

# Measurement of intima media thickness of carotid artery by B-mode ultrasound in healthy people of India and Bangladesh, and relation of age and sex with carotid artery intima media thickness: An observational study

Jayanta Paul, Kishore Shaw, Somnath Dasgupta, Mrinal Kanti Ghosh<sup>1</sup>

Departments of General Medicine and <sup>1</sup>Radiology, Burdwan Medical College, Burdwan, West Bengal, India

**Address for correspondence:** Dr. Jayanta Paul, Burdwan Medical College, C/o Jitendra Chandra Paul, J+B lodge, Santosh Sarani, Banamalipur, Barasat, North 24 Parganas, West Bengal - 700 124, India.

E-mail: drjayantapaul@gmail.com

## ABSTRACT

**Background:** Carotid artery intima media is a surrogate marker of atherosclerosis and related with ethnicity, age, sex, traditional and non-traditional risk factors. Black ethnicity is related to greater mean and maximum carotid artery intima media thickness when compared to South Asians. Our study was done to find out the mean carotid artery intima media thickness (CAIMT) of normal healthy people of India and Bangladesh, and the relationship of non-modifiable risk factors such as age and sex with CAIMT. **Materials and Methods:** In this observational study, CAIMT of 93 people were examined by B-mode ultrasonography. All subjects underwent a careful interview and clinical, radiological, biochemical examination. Data was analyzed by software statistical package for social sciences (SPSS) (17<sup>th</sup> version for window). **Results:** In our study, the mean CAIMT of healthy subjects including all age group was (754.94 ± 11.96 micron.). Mean CAIMT was higher in age group of 61-80 years (908.75 ± 39.02 micron) than age group of 20-40 years (713.62 ± 16.59 micron) and 41-60 years (745.55 ± 13.05 micron). CAIMT was positively correlated with age (*P* value <0.001) and sex (*P* value=0.001). **Conclusion:** An aggregated analysis based on this study in different age groups of healthy people may be useful for assessing carotid artery abnormalities as an aid to defining abnormalities and predicting risk of atherosclerosis in individual healthy people living in India and Bangladesh.

**Key words:** Age, carotid artery intima media thickness, ethnicity, normal healthy subjects, sex

## INTRODUCTION

Carotid artery intima-media thickness (CAIMT) is increasingly used as a surrogate marker of early atherosclerosis, and in a recent review it was shown that CAIMT is a strong predictor of future vascular events such as myocardial infarction and stroke.<sup>[1]</sup> The normal values

of CAIMT are dependent on the methodology used for its measurement, life style, food habit, ethnicity of the people of the different parts of the world, and all these factors should be considered, also taking into account the gender of the person and the range of age.<sup>[2-6]</sup> There are many non-invasive markers to assess arterial wall disturbances, including arterial wall thickening and stiffening, endothelial dysfunction and coronary artery calcification.<sup>[6,7]</sup>

The CAIMT is easily, safely, reliably and inexpensively measured with B-mode ultrasound, and the predictive value of this test is increased when CAIMT is measured at multiple extracranial carotid sites.<sup>[8]</sup> The CAIMT can be measured both from the near-wall and the far-wall of the carotid artery. In the far wall, it is usually easy to detect the

Access this article online	
Quick Response Code: 	Website: www.jcdronline.com
	DOI: 10.4103/0975-3583.95367

media-adventitia interface, and this measurement location has been suggested as being more accurate.<sup>[9,10]</sup>

The normal intima-medial thickness of common carotid artery as evaluated by B-mode ultrasound imaging was  $0.74 \pm 0.14$  mm.<sup>[11]</sup> Some studies also indicated that CAIMT  $<0.8$  mm is associated with normal healthy individuals, and a value of CAIMT at or above 1 mm is associated with atherosclerosis and a significantly increased cardiovascular disease (CVD) risk in any age group<sup>[8,9]</sup>. Kumar *et al.*<sup>[12]</sup> and Howard *et al.*<sup>[13]</sup> observed that CAIMT of healthy controls were 0.73 mm and  $< 0.7$  mm, respectively.

There is still controversy regarding the CAIMT value of normal healthy people of different ethnicity, because CAIMT also depends on ethnicity<sup>[14]</sup>, which is a non-modifiable risk factor. Black ethnicity is related to greater mean and maximum CAIMT when compared to South Asians, even after adjusting for traditional cardiovascular risk factors.<sup>[14]</sup> People of India and Bangladesh have similar type of food habits, life style and ethnicity which can be responsible for modification of the CAIMT. Majority of previous studies which were done to detect the CAIMT of normal healthy person, were performed in people of different parts of the world with different type of ethnicity, food habits and life style. For this reason, CAIMT value of normal healthy person which was estimated by previous different studies may not be applicable on the people of India and Bangladesh.

Our study was done to find out the mean CAIMT of normal healthy people of India and Bangladesh, and the relationship of non-modifiable risk factors such as age and sex with CAIMT.

## MATERIALS AND METHODS

In this prospective observational study, the study subjects included 93 normal healthy people. Out of 93 healthy subjects, 37 people were from Bangladesh. The study subjects were healthy relatives and friends of patients who were admitted at our hospital. After taking consent, all subjects underwent a careful interview and clinical, radiological, biochemical examination with an evaluation of patient history based on hospital and outpatients records. Modifiable traditional risk factors of atherosclerosis (Smoking, Hypercholesterolemia, Diabetes, Hypertension, and 24 hours total urine protein excretion) which may influence CAIMT value were examined carefully.

In our study, all participants are non-smokers, Non-hypercholesterolemic, non-hypertensive, non-diabetic, and

24 hours urine total protein was not measurable by Esbch's albuminometer. All healthy subjects had normal body mass index, body weight and waist circumference.

Non-hypertensive condition was diagnosed when a patient had not received medicine for hypertension, or had systolic blood pressure  $\leq 140$  mmHg and diastolic blood pressure  $\leq 90$  mmHg after taking 5 minutes rest. Data on smoking was obtained by questionnaire. Participants were classified as never-smokers if they responded that they had smoked fewer than 100 cigarettes or 5 packs of cigarettes during their lifetime.<sup>[15]</sup>

Venous blood was taken in the morning after an overnight fast for at least 12 hours for biochemical analysis. Plasma glucose was measured by a "glucose oxidase-peroxidase" method. Diabetes was diagnosed according to "American Diabetes Association" when a previous or current 12 hour fasting glucose level was 7 mmol/l or greater ( $\geq 126$  mg %). Serum total cholesterol was measured by "cholesterol oxidase-peroxidase" method. Patients who used cholesterol lowering medication or had a total serum cholesterol level  $\geq 200$  mg/dl were classified as having hypercholesterolemic.<sup>[16]</sup> 24 hours urine total albumin excretion is the "gold stander" for measurement of albuminuria,<sup>[17]</sup> and here it was measured by Esbach's albuminometer. All biochemical measurements were estimated through Department of Biochemistry, Burdwan Medical College.

CAIMT is defined as a low level echo grey band that does not project into the arterial lumen, and was measured at the diastolic phase as the distance between the leading edge of the first and second echogenic lines of the far walls of the distal segment of the common carotid artery, the carotid bifurcation, and the internal carotid artery on both sides.<sup>[18]</sup> with a duplex ultrasound system with 7.5 MHz scanning frequency in the B-mode, pulsed Doppler mode and color mode. The B-mode scanning protocol included the scanning of the right and left common carotid arteries (3 cm before the carotid bifurcation), carotid bifurcation, as well as of the internal carotid artery 2 cm distally from the carotid bifurcation.<sup>[19]</sup> CAIMT measurements were always performed in plaque-free arterial segments.<sup>[18]</sup> All examinations and measurements were performed by the same examiner to exclude examiner bias.

Independent samples *t* test and multivariate linear regression analysis were performed for result and analysis. *P* value less than 0.05 was taken as statistically significant. Data were expressed as means  $\pm$  SE (Standard Error). All these analysis were performed using a commercially

available software SPSS (17<sup>th</sup> version for window) on personal computer.

## RESULTS AND ANALYSIS

Out of 93 healthy subjects, 50 were male and 43 were female. 37 people came from different part of Bangladesh and 56 subjects were come from different area of West Bengal. The mean age of total study subjects was  $44.34 \pm 1.33$  years [Figure 1]. Mean age of male and females was  $43.54 \pm 1.97$  years and  $45.28 \pm 1.78$  years, respectively [Figure 1]. T test of equality of means found that male and female groups are age matched ( $P$  value=0.513) [Table 1]. 12.90%, 36.56% and 50.54% subjects were in the age group of 61-80 years, 20-40 years and 41-60 years, respectively [Figure 2].

There was significant positive correlation between age and CAIMT ( $P$  value<0.001) [Table 2]. Mean CAIMT was higher in age group of 61-80 years ( $908.75 \pm 39.02$  micron) as compared to the age group of than 20-40 years ( $713.62 \pm 16.59$  micron), and 41-60 years ( $745.55 \pm 13.05$  micron) [Figure 3]. In our study, the mean CAIMT of healthy subjects including all age group was  $754.94 \pm 11.96$  micron.

Sex was also significantly correlated with CAIMT ( $P$  value=0.001) [Table 2]. Male sex had significant higher CAIMT ( $780.02 \pm 15.15$  micron,  $P$  value=0.024) than age matched ( $P$  value=0.513) female sex ( $725.77 \pm 18.13$  micron) [Figure 4].

## DISCUSSION

Carotid artery intima medial thickness [Figure 5] is a surrogate marker of atherosclerosis [1] and can diagnose early atherosclerosis. We should know normal value of CAIMT to take a decision whether the person is having

**Table 1: Independent samples t test for equality of means between age of female and male sex in the study**

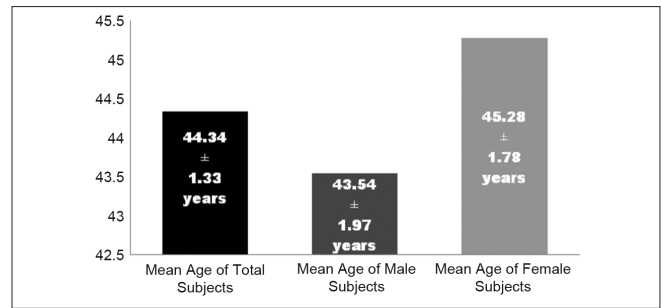
		<i>P</i> value
Age	Equal variances assumed	0.5190
	Equal variances not assumed	0.513

*Variances are: Male and female sex of healthy subjects*

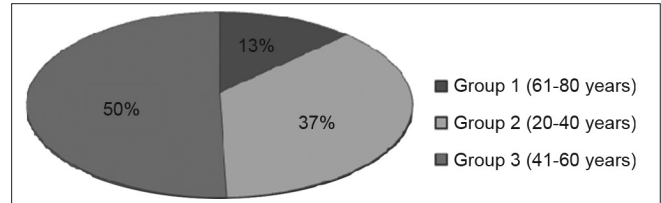
**Table 2: Linear multivariate regression analysis of age and sex correlating with carotid artery intima media thickness**

Independent variables	Standardized coefficients beta	t	<i>P</i> value
Age	0.569	6.821	0.000
Sex	0.274	3.290	0.001

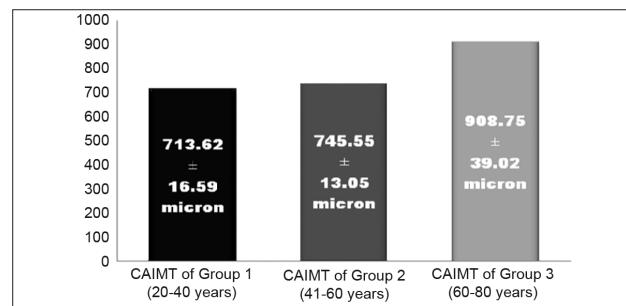
*Here dependent variable: Carotid artery intima media thickness*



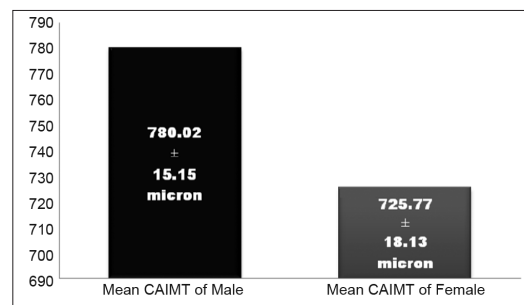
**Figure 1: Mean age of different groups of healthy subjects in the study**



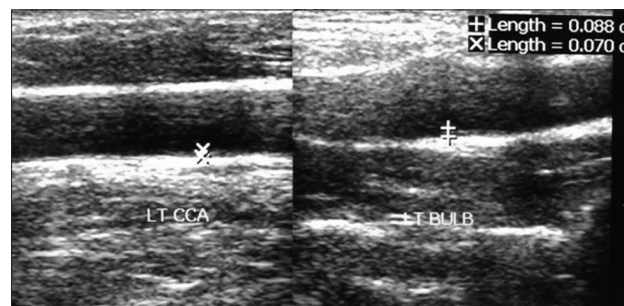
**Figure 2: Age distribution of healthy subjects in the study**



**Figure 3: Mean carotid artery intima media thickness of different age groups in the study**



**Figure 4: Mean carotid artery intima media thickness of males and females in the study**



**Figure 5: Intima media thickness Measurement on Left common carotid artery (LT CCA) and left carotid bifurcation (LT BULB).**

an abnormal thickening of the carotid artery or not. Our study is helpful for taking this decision. In this study, we found that the CAIMT of normal healthy persons (including all age group) was  $754.94 \pm 11.96$  micron, which is nearly similar to other previous several studies.<sup>[8,9,11-13]</sup> In several studies, it is observed that the CAIMT changes in relation to age and sex. In particular, it grows higher with increasing age<sup>[3,4]</sup> and always higher in men than women.<sup>[2,20]</sup> Our study also showed that CAIMT was positively correlated with age ( $P$  value $<0.001$ ) and was higher in the age group of 60-88 years, than lower age groups. There was significant correlation between CAIMT and sex ( $P$  value=0.001) and also higher CAIMT was seen in male sex than age matched female sex in this study. There are some limitations in this study, 1) premature atherosclerosis, serum homocysteine, lipoprotein (a), physical activity, atherogenic diet, pro-inflammatory factors and pro-thrombotic factors could not be included due to the limitations of budget and study design, 2) Small number of participants.

## CONCLUSION

In conclusion, An aggregated analysis based on this study in different age groups of healthy people may be useful for assessing carotid artery abnormalities as an aid to defining abnormalities, and predicting risk of atherosclerosis in individual healthy people living in India and Bangladesh.

## REFERENCES

- Lorenz MW, Markus HS, Bots ML, Rosvall M, Sitzer M. Prediction of clinical cardiovascular events with carotid intima-media thickness. A systematic review and meta-analysis. *Circulation* 2007;115:459-67.
- Haroun MK, Jaar BG, Hoffman SC, Comstock GW, Klag MJ, Coresh J. Risk factors for chronic kidney disease: A prospective study of 23,534 men and women in Washington County, Maryland. *J Am Soc Nephrol* 2003;14:2934-41.
- Stein JH, Douglas PS, Srinivasan SR, Bond MG, Tang R, Li S, *et al.* Distribution and cross-sectional age-related increases of carotid artery intima-media thickness in young adults: The Bogalusa Heart Study. *Stroke* 2004;35:2782-7.
- Bots ML, Evans GW, Riley WA, Grobbee DE. Carotid intima-media thickness measurements in intervention studies: Design options, progression rates, and sample size considerations: A point of view. *Stroke* 2003;34:290-7.
- Kablak-Ziembicka A, Przewlocki T, Tracz W, Pieniazek P, Musialek P, Sokolowski A. Gender differences in carotid intima-media thickness in patients with suspected coronary artery disease. *Am J Cardiol* 2005;96:1217-22.
- O'Rourke MF, Hashimoto J. Mechanical factors in arterial aging: A clinical perspective. *J Am Coll Cardiol* 2007;50:1-13.
- Simon A, Megnien JL, Levenson J. Detection of preclinical atherosclerosis may optimize the management of hypertension. *Am J Hypertens* 1997;10:813-24.
- Simon A, Garipey J, Chironi G, Megnien JL, Levenson J. Intima-media thickness: A new tool for diagnosis and treatment of cardiovascular risk. *J Hypertens* 2002;20:159-69.
- Wikstrand J, Wendelhag I. Methodological considerations of ultrasound investigation of intima-media thickness and lumen diameter. *J Intern Med* 1994;236:555-9.
- Wong M, Edelstein J, Wollman J, Bond MG. Ultrasonic-pathological comparison of the human arterial wall. Verification of intima-media thickness. *Arterioscler Thromb* 1993;13:482-6.
- Mohan V, Ravikumar R, Shanthi Rani S, Deepa R. Intimal medial thickness of the carotid artery in South Indian diabetic and non-diabetic subjects: The Chennai Urban Population Study. *Diabetologia* 2000;43:494-9.
- Sunil Kumar K, Lakshmi AY, Srinivasa Rao PV, Das GC, Siva Kumar V. Carotid intima-medial thickness in patients with end-stage renal disease. *Indian J Nephrol* 2009;19:13-4.
- Howard G, Sharett AR, Heiss G, Evans GW, Chambless LE, Riley WA, *et al.* Carotid artery intima-medial thickness distribution in general populations as evaluated by B-mode ultrasound. *Stroke* 1992;24:1297-304.
- Bennett PC, Gill PS, Silverman S, Blann AD, Lip GY. Ethnic differences in common carotid intima-media thickness, and the relationship to cardiovascular risk factors and peripheral arterial disease: The Ethnic-Echocardiographic Heart of England Screening Study. *QJM* 2011;104:245-54.
- Howard G, Wagenknecht LE, Burke GL, Diez-Roux A, Evans GW, McGovern P, *et al.* Cigarette smoking and progression of atherosclerosis: The Atherosclerosis Risk in Communities (ARIC) Study. *JAMA* 1998;279:119-24.
- V Nesar Hoseini, O Taziki. Relationship between Microalbuminuria and Severity of Coronary Artery Disease in Non-Diabetic Patients. *Iran Cardiovasc Res J* 2008;4:234-7.
- Joanne M, Bargman, Karl Skorecki. Chronic Kidney Disease. Harrison's Principals of Internal Medicine. 17<sup>th</sup> ed. Vol. 2. New York: McGraw-Hill Companies; 2008. p. 1761-71.
- Francesco AB, Francesca M, Giovanni T, Carmine Z. Prognostic value of ultrasonographic measurement of carotid intima media thickness in dialysis patients. *J Am Soc Nephrol* 2001;12:2458-64.
- Leskinen Y, Lehtimäki T, Loimaala A, Lautamatti V, Kallio T, Huhtala H, *et al.* H. Carotid atherosclerosis in chronic renal failure- the central role of increased plaque burden. *Atherosclerosis* 2003;171:295-302.
- Kablak-Ziembicka A, Przewlocki T, Tracz W, Pieniazek P, Musialek P, Sokolowski A. Gender differences in carotid intima-media thickness in patients with suspected coronary artery disease. *Am J Cardiol* 2005;96:1217-22.

**How to cite this article:** Paul J, Shaw K, Dasgupta S, Ghosh MK. Measurement of intima media thickness of carotid artery by B-mode ultrasound in healthy people of India and Bangladesh, and relation of age and sex with carotid artery intima media thickness: An observational study. *J Cardiovasc Dis Res* 2012;3:128-31.  
**Source of Support:** Nil, **Conflict of Interest:** None declared.