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Coronary Artery Calcification Compared with Carotid Intima-Media Thickness in Prediction of Cardiovascular Disease Incidence: The Multi-Ethnic Study of Atherosclerosis (MESA)

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Abstract

Context—Coronary artery calcium (CAC) and carotid intima-media thickness (IMT) are noninvasive measures of atherosclerosis that consensus panels have recommended as possible additions to risk factor assessment for predicting the probability of cardiovascular disease (CVD) occurrence.

Objective—To assess whether maximum carotid IMT or CAC (Agatston Score) is the better predictor of incident CVD.

Design, Setting, Patients—Prospective cohort study of 45–84 year-olds initially free of CVD (*n* = 6,698) in four ethnic groups, with standardized carotid IMT and CAC measures at baseline, in six field centers of the Multi-Ethnic Study of Atherosclerosis (MESA).

Main Outcome Measure(s)—Incident CVD events (coronary heart disease, stroke, and fatal CVD) over a maximum of 5.3 years of follow-up.

Results—There were 222 CVD events during follow-up. CAC was associated more strongly than carotid IMT with risk of incident CVD. After adjustment for each other and traditional CVD risk factors, the hazard of CVD increased 2.1-fold (95% CI 1.8–2.5) for each standard deviation greater level of log-transformed CAC, versus 1.3-fold (95% CI 1.1–1.4) for each standard deviation greater maximum IMT. For coronary heart disease, the hazard ratios per standard deviation increment were 2.5-fold (95% CI 2.1–3.1) for CAC and 1.2-fold (95% CI 1.0–1.4) for IMT. An ROC analysis also suggested that CAC predicted incident CVD better than IMT did.

Conclusions—Although whether and how to clinically use bio-imaging tests of subclinical atherosclerosis remains a topic of debate, this study found that CAC predicts subsequent CVD events better than does carotid IMT.

Prospective epidemiologic studies have consistently documented that noninvasive measures of atherosclerosis, such as coronary artery calcium (CAC) and carotid intima-media thickness (IMT), are associated positively and strongly with future incidence of cardiovascular disease (CVD). For example, a meta analysis recently identified relative risks of coronary heart disease (CHD) of 1.0, 1.9, 4.3, 7.2, and 10.8 for CAC values of 0, 1–112, 100–400, 400–999, and ≥1000, respectively.[1] Another meta analysis reported significant relative risks of CHD of 1.26 for myocardial infarction and 1.32 for stroke for each 1-standard deviation increment of common carotid artery IMT.[2]

Whether and how to use these screening tests in clinical practice remains a matter of debate. Some task forces have recommended bio-imaging tests for atherosclerosis be considered for patients at intermediate risk of CHD (10–20% risk in 10 years), for whom preventive interventions are often uncertain.[1,3] Another group recommended measuring CAC or IMT in all asymptomatic 45–75 year old men and 55–75 year old women, as a guide to clinical decision-making.[4]

CAC and IMT are only moderately correlated within individuals,[5–10] so each test has some potential to be useful clinically to predict future CVD. Terry et al reported that CAC was associated more strongly than IMT with prevalent coronary artery stenosis.[11] Brook et al confirmed this, but found that an estimate of carotid plaque area predicted coronary stenosis somewhat more strongly than even CAC.[12] Neither of these cross-sectional studies assessed CVD incidence. The prospective Rotterdam Study found carotid plaques, increased IMT, aortic calcium, and low ankle-brachial blood pressure index predicted incident myocardial infarction fairly comparably, and the more subclinical measures present, the greater the risk.[13] Their study did not examine CAC. Very recently, the first prospective study assessed the potential utility of measuring CAC versus IMT for global CVD risk prediction. Newman et al[REF] found that CAC and common carotid IMT similarly predicted CVD and CHD in adults 70 years of age and older, but IMT was the better predictor of stroke. We now also address this question prospectively in the Multi-Ethnic Study of Atherosclerosis (MESA).

METHODS

MESA Cohort and Risk Factor Assessments

MESA recruited 6,814 adults aged 45–84 from the populations near six Field Centers – Baltimore, MD; Chicago, IL; Forsyth County, NC; Los Angeles, CA; New York, NY; and St. Paul, MN – to a baseline examination between July 2000 and September 2002.[14] They were Caucasians (38%), African Americans (28%), Hispanics (22%), and Chinese Americans (12%) free of clinically recognized CVD drawn from households in geographically-defined areas (5 centers) or in an occupational union (New York). MESA conducted three subsequent examinations of the cohort between 2002 and 2007. Institutional Review Boards at each site approved the study, and all participants gave written informed consent.

Centrally-trained clinical teams collected information on cardiovascular risk factors during the baseline examination. They measured resting blood pressure three times in seated participants with a Dinamap model Pro 1000 automated oscillometric sphygmomanometer (Critikon, Tampa, FL). A central laboratory measured total and HDL-cholesterol and glucose levels from blood samples obtained after a 12-hour fast. We defined diabetes as fasting glucose ≥6.99 mmol/L (126 mg/dL) or use of hypoglycemic medication.

CAC Assessment

Scanning centers assessed CAC by chest-computed tomography using either a cardiac-gated electron-beam computed tomography scanner (Chicago, Los Angeles, and New York Field Centers) or a multi-detector computed tomography system (Baltimore, Forsyth County and St. Paul Field Centers). Certified technologists scanned all participants twice. A phantom of known physical calcium concentration was included in the field of view. A radiologist or cardiologist read all CT scans at a central reading center (Los Angeles Biomedical Research Institute at Harbor-UCLA in Torrance, CA) using an interactive scoring system similar to that of Yaghoubi et al.[15] The reader-work station interface identified and quantified CAC from images calibrated according to the readings of the calcium phantom. The Agatston score,[16] which is a pseudo-continuous variable derived from plaque densities and their areas in all coronaries, was computed. We used the average phantom-adjusted Agatston score for the two scans in all analyses. Carr et al have reported the details of the MESA computed tomography scanning and interpretation methods.[17] Each participant and his/her physicians were notified whether the CAC scores, for the participant's age, were less than average, average, or greater than average. No recommendation was made about treatment.

Carotid IMT Assessment

Trained technicians in each Field Center performed B-mode ultrasonography of the right and left near and far walls of the internal carotid and common carotid arteries.[18] They used the Logiq 700 ultrasound device (General Electric Medical Systems, Waukesha, WI) to record images. An ultrasound reading center (Department of Radiology, New England Medical Center) measured maximal IMT of the internal and common carotid sites as the mean of the maximum IMT of the near and far walls of the right and left sides. In addition, for this paper, we created a composite Z score for overall maximal IMT by summing the two carotid IMT sites (if both were measured) after standardization (subtraction of the mean and division by the standard deviation of each measure), and then dividing by the standard deviation of the sum. If only one of the two measures was available, it was used. The resulting variable, hereafter referred to as Z score maximum IMT, has a mean of zero and a standard deviation of one. Each participant and his/her physicians were notified whether or not an accompanying Doppler assessment suggested significant carotid stenosis (≥50%), but no recommendation was made about treatment.

CVD Follow-Up

We followed the cohort for incident CVD events for a median of 3.9 years (max 5.3). At intervals of 9–12 months, a telephone interviewer contacted each participant to inquire about interim hospital admissions, cardiovascular outpatient diagnoses, and deaths. In order to verify self-reported diagnoses, we requested copies of all death certificates and medical records for hospitalizations and outpatient cardiovascular diagnoses. We also conducted next-of-kin interviews for out of hospital cardiovascular deaths. We obtained records on an estimated 98% of reported hospitalized cardiovascular events and some information on 95% of reported outpatient diagnostic encounters.

Two physicians, blinded to the CAC and IMT data, independently reviewed and classified CVD events and assigned incidence dates. If, after review and adjudication, disagreements persisted, a full mortality and morbidity review committee made the final classification. MESA criteria for events were adopted from the Atherosclerosis Risk in Communities Study, the Cardiovascular Health Study, and the Women's Health Initiative. Reviewers classified myocardial infarction as definite, probable or absent, based primarily on combinations of symptoms, ECG, and levels of cardiac biomarker (generally, troponins or creatine kinase myocardial band). Reviewers graded angina based on their clinical judgment as definite, probable or absent. Probable angina required symptoms of ischemia, as well as documentation that a physician had diagnosed and treated for angina. Definite angina also required objective diagnostic evidence of CHD. In this paper, we only included definite angina (n=76), plus probable angina when accompanied by coronary revascularization (n=5). The reviewers classified CHD or CVD death as present or absent based on hospital records and interviews with families. Definite fatal CHD required an MI within 28 days of death, chest pain within the 72 hours before death, or a history of CHD and the absence of a known non-atherosclerotic or non-cardiac cause of death. Neurologists reviewed and classified stroke as present if there was a focal neurologic deficit lasting 24 hours or until death, with a clinically relevant lesion on brain imaging, and no nonvascular cause.

For this report, we defined incident CVD as CHD (definite and probable myocardial infarction, definite coronary heart disease death, resuscitated cardiac arrest, definite angina, and probable angina associated with coronary revascularization), stroke (fatal or nonfatal), or other atherosclerotic CVD death. Follow-up went from the baseline examination until the first CVD event, loss to follow-up, death, or else through January 12, 2005.

Statistical Analysis

From the 6,814 MESA participants, we excluded 77 missing both of the carotid IMT measures, 5 discovered to have had CVD events prior to baseline, and 34 with no follow-up data, leaving 6,698 for analysis. For most analyses, we either (1) categorized carotid IMT and CAC into three groups (the bottom 50% and the two upper quartiles), to accommodate the fact that 50% of participants had zero CAC, or (2) treated IMT and the natural logarithm (ln) of (CAC + 1) as continuous variables. The ln(CAC+1) transformation better normalized the CAC distribution. We used Cox proportional hazard regression to estimate hazard ratios. We performed tests for non-proportional hazards using Shoenfeld residuals; all were non-significant. Covariates for multivariable models included age (continuous), sex, race/ethnicity (4 groups), smoking (current, former, never), diabetes (yes, no), blood pressure (6 categories per JNC 6, including medications),[19] HDL and total cholesterol (continuous), and use of lipid lowering medication (yes, no). We compared the strength of association for IMT versus CAC based on the relative size of their hazard ratios and the corresponding X^2 test or Z test of the hazard ratios. We also compared IMT and CAC associations with receiver-operating characteristic curves (ROC) modeling carotid IMT and ln(CAC + 1) as a continuous variables in Cox models. Rates for Figure 1 were calculated for “low, medium, and high” values of Z score maximum IMT and CAC using intervals as described above. All analyses were done using STATA 9.2 (StataCorp, College Station, Texas).

RESULTS

The MESA sample for this analysis comprised 6,698 adults age 45–84 years at baseline (3,161 men, 3,537 women). Over 23,735 person-years of follow-up, we identified incident 222 CVD events (159 CHD [61 myocardial infarction, 81 angina, 3 resuscitated cardiac arrest, 13 CHD deaths]; 59 stroke, of whom 3 also had a CHD event; and 7 other atherosclerotic CVD deaths). Fifty percent of the MESA sample had detectable CAC. The mean ± SD value for ln(CAC±1) was 2.2 ± 2.5, for maximum internal carotid IMT was 1.07 ± 0.60 mm, for maximum common carotid IMT was 0.87 ± 0.19 mm and for Z score maximum IMT was 0.00 ± 1.00.

As shown in Table 1, the three measures of carotid IMT were all positively associated with incident CVD, with age, race/ethnicity, and sex-adjusted HRs for the highest versus lowest quartile of 3.3 (95% CI 2.1–5.2) for the maximum internal carotid IMT, 2.3 (95% CI 1.4–3.8) for the maximum common carotid IMT, and 3.8 (95% CI 2.2–6.4) for the Z score maximum IMT (all $p<0.0001$). The remaining IMT analyses therefore focused on Z score maximum IMT. For CAC (Table 1), the HRs of CVD increased across categories, the age, race/ethnicity, and sex-adjusted HR being 6.0 (95% CI 3.9–9.1) for the highest CAC quartile versus zero CAC ($p<0.0001$). The results for CHD risk (not shown) were similar. For reference to recommended clinical cutpoints for CAC,[1,3] the age, race/ethnicity, and sex-adjusted HRs (95% CIs) for CAC scores of 0, 1–99,100–399, and ≥400 were 1.0, 4.7 (95% CI 2.5–8.7), 11.5 (95% CI 6.2–21.5), and 16.1 (95% CI 8.5–30.8), respectively (not shown in tables).

When put in the same model, CAC was more strongly associated than was IMT with both CVD and CHD (Table 2). The multivariable adjusted HRs (95% CI) of CVD and CHD per standard deviation increment were 2.1 (1.8–2.5) and 2.5 (2.1–3.1), respectively, for ln(CAC + 1), compared with 1.3 (1.1–1.4) and 1.2 (1.0–1.4) for Z score maximum IMT. Furthermore, the Z statistics were larger and p-values were smaller for the CAC association. In contrast, for stroke, only Z score maximum IMT was statistically significant ($p<0.05$) with multivariable-adjusted hazard ratio of 1.3 (1.1–1.7) while the hazard ratio for ln(CAC + 1) was 1.1 (0.8–1.4).

A categorical analysis (Table 3) also suggested CAC predicted incident CVD and CHD better than did IMT. For example, the multivariable-adjusted HRs of CHD for the highest quartile

versus lowest 50th percentile were 8.2 (95% CI 4.5–15.1, p<0.0001) for CAC and 1.7 (95% CI 1.1–2.7, p=0.01) for IMT.

In supplemental analysis, we restricted to subjects at intermediate CHD risk, based on a Framingham risk score of 1–2% per year (*n* = 1841, with 54 CHD events). Among them, the multivariable adjusted HRs (95% CI) of CHD per standard deviation were 2.4 (1.7–3.3, p<0.0001) for ln(CAC + 1) and 1.3 (1.0–1.6, p<0.05) for Z score maximum IMT when both were included in the model. In the same subgroup at intermediate Framingham risk, for CVD (81 events), the multivariable adjusted HRs were 1.8 (1.4–2.2, p<0.0001) for ln(CAC+1) and 1.4 (1.1–1.6, p=0.001) for Z score maximum IMT.

Figure 1 shows crude rates of incident CVD by 9 joint categories of Z score maximum IMT and CAC. Rates of CVD were between 1–2% per year for those with (1) a moderate level of CAC and high IMT or (2) a high level of CAC and low IMT. CVD rates were >2% per year for those with a high level of CAC and either a moderate or high level of IMT. Those with zero CAC and either low or moderate IMT had almost no events during this follow-up period. Findings for CHD were similar (not shown).

ROC analysis suggested CAC score predicted CVD incidence better than did carotid IMT. With the multiple risk factors in the model for CVD, the area under the curve (AUC) was 0.772 (95% CI 0.74–0.80). After then adding Z score maximum IMT the AUC was 0.782 (95% CI 0.75–0.81); after substituting CAC score for IMT was 0.808 (95% CI 0.78–0.83); and after including both IMT and CAC was 0.811 (0.78–0.84). A similar ROC analysis for CHD produced AUCs of 0.771 (95% CI 0.74–0.80) for risk factors alone, 0.782 (95% CI 0.75–0.82) for risk factors plus IMT, 0.823 (95% CI 0.79–0.85) for risk factors plus CAC, and 0.824 (95% CI 0.79–0.85) for risk factors plus CAC and IMT.

COMMENT

This prospective analysis of the MESA cohort initially free of symptomatic CVD found that carotid maximum IMT and CAC, two measures of subclinical atherosclerosis, predicted future CVD events. However, CAC was the better predictor for CHD and total CVD. IMT was a modestly better predictor than CAC of stroke, although there were few stroke events. The associations observed were consistent with those reported by meta-analyses of prospective studies of each subclinical measure of atherosclerosis studied separately.[1,2] They were somewhat inconsistent with a small prospective study in the elderly, in which common carotid IMT was comparable to CAC in predicting CVD and CHD.[24] It may be that IMT becomes more predictive of CVD in old age, but the smaller sample size of that study also may have limited its ability to show differences between CAC and IMT associations with CVD.

Although previous consensus statements indicated that CAC and IMT are global atherosclerosis measures and either might be used clinically for refinement of CVD risk assessment,[4,20] our data suggest that in asymptomatic United States adults, CAC may be the better choice over IMT. As judged by proportional hazards modeling and by the AUC, CAC added more to CVD prediction beyond traditional risk factors than did IMT. CAC also was associated more strongly than IMT with CHD within the group of individuals at intermediate risk, for whom a subclinical atherosclerosis assessment may be most appropriate.[1,3,20] When more CVD events accrue in MESA, we can more thoroughly address the issue of what novel measures (e.g., CAC, IMT, C-reactive protein, and others) might improve CVD risk prediction in intermediate risk patients.

Modestly better prediction of stroke by IMT and clearly better prediction of CHD by CAC likely reflects their different vascular territories. The potential choice between measuring CAC or IMT or neither in preventive cardiology depends upon other considerations as well (e.g.,

differences in radiation exposure, cost, and availability). CAC may be most relevant in the U.S. where CHD is common. If risk of stroke in families with histories of early stroke were a concern, then carotid IMT may be very relevant. Also, in MESA there are substantial ethnic differences in CAC (highest in whites),[21] and to a lesser degree for IMT (highest in African Americans),[22] which may impact clinical use.

Strengths of this study include its multiethnic sample, standardized subclinical atherosclerosis assessments and risk factor measurements, and its reliance on symptomatic endpoints to avoid detection bias related to CVD events being diagnosed more readily in subjects with known subclinical atherosclerosis. Limitations include, firstly, the relatively short follow-up and relatively small number of strokes to date. Results could be different for long-term CVD prediction, especially as this population ages and the ratio of strokes to CHD events increases. Secondly, the shapes of distributions differ for IMT and CAC, with many zero values for CAC. However, our analyses using both categorical and continuous measures of IMT and CAC placed them on a more comparable footing. Thirdly, although all endpoints were symptomatic, we included both "hard" CHD (myocardial infarction and CHD death) and "soft" CHD (angina) to provide adequate statistical power. Fourthly, for ethnical reasons we felt compelled to report high CAC and IMT values to participants and refer them to their physicians. More participants were referred for high CAC (17%) than for high IMT (1%), which could have affected our findings if participants changed risk factors differentially. Yet, this seems unlikely, as a clinical trial suggested that telling patients their CAC score does not motivate significant health behavior change.[23]

In conclusion, although whether and how to employ bio-imaging tests for subclinical atherosclerosis remains a topic of debate, this study found that CAC predicted subsequent CVD events better than does carotid IMT.

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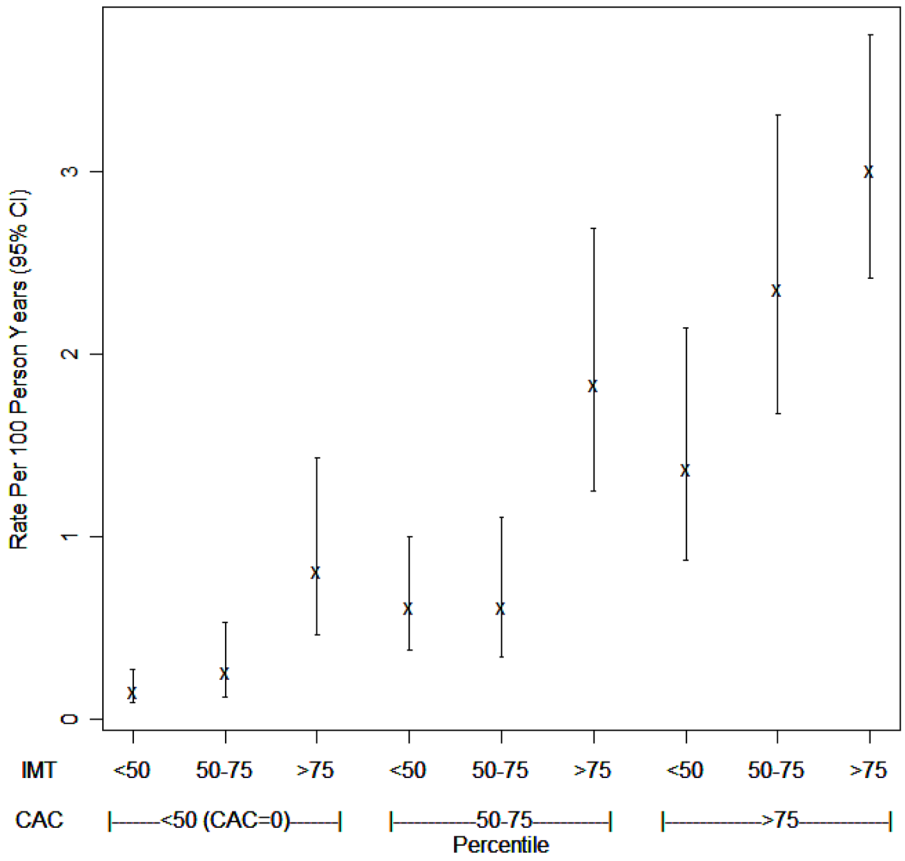

Figure 1.
Unadjusted Rate and 95 Percent Confidence interval of Cardiovascular Disease in Relation to Percentiles of Maximal Carotid Intima-Media Thickness (IMT) or Coronary Artery Calcium (CAC), MESA, 2000–2004

Table 1

Hazard Ratios (HRs) and 95% Confidence Intervals (CI) for an Incident Cardiovascular Disease Event in Relation to Quartiles of Maximal Carotid Intima-Media Thickness (IMT) or Coronary Artery Calcium (CAC), MESA, 2000 to 2004

Measure*		Quartile 1	2	3	4
Max Internal IMT	Range (mm)	0.37, 0.68	0.68, 0.85	0.85, 1.28	1.28, 5.66
	n Events	24	33	39	122
	Person-years	5745	6130	5977	5510
	Crude HR	1.0	1.3	1.6	5.3
	95% CI	Ref	0.8–2.2	0.9–2.6	3.4–8.2
	Age, race, sex-adjusted HR	1.0	1.2	1.3	3.3
	95% CI	Ref	0.7–2.1	0.7–2.1	2.1–5.2
Max Common IMT	Range (mm)	0.40, 0.74	0.74, 0.84	0.84, 0.97	0.97, 2.45
	n Events	22	37	61	102
	Person-years	6014	5843	6133	5705
	Crude HR	1.0	2.1	2.1	4.9
	95% CI	Ref	1.1–4.0	1.1–3.9	2.7–8.6
	Age, race, sex-adjusted HR	1.0	1.3	1.7	2.3
	95% CI	Ref	0.8–2.2	1.0–2.8	1.4–3.8
Z Score Max IMT	Range	−2.06, −0.70	−0.70, −0.20	−0.20, 0.49	0.49, 9.51
	n Events	18	31	52	121
	Person-years	6026	6036	6052	5621
	Crude HR	1.0	1.7	2.9	7.2
	95% CI	Ref	1.0–3.1	1.7–4.9	4.4–11.8
	Age, race, sex-adjusted HR	1.0	1.4	1.9	3.8
	95% CI	Ref	0.8–2.5	1.1–3.3	2.2–6.4
		1st & 2nd Quartile			
CAC Score	Range	0		1–88	88–6315
	n Events	33		53	141
	Person-years	12420		5995	5572
	Crude HR	1.0		3.3	9.5
	95% CI	Ref		2.1–5.1	6.5–13.9
	Age, race, sex-adjusted HR	1.0		2.6	6.0
	95% CI	Ref		1.6–4.0	3.9–9.1

* CAC score and each IMT variable were in separate models.

Table 2

Hazard Ratios (HRs) and 95% Confidence Intervals (CI) for an Incident Cardiovascular Disease (CVD), Coronary Heart Disease (CHD), or Stroke Event in Relation to One Standard Deviation (SD) Increment of Maximal Carotid Intima-Media Thickness (IMT) or Coronary Artery Calcium (CAC), MESA, 2000 to 2004

Measure*	HR per standard deviation (95% CI)	Z Statistic	p-value
		CVD (*n* = 222)	
		Age, race, sex-adjusted	
Z score Max IMT	1.3 (1.1,1.4)	4.1	<0.001
ln(CAC Score + 1)	2.1 (1.8,2.5)	8.6	<0.0001
		Multivariable-adjusted†	
Z score Max IMT	1.2 (1.0,1.3)	2.7	0.007
ln(CAC Score + 1)	1.9 (1.6,2.2)	7.5	<0.0001
		CHD (*n* = 159)	
		Age, race, sex-adjusted	
Z score Max IMT	1.2 (1.0,1.4)	2.5	0.01
ln(CAC Score + 1)	2.5 (2.1,3.1)	8.8	<0.0001
		Multivariable-adjusted†	
Z score Max IMT	1.1 (1.0,1.3)	1.5	0.12
ln(CAC Score + 1)	2.3 (1.9,2.8)	7.9	<0.0001
		Stroke (*n* = 59)	
		Age, race, sex-adjusted	
Z score Max IMT	1.4 (1.2,1.8)	3.5	0.001
ln(CAC Score + 1)	1.1 (0.8,1.5)	0.8	0.41
		Multivariable-adjusted†	
Z score Max IMT	1.3 (1.1,1.7)	2.5	0.01
ln(CAC Score + 1)	1.1 (0.8,1.4)	0.4	0.71

*CAC and IMT were included as continuous variables in the same model. One SD increment was 1.0 for Z-score Max IMT and 2.5 for ln(CAC Score + 1).

†Adjusted as described in Methods.

Table 3

Hazard Ratios (HRs) and 95% Confidence Intervals (CI) for an Incident Cardiovascular Disease (CVD), Coronary Heart Disease (CHD), or Stroke Event in Relation to Quartiles of Maximal Carotid Intima-Media Thickness (IMT) or Coronary Artery Calcium (CAC), MESA, 2000 to 2004

Measure*	HR (95% CI)			χ^2 Statistic	p-value
	<50th Percentile	3rd Quartile	4th Quartile		
			CVD (*n* = 222)		
			Age, race, sex-adjusted		
Z score Max IMT	1.0	1.4 (0.9,2.0)	2.2 (1.5,3.2)	20.1	<0.0001
CAC Score	1.0	2.6 (1.6,4.1)	5.3 (3.4,8.2)	58.4	<0.0001
			Multivariable-adjusted†		
Z score Max IMT	1.0	1.3 (0.9,2.0)	1.7 (1.2,2.5)	8.7	0.01
CAC Score	1.0	2.3 (1.5,3.7)	4.4 (2.8,6.8)	44.7	<0.0001
			CHD (*n* = 159)		
			Age, race, sex-adjusted		
Z score Max IMT	1.0	1.5 (1.0,2.4)	2.1 (1.4,3.3)	11.5	<0.01
CAC Score	1.0	4.1 (2.2,7.7)	10.3 (5.6,18.9)	63.8	<0.0001
			Multivariable-adjusted†		
Z score Max IMT	1.0	1.5 (0.9,2.3)	1.7 (1.1,2.7)	5.4	0.07
CAC Score	1.0	3.5 (1.9,6.6)	8.2 (4.5,15.1)	51.5	<0.0001
			Stroke (*n* = 59)		
			Age, race, sex-adjusted		
Z score Max IMT	1.0	0.9 (0.4,2.0)	2.4 (1.2,4.7)	9.9	<0.01
CAC Score	1.0	1.4 (0.8,2.7)	1.2 (0.6,2.4)	0.7	0.70
			Multivariable-adjusted†		
Z score Max IMT	1.0	0.9 (0.4,2.0)	1.8 (0.9,3.6)	4.7	0.10
CAC Score	1.0	1.3 (0.6,2.6)	1.0 (0.5,2.1)	0.6	0.73

*CAC score and IMT were in the same model

†Adjusted as described in Methods.