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Contrast of the impact of multiple cardiovascular risk factors on the femoral and carotid intima-media thickness in asymptomatic young adults: The Bogalusa Heart Study

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Abstract

Objective—Impact of multiple cardiovascular (CV) risk factors on the intima-media thickness (IMT) of femoral and carotid artery segments measured simultaneously has not been studied in asymptomatic adults. This study examined the impact of multiple CV risk factors on the IMT in asymptomatic adults.

Methods—Femoral and carotid IMT were measured by B-mode ultrasonography in 1080 asymptomatic subjects (aged 24–43 years) of the Bogalusa Heart Study.

Results—In multivariate analyses, systolic blood pressure, age, male, total cholesterol/HDL cholesterol ratio and smoking were common independent predictor variables for the femoral and carotid IMT. Systolic blood pressure followed by age were the major determinant risk factors for the IMT of all arterial segments except carotid bulb for which age was the major predictor. The independent variables listed explained 11% of the variability in femoral IMT, 28% in common carotid, 18% in carotid bulb, 10% in internal carotid and 27% in composite carotid segments. Mean IMT increased with increasing number of risk factors in all arterial segments; p for trend = 0.003 for femoral and 0.001 for all carotid segments.

Conclusions—The observed deleterious trend of increasing IMT of the femoral and different segments of the carotid artery with increasing number of CV risk factors provide evidence of silent systemic atherosclerosis in asymptomatic young adults. These findings underscore the importance of multiple for risk factors profiling in early life. Studies of the femoral and carotid IMT may be helpful along with measurements of risk factors for evaluation of asymptomatic atherosclerotic disease.

Keywords

femoral and carotid artery; intima-media thickness; risk factors; ultrasonography; arterial disease

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1. Introduction

Epidemiologic studies have emphasized the importance of multiple risk factors profile in the prediction and prevention of CV diseases. [1] Although the clinical manifestations of CV diseases occur during and after middle age, autopsy studies in youth have shown that CV risk factors are related to the early stages of coronary atherosclerosis.[2] Importantly, the extent of atherosclerosis increases markedly with multiple risk factors.[3] B-mode ultrasonography is now being used to measure non-invasively the IMT of the carotid and femoral sites in epidemiological and clinical studies.[4–9] Carotid and femoral IMT are considered surrogate indicators of atherosclerotic coronary and peripheral arterial disease (PAD) in middle aged and older adults.[5–7,9–10] It has also been shown that risk factors of coronary artery disease are also associated with PAD.[4]

Although atherosclerosis is considered a generalized disease process, the extent of atherosclerosis and its underlying risk factors differ among arterial sites.[11] Some familial hypercholesterolemic patients have higher femoral artery IMT whereas in others the carotid artery is more affected.[12] Autopsy studies by Bosing at el [13], concluded that “a generalized uniform involvement of atherosclerosis in different vascular segments is rare and there exists a considerable intra-individual differences.”

It has been shown that atherosclerotic lesions are more frequent and advanced in femoral arteries than carotid arteries independent of increasing number of risk factors.[14–16] Studies revealed that IMT of femoral artery is a better indicator of extent and severity of coronary artery atherosclerosis than in carotid arteries.[17,18] Atherosclerosis in femoral arteries occurred earlier than carotid arteries [15] and femoral artery is more susceptible to the atherogenic influence of risk factors.[16]

There is no single peripheral vessel ultrasound parameter that could be used as a CV risk predictor. Therefore, an isolated common carotid artery IMT measurement may be an inadequate parameter of generalized atherosclerosis.[19] There is no general consensus as to which segment of the carotid artery is more informative and whether IMT of femoral artery provides any extra information.[20] Study suggests that IMT of each arterial site explained one part of risk and that measuring IMT of both carotid and femoral artery regions may complement each other in the evaluation of atherosclerosis.[21] Assessment of the IMT of common femoral artery in familial hypercholesterolemic individuals is most informative and measurement of both the carotid and femoral IMT provides a better estimation of total atherosclerotic burden.[12]

The majority of studies published so far have assessed only common carotid artery IMT, some of them assessed carotid bulb IMT, while a few reports evaluated common femoral IMT. A study evaluating asymptomatic individuals and incorporating 4 peripheral arterial sites concurrently in the same population has not been reported. Although risk factors for CV diseases are associated with IMT, information on the impact of multiple CV risk factors on the IMT of femoral artery and carotid artery segments measured simultaneously has not been studied in asymptomatic, younger adults. The present study examined this aspect in the Bogalusa Heart Study cohort.

2. Materials and methods

2.1. Study subjects

As part of the adult survey, 1203 subjects residing in the semi-rural, biracial community of Bogalusa, Louisiana, were examined in 2001 to 2002. Of these, 1080 subjects, aged 24–43 years underwent B-mode ultrasonography of the carotid and femoral artery. The eligible

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participants consist of 71% white and 43% male. Tulane University Health Sciences Center Institutional Review Board approved the study. Informed consent was obtained from all participants.

2.2. General examination and clinical measurements

Trained field observers followed standardized protocols as described previously.[22] Duplicate measurements of height to the nearest 0.1 cm and weight to the nearest 0.1 kg were made and the mean values were used to calculate body mass index (BMI) as a measure of overall adiposity. Mean values of waist circumference measured in triplicate were used as an indicator of visceral fatness. Two randomly assigned observers measured blood pressure (3 measurements each) using the right arm of subjects, seated and relaxed. Blood pressure levels were reported as the mean of 6 measurements taken at 2 stations by 2 independent observers at the same visit. Information on smoking status (yes/no) was obtained as part of a health habit questionnaire. Individuals were considered smokers if they reported current use of cigarettes or having stopped smoking within the past year.

2.3. Laboratory analysis

Subjects were instructed to fast for 12 hours before venipuncture and the compliance was determined by interviewing on the morning examination. Serum cholesterol and triglycerides levels were assayed using an enzymatic procedure on the Hitachi 902 automatic analyzer (Roche Diagnostics, Indianapolis, IN). Serum lipoprotein cholesterol levels were analyzed by a combination of heparin-calcium precipitation and agar-agarose gel electrophoresis procedures.[23]

2.4. Femoral and carotid ultrasonography

Trained sonographers performed B-mode ultrasound examinations with a Toshiba Sonolayer SSH160A (Toshiba Medical, Tokyo, Japan) equipped with a 7.5-MHz linear array transducer on subjects in a supine position with the head slightly extended and turned to the opposite direction of the carotid artery being studied. Optimal Images of maximum far wall IMTs in the long axis were recorded at the common carotid, carotid bulb (carotid bifurcation), internal carotid and left common femoral artery according to the previously developed protocols in the Atherosclerosis Risk In Communities Study.[24] Images were recorded on super VHS tapes and read by certified readers from the Vascular Ultrasound Research Laboratory (Dr. Gene Bond, Wake Forest University School of Medicine, Winston-Salem, NC) using a semiautomatic ultrasound image processing program developed by the California Institute of Technology Jet Propulsion Laboratory (Pasadena, California) according to strict protocols.[24] Mean values of 3 right and 3 left far wall IMT measurements were calculated separately for the 3 common carotid, carotid bulb and internal carotid segments. Femoral artery has only left sided single measurement. Second ultrasound performed in 10% of the subjects labeled with blind duplicate ID. The two recordings were performed by the same technologist, who was blinded with regard to the results of the first examination. Duplicate measurements on the femoral IMT of 69 subjects showed correlation coefficients of 0.63, $p = 0.0001$. In blind duplicate measurements on IMT of left common carotid, left carotid bulb, left internal carotid, right common carotid, right carotid bulb and right internal carotid, the statistically significant correlation coefficients were 0.71, 0.57, 0.76, 0.71, 0.74 and 0.83 respectively with $p = 0.0001$.

2.5. Statistical analyses

All statistical analyses were performed using SPSS system (version 16.0, SPSS Inc., Chicago Illinois, for Windows). All p values were 2 tailed with significance level of $p < 0.05$. Triglycerides, insulin, glucose and IMT were log transformed to reduce skewness.

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Participants with one sided measurement of any carotid segment were also included in analysis to increase the sample size. Composite carotid IMT was calculated as an average IMT of all carotid segments. Differences between groups' means were assessed using independent t–test or ANOVA as appropriate. If there was a race-gender interaction, the analyses was performed in 4 race sex groups.

Analysis of covariance controlling for age was used to assess the race-gender differences in IMT and risk factors. Post hoc tests used the Sidak method for multiple comparisons when appropriate. Partial Pearson correlation coefficients were used to assess the bivariate relation between IMT and risk factor variables, controlling for age within each race-gender group and age, race and gender for the entire sample. Chi-squire test was used for categorical variables to assess the race-gender differences.

Stepwise linear regression methods were used to assess the independent relation between risk factor variables and IMT of femoral and carotid segments using significance levels to enter 0.05 and to stay within 0.10. Independent variables included age, race, gender, BMI, waist circumference, systolic and diastolic blood pressure, total cholesterol, HDL cholesterol, LDL cholesterol, total cholesterol/HDL cholesterol ratio, log triglycerides, log insulin, log glucose and cigarette smoking.

The effect of multiple risk factors on IMT of femoral and carotid arteries was examined by comparing the mean IMT values of individuals with 0, 1or 2, 3, and 4 or 5 risk factors. Risk factors included cigarette smoking, and adverse levels of systolic blood pressure, waist circumference, total cholesterol/HDL cholesterol ratio and insulin. The adverse levels were defined as age-, race-, and gender- specific values above the 75^{th} percentiles for the study group. Linear trend tests were used to assess the impact of multiple risk factors on IMT of femoral and carotid arteries.

3. Results

The mean levels of anthropometric, hemodynamic and metabolic characteristics of the study cohort by race and gender are listed in Table 1. Males vs females and blacks vs whites displayed higher systolic and diastolic blood pressure, LDL cholesterol, total cholesterol/ HDL cholesterol ratio and glucose.

Mean IMT of femoral artery and different carotid segments by race and gender are shown in Table 2. Age-adjusted femoral IMT showed gender difference (males > females, $p = 0.001$) among whites only and no race difference in both genders. Males had a thicker IMT in femoral and all segments of carotid artery ($p=0.0001$). Overall, IMT of carotid arterial segments was significantly thicker than femoral IMT ($p = 0.001$). Analysis was repeated for the mean IMT values after adjusted for age and the results were similar.

Partial correlations between IMT of femoral and different carotid arterial sites and CV risk variables adjusted for age, race and gender are listed in Table 3. IMT of femoral and carotid arterial segments were significantly correlated with age.

Predictor variables of IMT of femoral, common carotid, carotid bulb, internal carotid and composite carotid arteries are listed in Table 4. Systolic blood pressure followed by age were the major predictors of IMT of all the arterial segments except carotid bulb in which age was the major predictor and systolic blood pressure remained as third predictor variable. The independent variables listed explained 11% of the variability in femoral IMT, 28% in common carotid, 18% in carotid bulb, 10% in internal carotid and 27% in composite carotid segments.

The mean IMT of femoral and different carotid segments for subjects with 0, 1or 2, 3, and 4 or more risk factors are shown in Figure 1. Analysis was repeated for the mean IMT values after adjusted for age and gender and the values were similar. Mean IMT increased with increasing number of risk factors in femoral (p for trend = 0.003), common carotid (p for trend = 0.001), carotid bulb (p for trend = 0.001), internal carotid (p for trend = 0.001), and composite carotid (p for trend = 0.001) arterial segments. The respective mean IMT (mm) values were 0.66, 0.69, 0.73, 0.79 for femoral; 0.72, 0.75, 0.80, 0.84 for common carotid; 0.91, 0.96, 1.05, 1.08 for carotid bulb; 0.69, 0.72, 0.75, 0.79 for internal carotid and 0.72, 0.75, 0.81, 0.85 for composite carotid for subjects with 0, 1–2, 3 and 4–5 risk factors.

Analyses were repeated including smoking and risk factors (hypertension, waist circumference, dyslipidemia and hyperglycemia) of metabolic syndrome defined by National Cholesterol Education Program Adult Treatment Panel III. Subjects were classified as clinically hypertensive if they had systolic blood pressure ≥ 135 mm of Hg or diastolic blood pressure ≥ 85 mm of Hg or had been treated for hypertension. Abdominal obesity was defined as waist circumference > 40 inches for men and > 35 inches for women. Subjects were classified as having dyslipidemia if their fasting levels of LDL cholesterol were ≥ 130 mg/dl or HDL cholesterol < 40 mg/dl for male and < 50 mg/dl for female or non-HDL cholesterol ≥ 160 mg/dl or triglycerides ≥ 150 mg/dl. Hyperglycemia was defined as fasting blood glucose ≥ 110 mg/dl or having treatment for diabetes. Mean IMT increased with increasing number of risk factors in femoral (p for trend = 0.001), common carotid (p for trend = 0.001), carotid bulb (p for trend = 0.001), internal carotid (p for trend = 0.019), and composite carotid (p for trend = 0.001) arterial segments. The respective mean IMT (mm) values were 0.63, 0.68, 0.76, 0.78 for femoral; 0.72, 0.74, 0.80, 0.89 for common carotid; 0.90, 0.95, 1.03, 1.12 for carotid bulb; 0.68, 0.71, 0.75, 0.79 for internal carotid and 0.77, 0.80, 0.87, 0.93 for composite carotid for subjects with 0, 1–2, 3 and 4–5 risk factors.

4. Discussion

The associations between carotid and femoral IMT with CV risk factors have been studied in several studies but femoral IMT has been less investigated compared to carotids. This study investigated and compared the impact of multiple CV risk factors on the IMT of femoral and carotid artery segments measured simultaneously in asymptomatic younger adults.

The present study shows an adverse impact of multiple CV risk factors on the femoral artery and carotid artery IMT in asymptomatic, healthy population of younger adults. The observed independent associations of age, male gender, systolic blood pressure, cigarette smoking and total cholesterol/HDL cholesterol ratio with IMT are in expected directions and consistent with previous findings made primarily in middle-aged and older populations.[16] These associations in a large sample of community-based cohort, free from the selection bias of a patient population, are indicative of the impact of multiple CV risk factors on the early stages of atherosclerosis in extra coronary arteries and, by inference, coronary arteries. Multiple risk factors influenced the IMT of femoral and carotid arteries to different degrees according to the site.

The noninvasive ultrasonographic evaluation of femoral and carotid IMT in this study expands earlier autopsy findings from the Bogalusa Heart Study and the Pathobiological Determinants of Atherosclerosis in Youth Study, showing a strong association between traditional CV risk factors and early phases of atherosclerosis in young adults.[2,3] Further recent studies using electron beam computed tomography showed an association between coronary calcification, an indicator of coronary atherosclerosis, and CV risk factors in young

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adults.[25] Taken together, these findings emphasize the adverse impact of risk factors on the underling subclinical systemic atherosclerosis.

In general, risk factors for atherosclerosis in carotid and femoral vascular sites are the same but the two sites do not share determinant risk factors to the same extent.[26,27] The explained variance of the IMT by the independent risk factors is highest for common carotid followed by carotid bulb, femoral and internal carotid arterial segments in that order. Differential effects of ageing, blood pressure, smoking, and hyperlipidemia on atherosclerotic process have been demonstrated in carotid and femoral arteries. The impact of CV risk factors may vary according to vascular site; for instance smoking and diabetes have a larger impact on PAD than the other risk factors.[28] Although the determinant risk factors are similar, differences in vascular anatomy leading to regional changes in blood flow, differences in hydrostatic pressures and local changes in the arterial wall may still differ between the vascular sites. Carotid artery is elastic and femoral artery is muscular in nature.

Different areas of the femoral arteries are exposed to higher hydrostatic pressure and to different flow patterns and may reflect greater changes as found in the carotid artery at the bifurcation.[8,29] Hemodynamic conditions at regions of flow separation and oscillatory shear stress are considered to favor lesion formation in the coronary arteries as well as in the carotid bulb and internal carotid segments.[30] It has been reported that the carotid bulb IMT is associated more closely with coronary artery disease than the common carotid IMT [31] although common carotid IMT is widely used in ultrasound studies. In the present study, the magnitude of associations of risk factors with common carotid IMT were greater than carotid bulb. For the most part, the increases in IMT in this young population did not reach the point of developing lumen stenosis. Therefore, measuring IMT in the common carotid as well as carotid bulb segments are useful in detecting subclinical atherosclerosis. The vessel diameter of femoral arteries is much larger than in the coronary and carotid vessels and studies of IMT at one area of the arterial site may only reflect symptoms from local atherosclerosis rather than generalized atherosclerosis.

Atherosclerotic changes as measured by ultrasonography have been reported to be more advanced in the femoral artery vs the carotid site,[14,15] and that examination of both arterial segments may provide more accurate information on the extent ofatherosclerosis.[12] In this study, IMT of femoral vessel, at least at the site recorded, is comparable to the IMT of the carotid arterial regions in respect of traditional CV risk factors. However, explained variances in the common carotid, carotid bulb and composite carotid IMT are greater than internal carotid and femoral arteries. Generally, IMT of common carotid artery are more reliable and easier to measure compared to other carotid segments. But, the common carotid artery is less sensitive to local atherosclerosis than carotid bulb.[12] However, compared to carotid artery, femoral artery data are scarce. That atherosclerosis occurs later in the common carotid than in the internal carotid or carotid bulb segment [32] suggests variations in susceptibility to atherosclerosis among different segments of the carotid artery. As noted earlier, carotid bulb IMT in study subjects was greater than that of common carotid IMT, internal carotid IMT and femoral IMT. Of particular interest, IMT thickness increased 0.12 mm vs 0.17 mm in common carotid and carotid bulb respectively with 0 vs 4–5 risk factors. The observed increased IMT in the carotid bulb suggests that this site may be more sensitive and useful for studying early changes and more reliable for follow-up of progression or regression of IMT in prospective studies and clinical trials.

Although atherosclerosis is considered a generalized disease process that simultaneously affects several vascular beds, studies revealed that some vascular beds affect more than others.[12,13] Other studies suggest that IMT of the carotid and femoral sites are not exchangeable and the femoral IMT may be considered as a dichotomized risk marker.[33]

Studies showed that there exists a correlation between femoral and carotid IMT.[16,33] In this study, the correlation coefficient (r) between IMT of common carotid and common femoral is 0.19. This weak strength of association imply that in low risk population the values of femoral and carotid IMT are not interchangeable. Therefore, IMT of both arterial segments should be measured for the assessment of subclinical manifestation of atherosclerosis and prediction of future CV risk.[17,33]

Ultrasonography of the carotid and femoral arteries is practical and provides a noninvasive and relatively inexpensive method to assess systemic effects of the hypertensive-diabetic-atherosclerotic process. It is known that diabetes greatly accelerates PAD and the correlation of obesity, total cholesterol/HDL cholesterol ratio, and triglycerides in this study of young adults may be a subtle predictor of future disease at these sites.

As a limitation, compared with the carotid artery, the femoral artery is more difficult to examine because of the location, especially in obese subjects. Although the correlation of duplicate femoral, left common carotid, left carotid bulb, left internal carotid, right common carotid, right carotid bulb, and right internal carotid IMT measures were highly statistically significant, the correlations themselves were not that strong. Inaccuracy in the measurement of the study outcome could bias study findings. In assessing IMT by ultrasound, it is often difficult to differentiate whether an increased IMT is the result of intima thickening, reflecting local atherogenesis, or of media thickening, which is a consequence of arterial wall hypertrophy.[34] Further studies are indicated to resolve this issue.

The findings of this study that the IMT of femoral and carotid artery increased considerably in asymptomatic, young adults with multiple risk factors support the concept of the importance of multivariate risk profile and the attendant accelerated atherosclerosis systemically. Multiple risk factors are established for its clinical manifestations in middle-aged and older populations as enunciated by the Framingham Heart Study.[1] The traditional CV risk factors evaluated in this study, with the exception of cigarette smoking which we found at the high risk group are metabolically related,[35] and coexist frequently in youth.[36] The observed deleterious impact of multiple risk factors on the femoral and carotid IMT parallel the earlier autopsy results showing marked increases in the extent of coronary atherosclerosis in young subjects with increasing number of risk factors.[3]

In summary, IMT increases with age as the number of CV risk factors increases in population of asymptomatic younger adults. Current findings indicate the need for CV risk assessment, prevention and control in young subjects, beginning as early as childhood with the emphasis on multiple risk factors rather than only on a specific risk factor. IMT should be considered as an additional risk factor with the traditional CV risk factors for risk stratification. Although ultrasonographic examination of non coronary arterial segments may not be practiced for routine screening in the general population, it can be useful in selected high-risk groups. Studies of the femoral IMT in conjunction with carotid IMT particularly common carotid and carotid bulb is an important assist in evaluating the burden of multiple risk factors on atherosclerotic hypertensive changes in young subjects and evaluating a generalized vascular age in contrast to chronological age.

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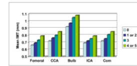

Figure 1. The effect of multiple risk factors on IMT of femoral artery and different segments of carotid artery in young adults. The Bogalusa Heart Study

A highly significant trend of increasing thickness is shown with greater numbers of risk factors. Risk factors included were total cholesterol / HDL cholesterol ratio, waist circumference, systolic blood pressure, insulin level (75^{th} percentile specific for age, race, gender) and smoking.

p for trend = 0.003 for femoral; p for trend = 0.001 for CCA, bulb, ICA and composite carotid

CCA, common carotid artery; Bulb, carotid bulb; ICA, internal carotid artery; Com, composite carotid.

Table 1

Anthropometric, hemodynamic, and metabolic characteristics of the study cohort by race and gender (n = 1080)

					Comparison*	
Variables†	**White male (n = 348)**	**Black Male (n = 117)**	**White Female (n = 419)**	**Black Female (n = 196)**	**Race**	**Gender**
Age (years)	36.7 ± 4.3	36.6 ± 4.3	36.5 ± 4.3	35.6 ± 4.7	ns	ns
BMI (kg/m^2)	29.0 ± 5.6	29.3 ± 7.2	28.3 ± 6.9	31.2 ± 8.1	0.001[b]	ns
Waist (cm)	99.0 ± 14	96.4 ± 18	87.0 ± 16	92.9 ± 17	ns	0.0001[a]
Systolic BP (mm Hg)	118 ± 11	128 ± 17	111 ± 11	119 ± 16	0.0001	0.0001
Diastolic BP (mm Hg)	74.7 ± 8.2	80.7 ± 13	69.9 ± 9.0	74.1 ± 11	0.0001	0.0001
LDL cholesterol (mg/dl)	130 ± 35	127 ± 45	124 ± 32	115 ± 31	0.005	0.001
HDL cholesterol (mg/dl)	41.5 ± 12	49.8 ± 16	50.6 ± 13	52.0 ± 13	0.0001[c]	0.0001[a]
Triglycerides (mg/dl)	166 ± 131	122 ± 81	124 ± 74	87.8 ± 37	0.0001	0.0001
Total/HDL-C	4.99 ± 1.5	4.21 ± 1.5	4.03 ± 1.2	3.63 ± 1.1	0.0001	0.0001
Insulin (μU/ml)	13.2 ± 10	12.0 ± 9.7	11.5 ± 8.3	15.5 ± 20	ns	ns
Glucose (mg/dl)	87.5 ± 19	91.3 ± 34	82.8 ± 18	87.3 ± 30	0.01	0.0001
Smoking (%)	32.5	41.9	32.5	35.2	ns	ns

ns, not significant; BMI, body mass index; BP, blood pressure; LDL, low density lipoprotein; HDL-C, high density lipoprotein cholesterol.

[a] whites only.

[b] females only.

[c] males only.

* Analysis of Covariance (p value adjusted for age)

† Mean ± SD for continuous variables; SD, standard deviation

Table 2

Mean (mm ± SD) Intima –media thickness of femoral and carotid artery in young adults by race and gender.

Arterial segments (IMT)	White male (n =348)	Black male (n =117)	White female (n =419)	Black Female (n =196)	Comparison*	
					Race	Gender
Femoral (n=1080)	0.75 ± 0.37	0.70 ± 0.19	0.64 ± 0.26	0.66 ± 0.22	ns	0.0001[a]
Common carotid (n=1079)	0.78 ± 0.14	0.84 ± 0.15	0.71 ± 0.10	0.76 ± 0.12	0.0001	0.0001
Carotid bulb (n=1060)	1.02 ± 0.28	1.02 ± 0.23	0.91 ± 0.21	0.94 ± 0.28	ns	0.0001
Internal carotid (n=1029)	0.75 ± 0.21	0.76 ± 0.20	0.68 ± 0.18	0.71 ± 0.19	ns	0.0001
Composite carotid (n=1018)	0.85 ± 0.17	0.88 ± 0.15	0.76 ± 0.13	0.80 ± 0.15	0.0001	0.0001

[a] whites only.

* P value adjusted for age

Table 3

Partial correlation between intima-media thickness of femoral artery, different segments of carotid artery and cardiovascular risk factor variables in young adults.

Variables	Femoral *	Common*	Bulb*	Internal*	Composite*
BMI	0.08[a]	0.21[c]	0.02	0.12 [c]	0.15[c]
Waist	0.09[b]	0.22[c]	0.03	0.09 [b]	0.15[c]
Systolic BP	0.15[c]	0.23[c]	0.15[c]	0.15 [c]	0.23 [c]
Diastolic BP	0.11[c]	0.19[c]	0.10[b]	0.13 [c]	0.18 [c]
LDL cholesterol	0.09[b]	0.19[c]	0.15[c]	0.15[c]	0.22[c]
HDL cholesterol	−0.07[a]	−0.12[c]	−0.09[b]	−0.07[a]	−0.13 [c]
Triglycerides	0.08[a]	0.13[c]	0.12[c]	0.08[b]	0.15 [c]
Total/HDL-C	0.09[b]	0.23[c]	0.19[c]	0.15[c]	0.25 c
Insulin	0.01	0.15[c]	0.05	0.09[b]	0.12[c]
Glucose	−0.03	0.13[c]	0.05	0.04	0.08[a]

BMI, body mass index; BP, blood pressure; LDL, low density lipoprotein HDL-C, high density lipoprotein cholesterol.

[a] $p < 0.05$.

[b] $p < 0.01$.

[c] $p < 0.001$.

[*] Adjusted for age, race and gender

Table 4

Predictors of intima-media thickness of femoral and different segments of carotid artery by multiple regression in young adults: The Bogalusa Heart study

Common carotid		Carotid bulb		Internal carotid		Composite carotid		Femoral	
Predictors	**Partial R^2**	**Predictors**	**Partial R^2**	**Predictors**	**Partial R^2**	**Predictors**	**Partial R^2**	**Predictors**	**Partial R^2**
Systolic BP	0.132	Age	0.079	Systolic BP	0.052	Systolic BP	0.115	Systolic BP	0.046
Age	0.039	Total/HDL	0.047	Age	0.023	Age	0.066	Age	0.026
Male	0.037	Systolic BP	0.024	Total/HDL	0.021	Total/HDL	0.052	Male	0.022
Black	0.020	Smoking	0.013	Male	0.008	Male	0.019	Smoking	0.012
Total/HDL	0.031	Male	0.012			Black	0.009	Total/HDL	0.005
Waist	0.007	BMI	0.004			Smoking	0.007		
Smoking	0.006					LDL	0.006		
LDL	0.003								
Total R^2 = 0.28		Total R^2= 0.18		Total R^2 = 0.10		Total R^2 = 0.27		Total R^2 = 0.11	

Stepwise regression model included age, race, gender, waist circumference, BMI, systolic and diastolic blood pressure, LDL cholesterol, HDL cholesterol, total cholesterol/HDL cholesterol ratio, log triglycerides, log insulin, log glucose and cigarette smoking.

BMI, body mass index; BP, blood pressure; LDL, low density lipoprotein; HDL, high density lipoprotein, Total/HDL, total cholesterol/HDL cholesterol ratio.