, and Blood Institute and the National Center for Research Resources and the National Center for Advancing Translational Sciences, National Institutes of Health, through UCSF-CTSI Grant Number UL1 RR024131. Body composition measures in MASALA were supported by grant K24 HL112827. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Heart, Lung, and Blood Institute or the National Institutes of Health. **Declaration of interest**: none.

ABSTRACT

Introduction: South Asian adults are at high risk for atherosclerotic cardiovascular disease (ASCVD), for which coronary artery calcification (CAC) is an early predictor. Adherence to the Dietary Approaches to Stop Hypertension (DASH) diet is a modifiable risk factor that may mitigate the progression of CAC and ASCVD.

Methods: Using data from the Mediators of Atherosclerosis in South Asians Living in America cohort, we calculated a DASH dietary score (categorized as low, moderate, and high) to examine associations of DASH diet adherence and CAC after a five-year follow up.

Results: We found that participants in the high DASH category were 41% less likely to have CAC score>100 (age-adjusted Incident Rate Ratio (IRR) 0.59; 95% Confidence Interval (CI): 0.36, 0.95) compared to those in the low category; this association was attenuated in multivariable models. Differences were observed by sex. Men in the high DASH category were 51% less likely to have CAC score >100 (aIRR: 0.49; 95%CI: 0.26, 0.95) and experienced 0.46 fold-CAC change (fold-change: 0.46; 95%CI: 0.18, 0.90) in multivariable models.

Conclusions: The findings indicate a relationship between DASH diet and early predictors of ASCVD risk among South Asians living in the U.S., particularly men.

KEY WORDS

South Asian, Coronary Artery Calcium, Dietary Approaches to Stop Hypertension, dietary intake, atherosclerotic cardiovascular disease

INTRODUCTION

South Asians are more likely to develop subclinical risk factors for ASCVD at a younger age when compared to other Asian groups and non-Hispanic whites, [1] including coronary artery calcification (CAC), which has been identified as a strong predictor of early ASCVD among individuals who may otherwise remain asymptomatic and regarded at low risk for cardiac events. [2] CAC is the accumulation of calcium in the coronary arteries as a result of lipid and cholesterol plaque buildup. [3] The presence and rupture of plaques may reduce blood flow through the coronary arteries, increasing risk for a cardiac event. [3] Connections between dietary patterns and CAC is not well-investigated in large epidemiological studies, specifically among South Asians.

The Dietary Approaches to Stop Hypertension (DASH) dietary pattern that emphasizes fruits, vegetables, whole grains, nuts and legumes, and low-fat dairy, has been identified by the American College of Cardiology and the American Heart Association for the primary prevention of ASCVD. [4] For the present study, we examined associations between the DASH dietary pattern and its components and CAC score in the Mediators of Atherosclerosis in South Asians in America (MASALA) cohort, a prospective, multicenter study designed to identify risk factors of ASCVD among older South Asian adults in the U.S. [5]

MATERIALS AND METHODS

Study Population

The MASALA study is an ongoing community-based cohort study of South Asian adults aged 40-84 years, free from cardiovascular disease at enrollment, who were recruited from the San Francisco Bay Area or greater Chicago area. Details of this cohort's recruitment, enrollment, design, and methods have been presented elsewhere. [5,6] Exam 1 (baseline) was conducted from

2010–2013 and exam 2 data was conducted five years later (2015–2018). The current analyses were approved by the New York University institutional review board (IRB-FY2021-5009).

Data Collection and Creation of Variables

Dietary Data and DASH Diet Score Concordance Calculation (Exposure variable):

Dietary intake data were collected during exam 1 by trained MASALA study staff using the Study of Health Assessment and Risk in Ethnic (SHARE) FFQ. [7] The SHARE FFQ is a 163-item interviewer-administered tool is validated to assess dietary intake of South Asian adults living in North America. Using the SHARE FFQ raw data, we computed the DASH diet concordance score following the Fung et al. method to quantify adherence characterized by high intake of (1) fruit, (2) vegetables, (3) nuts/legumes, (4) low-fat dairy products, and (5) whole grains; and low intake of (6) sodium, (7) sugar-sweetened beverages, and (8) red/processed meats. [8] Participants were classified into quintiles according to intake of each component, computing a theoretical DASH diet score ranging from 8 (low concordance) to 40 (high concordance). Total DASH diet concordance score was categorized based on cut-off scores consistent with previous studies: ≤20 (low), 21–28 (moderate), and ≥29 (high). [8,9] To our best knowledge, DASH scores have not previously been validated for South Asian adults.

Coronary Artery Calcium (CAC) Score (outcome variable): Cardiac computed tomography (CT) scans were performed using a gated-cardiac electron-beam computed tomography scanner. Calcified plaque in coronary arteries were identified according to attenuation of >130 Hounsfield units (HU) CAC volume and peak density were reported for each

of the four major coronary arteries and the summed score was used. Additional details regarding the CT imaging measurements can be found in a previously published manuscript. [10]

CAC score was assessed according to severity, a CAC score of zero indicates very low ASCVD risk and a CAC score >100 indicating high risk for ASCVD outcomes. [2,11] For analyses, CAC score at exam 2 was operationalized as: continuous overall CAC score; incident CAC, defined as CAC score=0 at baseline and CAC score>100 after five-year follow up; CAC presence, CAC score>0 versus score=0; CAC severity, CAC score ≤100 versus >100; and CAC change, calculated as the difference in CAC score between baseline and exam 2.

Covariates: Sociodemographic and health behavior data, including age, gender, percentage of life lived in the U.S., annual family income, education, smoking status, alcohol intake, and physical activity were collected at Exam 1. Clinical characteristics including hypertension (blood pressure ≥130/≥85 mmHg), high density lipoprotein cholesterol, low density lipoprotein cholesterol, diabetes, and body mass index (kg/m^2) collected at Exam 1 were included in final models.

Statistical Analysis

Descriptive statistics (mean and standard deviation (SD) for continuous variables; count and percent for discrete variables) for sociodemographic characteristics, energy intake (kilocalories per day), and health behaviors were computed for the analytic sample, and by DASH category. For continuous variables, tests of linear trends across groups were assessed using analysis of variance (ANOVA). For categorical variables, between-group differences were evaluated using Pearson's Chi-square.

Modified Poisson regression with a robust error variance estimated incidence rate ratio (IRR) associations of DASH category (low, moderate, high) with incident CAC, CAC presence, and CAC severity. This method is validated for directly estimating rates for dichotomous, common outcomes in prospective studies and useful for modest sample sizes. [12] Negative binomial regression estimated associations between DASH category and continuous CAC score, [13] as 42.5% of the sample had a CAC score of zero and there was overdispersion of CAC score. We modeled CAC change using data from the entire cohort, including those with a CAC score of zero at both baseline and exam 2. We coded 12 participants with negative change scores as having no CAC change, and log-transformed change in CAC+1. Consistent with previous literature, [14] we used linear regression to estimate the relationship between DASH category and log-transformed change in CAC.

Statistical analyses were performed using STATA 16.1. [15] Potential confounders were identified a priori from a literature review and using causal diagrams. [16] Identified confounders were included in multivariable models. Educational attainment and income were highly correlated ($p<0.0001$). There were 19 participants (3%) missing household income; therefore, we adjusted for educational attainment. Final models were adjusted for age, sex, percent of life lived in the U.S., education attainment, smoking status, alcohol intake, and physical activity (Model 1), with the additional adjustment for hypertension, high density lipoprotein, low density lipoprotein, diabetes, and body mass index (Model 2); and adjustment for energy intake (Model 3). We assessed the direct and indirect effects of hypertension on the causal pathway between DASH category and CAC score using parametric regression models, [17] which were not significant. As directional differences were identified by sex, we stratified analyses. The interaction of DASH category and sex was tested using a multiplicative term with an *a priori*

significance *p* value of <0.10. These analyses were conducted to determine if associations between DASH category and CAC score, presence, and severity differed between men and women, as sex-specific differences have been reported. [18].

RESULTS

Sample Characteristics

Descriptive characteristics of participants are shown in **Table 1**. A greater proportion of women were in the high DASH category compared to men (n=62; 57.4% women; p<0.0001). Percent of life lived in the U.S. was inversely associated with DASH category, with those in the low DASH category living in the U.S. longer (50.7% of life lived in the U.S.) than those in the high DASH category (44.6% of life lived in the U.S.; p=0.01). Never smoking, no alcohol intake, and physical activity were all associated with higher DASH category (p<0.0001; p<0.0001; p=0.01, respectively).

Table 1. Participant characteristics by category of DASH diet score, among South Asian adults in the MASALA Study (n=671).

Characteristic	Total Study Population (n=671)	DASH Score ≤20 (low) (n=134)	DASH Score 21-28 (n=429)	DASH Score ≥29 (high) (n=108)	*p value*
Demographics and Energy Intakes *(Exam 1)*					
Age (y) (mean (SD))	55.3 (9.0)	54.6 (9.6)	55.5 (8.9)	55.7 (8.8)	0.57
Women (n (%))	291 (43.4)	36 (26.9)	193 (45.0)	62 (57.4)	<0.0001
Percent of life lived in US (mean (SD))	48.6 (16.9)	50.7 (17.5)	49 (17.0)	44.6 (15.0)	0.01
Bachelor's degree or higher (n (%))	598 (89.1)	115 (85.8)	384 (89.5)	99 (91.7)	0.32
Income >$100K (n (%))	438 (67.2)	88 (66.2)	276 (66.8)	74 (69.8)	0.81
Energy Intake (mean (SD))	1687.2 (497.9)	1644.5 (494.9)	1672.5 (512.5)	1799 (426.2)	0.03
Never Smoked (n (%))	554 (82.6)	93 (69.4)	360 (83.9)	101 (93.5)	<0.0001
No Alcohol Intake (n (%))	435 (64.8)	59 (44.0)	293 (68.3)	83 (76.9)	<0.0001
Physical Activity* (n (%))					0.01
Poor	99 (14.8)	24 (17.9)	64 (14.9)	11 (10.2)	
Intermediate	136 (20.3)	38 (28.4)	82 (19.1)	16 (14.8)	
Ideal	436 (65.0)	72 (53.7)	283 (66.0)	81 (75.0)	
Risk Factors for ASCVD *(Exam 1)*					
Hypertension (≥130/85) (n (%))	322 (48.0)	66 (49.3)	214 (49.9)	42 (38.9)	0.12
HDL Cholesterol, mg/dL (mean (SD))	50 (13.1)	48 (12.6)	50 (13.4)	50 (12.5)	0.22

Table 1. Participant characteristics by category of DASH diet score, among South Asian adults in the MASALA Study (n=671).

Characteristic	Total Study Population (n=671)	DASH Score ≤20 (low) (n=134)	DASH Score 21-28 (n=429)	DASH Score ≥29 (high) (n=108)	*p value*
LDL Cholesterol, mg/dL (mean (SD))	111 (32.2)	113 (30.0)	110 (33.9)	109 (28.5)	0.58
BMI, kg/m^2 (mean (SD))	25.8 (3.8)	25.9 (3.7)	25.9 (3.9)	25.0 (3.5)	0.11
Diabetes (n (%))	160 (23.9)	31 (23.1)	107 (24.9)	22 (20.4)	0.60
Primary Outcomes of Interest: CAC Measurements (*Exam 2*)					
CAC Score (median (IQR))	7 (140.0)	25 (293.0)	7 (134.0)	0 (91.5)	0.22[1]
Incident CAC (>0) (n (%))	107 (16.0)	19 (14.2)	73 (17.0)	15 (13.9)	0.45
CAC Presence (>0) (n (%))	385 (57.4)	83 (61.9)	249 (58.0)	53 (49.1)	0.12
CAC Severity (>100) (n (%))	197 (29.4)	51 (38.1)	121 (28.2)	25 (23.2)	**0.03**
CAC Change (mean (SD)[#]	2.3 (2.4)	2.7 (2.5)	2.2 (2.3)	2.0 (2.4)	0.07

*Typical Week's Activity Survey (Poor indicates no activity; Intermediate indicates 1-149 minutes of moderate or 1-74 minutes of vigorous activity per week; Ideal indicates ≥150 minutes of moderate or ≥75 minutes of vigorous activity per week; [#] CAC change was calculated based on the log-transformed change in CAC.

[1] Median test; p-values were otherwise estimated by analysis of variance for continuous variables and Pearson's chi-square for categorical variables.

Associations between DASH diet score category and CAC score

DASH category was not associated with continuous CAC score, incident CAC, and presence of CAC (**Table 2**). In age-adjusted models, participants in the high DASH category were 41% less likely to have a CAC score >100 (IRR= 0.59; 95% CI: 0.36, 0.95; p_{trend}=0.02) and had less CAC change at five-year follow up compared to participants in the low DASH category. These associations were attenuated in multivariable adjusted models, primarily due to adjustment for sex.

Associations of DASH category and CAC severity and change in CAC differed for men and women (p for interaction=0.03 for both); therefore, models were stratified by sex (**Table 3)**. Among men, in multivariable adjusted models (Model 1), those in the high DASH category were 51% less likely to have a CAC score >100 (aIRR: 0.49; 95% CI: 0.26, 0.95; p_{trend}=0.03) and had 0.46 fold-CAC change (calculated by exponentiating the aβ: -0.91; 95% CI: -1.71, -0.10; p_{trend}=0.02) compared to men in the low DASH category. Women in the high DASH category were four times more likely to have a CAC score >100 (aIRR: 4.01; 95% CI: 0.88, 18.35; p_{trend}=0.03) compared to those in the low DASH category. DASH category was not associated with change in CAC score among women.

Table 2. Sequentially-adjusted CAC score by category of DASH score, among South Asian adults in the MASALA study (n=671).

	DASH Score ≤20 (low) (n=134)	DASH Score 21-28 (n=429)		DASH Score ≥29 (high) (n=108)		P_{trend}*
	Reference	β/IRR[§]	95% CI	β/IRR[§]	95% CI	
CAC Score (Continuous)						
Age Adjusted	0.00	-0.50	-1.01, 0.01	-0.46	-1.13, 0.21	0.11
Model 1[+]	0.00	-0.18	-0.72, 0.35	0.43	-0.29, 1.16	0.23
Model 2[++]	0.00	-0.24	-0.78, 0.29	0.17	-0.53, 0.87	0.63
Model 3[+++]	0.00	-0.24	-0.78, 0.29	0.17	-0.55, 0.87	0.68
Incident CAC (at Exam 2)[1]						
Age Adjusted	1.00	0.78	0.49, 1.24	0.53	0.27, 1.02	0.06
Model 1[+]	1.00	1.09	0.64, 1.85	0.74	0.35, 1.55	0.45
Model 2[++]	1.00	1.10	0.64, 1.87	0.75	0.35, 1.60	0.51
Model 3[+++]	1.00	1.16	0.68, 1.99	0.87	0.40, 1.88)	0.80
CAC Presence (0 vs. >0)[2]						
Age Adjusted	1.00	0.92	0.71, 1.17	0.77	0.54, 1.08	0.14
Model 1[+]	1.00	1.05	0.81, 1.36	0.99	0.68, 1.43	1.00
Model 2[++]	1.00	1.06	0.82, 1.38	1.03	0.71, 1.49	0.84
Model 3[+++]	1.00	1.07	0.82, 1.39	1.06	0.72, 1.53	0.75
CAC Severity (≤100 vs. >100)[3]						
Age Adjusted	1.00	0.73	0.52, 1.01	0.59	0.36, 0.95	**0.02**

Table 2. Sequentially-adjusted CAC score by category of DASH score, among South Asian adults in the MASALA study (n=671).

	DASH Score ≤20 (low) (n=134)	DASH Score 21-28 (n=429)		DASH Score ≥29 (high) (n=108)		P_{trend}*
	Reference	β/IRR[§]	95% CI	β/IRR[§]	95% CI	
Model 1[+]	1.00	0.85	0.60, 1.20	0.79	0.47, 1.32	0.32
Model 2[++]	1.00	0.84	0.59, 1.19	0.83	0.49, 1.40	0.40
Model 3[+++]	1.00	0.84	0.59, 1.19	0.84	0.50, 1.41	0.42
CAC Change (exam 1 to exam 2)[4]						
Age Adjusted	0.00	-0.56	-0.97, -0.15	-0.79	-1.33, -0.26	**0.003**
Model 1[+]	0.00	-0.23	-0.62, 0.16	-0.22	-0.75, 0.30	0.37
Model 2[++]	0.00	-0.24	-0.62, 0.14	-0.16	-0.66, 0.35	0.50
Model 3[+++]	0.00	-0.22	-0.60, 0.16	-0.10	-0.61, 0.41	0.65

IRR: Incidence Rate Ratio for the negative binomial regression model; CI: Confidence Interval
[§]β for continuous outcomes; IRR for categorical outcomes
*p-trend calculated by linear regression, using 3 categories of DASH diet score as a continuous variable
[1] Incident CAC defined as CAC 0 at exam 1 and >100 at exam 2; [2]CAC Presence is defined by any score >0; [3]CAC Severity is defined by a score >100; [4] Log of CAC change as the outcome in the linear model; the exponentiated regression coefficient was used to interpret the change from exam 1 to exam 2 by DASH category.
[+]Model 1: Adjusted for age, sex (male/female), percent life lived in the U.S., education (≥bachelors/<bachelors), physical activity (ideal, intermediate, poor), smoking (current/former vs. never), alcohol intake (no consumption/any); [++]Model 2: Model 1 + hypertension (blood pressure ≥130/85), HDL cholesterol, LDL cholesterol, diabetes, BMI (kg/m^2); [+++]Model 3: Model 2 + energy intake (kilocalories/day)

Table 3. Sequentially-adjusted CAC presence, CAC severity, and continuous CAC score by category of DASH diet score stratified by sex, among South Asian adults in the MASALA study (n=671).

	DASH Score ≤20 (lowest)	DASH Score 21-28		DASH Score ≥29 (highest)		P_{trend}*
	Reference	β/IRR[§]	95% CI	β/IRR[§]	95% CI	
Men	(n=98)	(n=236)		(n-46)		
CAC Score (Continuous)						
Age Adjusted	0.00	-0.34	-0.81, 0.14	-0.29	-1.00, 0.42	0.25
Model 1[+]	0.00	-0.40	-0.90, 0.11	-0.34	-1.11, 0.42	0.22
Model 2[++]	0.00	-0.52	-1.03, -0.01	-0.36	-1.12, 0.41	0.17
Model 3[+++]	0.00	-0.52	-1.03, -0.01	-0.35	-1.11, 0.42	0.16
Incident CAC (at Exam 2)[1]						
Age Adjusted	1.00	1.12	0.61, 2.05	0.80	0.34, 1.85	0.66
Model 1[+]	1.00	1.14	0.60, 2.20	0.77	0.30, 1.97	0.66
Model 2[++]	1.00	1.09	0.56, 2.11	0.73	0.28, 1.92	0.59
Model 3[+++]	1.00	1.11	0.57, 2.17	0.81	0.31, 2.17	0.77
CAC Presence (0 vs. >0)[2]						
Age Adjusted	1.00	1.01	0.77, 1.32	0.83	0.54, 1.27	0.50
Model 1[+]	1.00	1.01	0.76, 1.35	0.86	0.54, 1.35	0.62
Model 2[++]	1.00	1.03	0.77, 1.38	0.88	0.55, 1.41	0.75
Model 3[+++]	1.00	1.04	0.78, 1.39	0.90	0.57, 1.45	0.82
CAC Severity (≤100 vs. >100)[3]						

Table 3. Sequentially-adjusted CAC presence, CAC severity, and continuous CAC score by category of DASH diet score stratified by sex, among South Asian adults in the MASALA study (n=671).

	DASH Score ≤20 (lowest)	DASH Score 21-28		DASH Score ≥29 (highest)		P_{trend}*
	Reference	β/IRR[§]	95% CI	β/IRR[§]	95% CI	
Age Adjusted	1.00	0.79	0.56, 1.11	0.50	0.27, 0.91	**0.02**
Model 1[+]	1.00	0.77	0.53, 1.11	0.49	0.26, 0.95	**0.03**
Model 2[++]	1.00	0.77	0.53, 1.12	0.53	0.27, 1.02	0.05
Model 3[+++]	1.00	0.77	0.54, 1.12	0.53	0.28, 1.04	0.05
CAC Change (exam 1 to exam 2)[4]						
Age Adjusted	0.00	-0.40	-0.90, 0.10	-0.86	-1.61, -0.11	**0.02**
Model 1[+]	0.00	-0.48	-1.01, 0.05	-0.91	-1.71, -0.10	**0.02**
Model 2[++]	0.00	-0.40	-0.91, 0.10	-0.77	-1.54, 0.005	**0.04**
Model 3[+++]	0.00	-0.39	-0.89, 0.12	-0.67	-1.45, 0.10	0.07
Women	(n=36)		(n=193)		(n=62)	
CAC Score (Continuous)						
Age Adjusted	0.00	0.53	-0.86, 1.92	1.68	0.19, 3.16	**0.01**
Model 1[+]	0.00	0.39	-1.03, 1.82	1.56	0.02, 3.09	**0.01**
Model 2[++]	0.00	0.06	-1.46, 1.58	0.80	-0.97, 2.56	0.25
Model 3[+++]	0.00	0.12	-1.45, 1.69	0.88	-0.97, 2.74	0.23
Incident CAC (at Exam 2)[1]						
Age Adjusted	1.00	0.97	0.37, 2.52	0.59	0.17, 2.05	0.37
Model 1[+]	1.00	1.10	0.41, 2.95)	0.69	0.19, 2.50	0.53

Table 3. Sequentially-adjusted CAC presence, CAC severity, and continuous CAC score by category of DASH diet score stratified by sex, among South Asian adults in the MASALA study (n=671).

	DASH Score ≤20 (lowest)	DASH Score 21-28		DASH Score ≥29 (highest)		P_{trend}*
	Reference	β/IRR[§]	95% CI	β/IRR[§]	95% CI	
Model 2[++]	1.00	1.24	0.45, 3.43	0.80	0.22, 2.93	0.68
Model 3[+++]	1.00	1.29	0.46, 3.63	0.85	0.22, 3.25	0.76
CAC Presence (0 vs. >0)[2]						
Age Adjusted	1.00	1.19	0.61, 2.31	1.31	0.62, 2.75	0.48
Model 1[+]	1.00	1.19	0.62, 2.84	1.33	0.62, 2.84	0.46
Model 2[++]	1.00	1.16	0.58, 2.31	1.31	0.61, 2.79	0.47
Model 3[+++]	1.00	1.17	0.59, 2.34	1.35	0.62, 2.94	0.43
CAC Severity (≤100 vs. >100)[3]						
Age Adjusted	1.00	2.12	0.50, 9.00	3.56	0.80, 15.96	**0.05**
Model 1[+]	1.00	2.27	0.52, 9.84	4.01	0.88, 18.35	**0.03**
Model 2[++]	1.00	2.02	0.45, 9.02	4.04	0.87, 18.85	**0.02**
Model 3[+++]	1.00	2.01	0.45, 8.96	3.78	0.80, 17.85	**0.04**
CAC Change (exam 1 to exam 2)[4]						
Age Adjusted	0.00	0.19	-0.39, 0.78	0.49	-0.18, 1.17	0.13
Model 1[+]	0.00	0.22	-0.39, 0.82	0.55	-0.15, 1.24	0.10
Model 2[++]	0.00	0.15	-0.44, 0.74	0.53	-0.15, 1.21	0.09
Model 3[+++]	0.00	0.14	-0.46, 0.74	0.51	-0.17, 1.20	0.10

IRR: Incidence Rate Ratio for the negative binomial regression model; CI: Confidence Interval

Table 3. Sequentially-adjusted CAC presence, CAC severity, and continuous CAC score by category of DASH diet score stratified by sex, among South Asian adults in the MASALA study (n=671).

	DASH Score ≤20 (lowest)	DASH Score 21-28		DASH Score ≥29 (highest)		P_{trend}*
	Reference	β/IRR[§]	95% CI	β/IRR[§]	95% CI	

[§]β for continuous outcomes; IRR for categorical outcomes
*p-trend calculated by unadjusted linear regression, using 3 categories of DASH diet score as an ordinal variable
[1] Incident CAC defined as CAC 0 at exam 1 and >100 at exam 2; [2]CAC Presence is defined by any score >0; [3]CAC Severity is defined by a score >100; [4] Log of CAC change as the outcome in the linear model; the exponentiated regression coefficient was used to interpret the change from exam 1 to exam 2 by DASH category.
[+]Model 1: Adjusted for age, percent life lived in the U.S., education (≥bachelors/<bachelors), physical activity (ideal, intermediate, poor), smoking (current/former vs. never), alcohol intake (no consumption/any); [++]Model 2: Model 1 + hypertension (blood pressure ≥130/85), HDL cholesterol, LDL cholesterol, diabetes, BMI (kg/m^2); [+++]Model 3: Model 2 + energy intake (kilocalories/day)

CONCLUSIONS

In this prospective cohort study, DASH category was not associated with incident CAC, CAC presence, severity, or change in CAC score among all participants in fully adjusted models, though participants in the high DASH category had lower risk of CAC severity and lower change in CAC score at the five-year follow up compared to those in the low category in age-adjusted models. In stratified models, men in the high DASH category had lower risk of CAC severity and lower CAC change compared to men in the low DASH category. Contrary to anticipated results, women in the high DASH category were more likely to have CAC score > 100 and had lower CAC change compared to women in the low DASH category. To our knowledge, this study presents the first evidence examining the DASH dietary pattern and CAC.

In contrast with previous studies, DASH category was not associated with CAC in the fully adjusted models;[19,20] however, we did observe sex differences in CAC severity and progression.[14,21-24] In analyses of the Multi-Ethnic Study of Atherosclerosis cohort, South Asian men had higher rates of annual CAC progression compared to Black, Latino, and Chinese American men, while there were no differences in CAC progression among South Asian women and other race/ethnic groups.[14,21] In the current study, we found an association between high DASH category and CAC severity among women, but our sample of women with CAC score>100 was small (n=38; 13%). Future studies with larger sample size will help to clarify the relationship between DASH diet and CAC score among women.

A limited number of previous studies have examined the relationship between overall dietary patterns and CAC score, which is necessary to fully characterize the diet-disease relationship.[25] Greater adherence to a "starchy veggies, meats, and alcohol" dietary pattern was associated with increased risk of CAC presence in a longitudinal study of U.S. adults.[26]

Similarly, lower CAC scores were observed among German men and women who reported following a "Mediterranean-like" diet compared to those following an "Animal fat/Alcohol" diet. [27] In the Coronary Artery Risk Development in Young Adults study, participants who had a higher animal-based low-carbohydrate diet score (consuming less than 43% of total energy from carbohydrate per day) had higher risk of CAC progression compared to those who did not follow a low-carbohydrate diet. [28] Collectively, results from these studies highlight the importance of consuming a diet rich in fiber- and nutrient-dense carbohydrates such as fruits, vegetables, whole grains, and beans and legumes for cardiovascular health. A larger sample may similarly elucidate a relationship between dietary intake and CAC score among South Asians in the U.S.

The MASALA study cohort is relatively small, which limited our ability to examine associations between DASH diet concordance and CAC by sex. The MASALA study is the first multi-center community-based cohort of South Asian adults living in the U.S., incorporating culturally competent practices to collect data on an underrepresented population group in the U.S. [5,6] The SHARE FFQ data allowed us to calculate the DASH diet score using individual food item and quantity reports. The study is further strengthened by its prospective design with five-year follow up, utilization of CT imaging to assess CAC score, and inclusion of an FFQ specifically designed and validated for South Asian adults living in North America. Future prospective studies examining the DASH diet pattern and its association with CAC score among a larger sample inclusive of other racial/ethnic groups would help to further characterize the role of diet in CAC presence, severity, and progression.

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Declaration of interests

☐The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☒The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Bridget Murphy Hussain reports financial support was provided by National Heart Lung and Blood Institute. Alka M Kanaya reports financial support was provided by National Heart Lung and Blood Institute. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.