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ORIGINAL ARTICLE

Carotid IMT in young adult offspring of diabetic and/or hypertensives

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Abstract Atherosclerosis begins in childhood and progresses through young adulthood to form the lesions that cause coronary heart disease. These preclinical lesions are associated with coronary heart disease risk factors in young persons. Intima-media thickness is a well-known marker of subclinical atherosclerosis and it also can indicate future cardio-cerebrovascular disease and is a noninvasive, feasible, reliable, and inexpensive method for detecting development of subclinical atherosclerosis. This study sought to determine whether family history of diabetes and hypertension are associated with carotid intima-media thickness (cIMT) in adolescents. Carotid intima-media thicknesses were measured by B-mode ultrasonography in 203 adolescents (18 to 25 years). The effects of family history of diabetes and hypertension, sex, age, body mass index, cholesterol, and blood pressure were studied. The mean values of cIMT were 0.489 mm in both study group and controls. In adolescents, higher cIMT was associated with diabetic father, over weight (BMI> 23.5 kg/m^2) and male sex. Higher cIMT is associated with diabetic father, over weight (BMI>23.5 kg/m^2), and male sex. Using cIMT in young adults with family history of diabetes and hypertension alone may not be useful screening tool for detection of atherosclerosis.

Keywords Atherosclerosis · Young adults · cIMT · Over weight

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Abbreviations

cIMT	Carotid intima-media thickness
BMI	Body mass index
HbA1C	Glycosylated hemoglobin

Introduction

Evidence indicates that atherosclerosis begins in childhood with the accumulation of lipid in the intima of arteries to form fatty streaks [1]. Nearly, all children have at least some degree of aortic fatty streaks by 3 years of age [2], and these fatty streaks increase after 8 years of age [3], with atherosclerotic plaques present in the coronary arteries during adolescence [4]. Atherosclerotic process results in changes in the structure and function of the arterial tree [5] resulting in deterioration in endothelial function and arterial stiffness which are early events in the development of cardiovascular diseases.

Intima media thickness is a well-known marker of subclinical atherosclerosis and it also can indicate future cardio-cerebrovascular disease [6–8] and is a noninvasive, feasible, reliable, and inexpensive method for detecting development of subclinical atherosclerosis. Studies in adults have revealed that IMT is also related to cardiovascular risk factors [6, 7]. In case–control studies, high-risk children who have hypertension, obesity, familial hyperlipidemia, type 1 diabetes, or a parental history of early coronary artery disease (the cases) have significantly higher carotid intima-media thickness (cIMT) compared with control subjects [9]. Knowledge of how risk factors relate to cIMT may help in the design of early interventions to prevent cardiovascular disease when the lesions are less advanced.

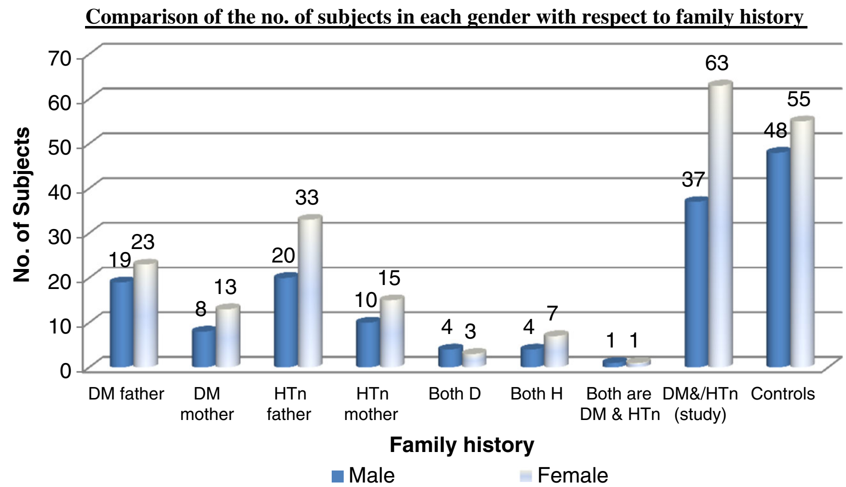


Fig. 1 Comparison of the no. of subjects in each gender with respect to family history

There has been no statistical data about the association between IMT and family history of diabetes or hypertension in young adults. This study aimed to verify the relationships between IMT and family history of diabetes or hypertension in young adults so that early intervention can be done to prevent further progression. This study also aimed to verify the relationships among obesity, dyslipidemia, elevated blood pressure, impaired glucose metabolism, gender, and IMT to explore as to which of these factors are related to IMT.

Methods

This study is a cross-sectional comparative study done during 2010–2011.

The study has included 203 subjects aged between 17 and 25 years.

Inclusion criteria Age, 18–25 years. Subjects with diabetic and/or hypertensive parents.

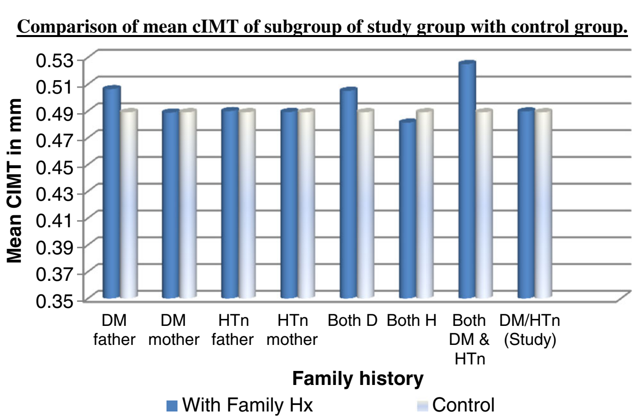


Fig. 2 Comparison of mean cIMT of subgroup of study group with control group

Exclusion criteria Subjects with preexisting Diabetes and/ or Hypertension, Dyslipidemia, CAD and smokers.

They are categorized as study group and controls.

Study group was defined as subjects with diabetic and/ or hypertensive parents which included 37 males and 63 females, with a mean age of 20.7 years (range 18 to 25 years).

Control group was defined as subjects without diabetic and/or hypertensive parents which included 48 males and 55 females, with a mean age of 20.3 years (range 18 to 25 years).

History regarding smoking, the presence of hypertension, diabetes mellitus, and CAD was taken.

Clinical characteristics

The body weight was assessed using a calibrated weighing machine, height was measured by a standard height bar, and BMI was calculated as body weight (kg) divided by square height (m^2). Waist circumference (WC) was measured at the midway between the lower rib and the iliac crest. Pulse was measured in right radial artery. Systolic

Table 1 Comparison of mean cIMT of subgroup of study group with control group

	Study	Control	*P* value
DM father	0.5063	0.48901	*0.036*
DM mother	0.4888	0.48901	0.736
HTn father	0.4899	0.48901	0.548
HTn mother	0.4892	0.48901	0.707
Both D	0.5050	0.48901	0.341
Both H	0.4812	0.48901	0.723
Both DM & HTn	0.5250	0.48901	
DM/HTn (Study)	0.4896	0.48901	0.236

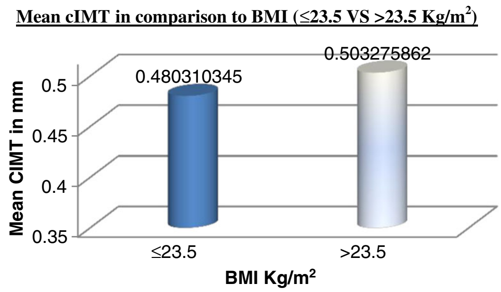


Fig. 3 Mean cIMT in comparison to BMI (≤23.5 vs. >23.5 kg/m^2)

Table 2 Mean cIMT in comparison to BMI (≤23.5 vs. >23.5 kg/m^2)

BMI	Subjects	Mean CIMT	*P* value
≤23.5	145	0.48031	*0.011*
>23.5	58	0.503276	

blood pressure (SBP) and diastolic blood pressure (DBP) were measured at the right arm in the supine position using mercury sphygmomanometer.

Biochemical measurements

In addition to physical examination, investigations like random blood sugar, HbA1C, and lipid profile were done.

IMT measurement

Bilateral common carotid intima media thickness (IMT) was measured using high resolution B-mode ultrasound (Siemens sonoline) (Linear probe −7.5–11 MHz). The subjects were examined supine with the neck extended and the probe in the anterolateral position. All measurements of IMT were made in the longitudinal plane at the point of maximum thickness on the far wall of the common carotid artery, bulb, and internal carotid artery. The IMT was defined as the distance between the intima-blood interface and the adventitia-media junction. After freezing the image, the measurements were made using electronic calipers. The mean of CIMT in three arterial segments bilaterally was used for statistical purposes.

Table 3 Comparison of number of subjects in each gender in study and control group with three CIMT ranges

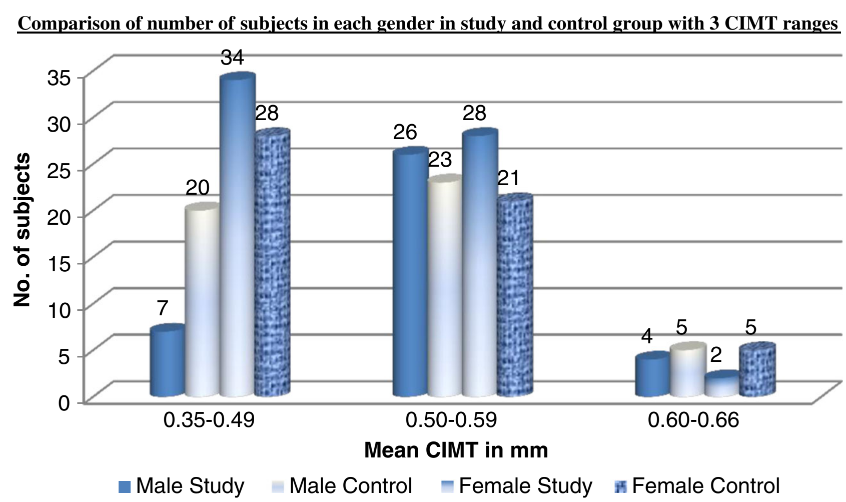
		Male		Female	
		Study	Control	Study	Control
CIMT_GP	0.35–0.49	7	20	34	28
	0.50–0.59	26	23	28	21
	0.60–0.66	4	5	2	5
Total		37	48	64	54

Results

Data were obtained for 203 subjects out of which 100 belonged to study group and 103 belonged to control group. All subjects were subjected to ultrasound images that allowed cIMT measurement. Mean (SD) values for cIMT of six walls measured were 0.4896 and 0.4842 mm for study group and control group, respectively.

Figure 1 demonstrates the number of subjects in each gender in subgroups of study group and controls which were

Fig. 4 Comparison of number of subjects in each gender in study and control group with three CIMT ranges



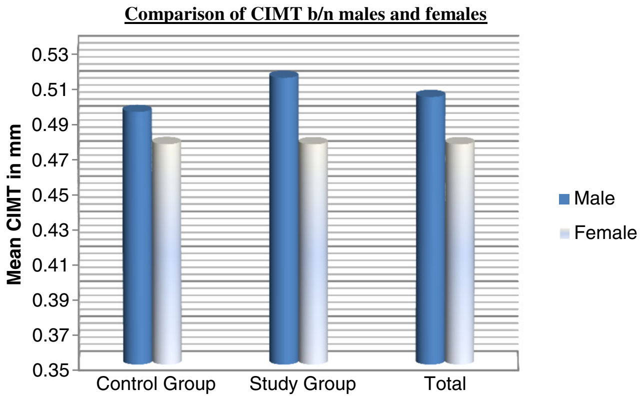


Fig. 5 Comparison of CIMT b/n males and females

statistically adequate except in the subgroups of study group with family history of both diabetes and hypertension where we had only two subjects.

Figure 2 and Table 1 demonstrate the comparison of mean cIMT of subgroup of study group with control group. Out of the study subgroups, subjects having diabetic father had statistically significant (P=0.036) higher mean cIMT. Though the subjects having family history of both diabetes and hypertension had higher mean cIMT, the number of subjects in this subgroup was not statistically sufficient.

Body mass index has a strong influence on the atherosclerotic process of the carotid arteries. Twenty percent overweight is associated with increased risk. In our study, a gradual increase in common carotid IMT was observed from lean to overweight to obese individuals which was in accordance with other studies [10–12]. Figure 3 and Table 2 demonstrate the mean cIMT in comparison to BMI (≤23.5 VS>23.5 kg/m^2) which is statistically significant (0.011).

Figure 4 and Table 3 demonstrate the comparison of number of subjects in each gender in study and control group with three CIMT ranges. Fifty-two percent (62) of females had cIMT b/n 0.35–0.49, 42 % (49) of females had cIMT b/n 0.50–0.59, and 6 % (7) of females had cIMT b/n 0.60–0.66.

Thirty-two percent (28) of males had cIMT b/n 0.35–0.49, 58 % (49) of males had cIMT b/n 0.50–0.59, and 10 % (9) of males had cIMT b/n 0.60–0.66.

Table 4 Comparison of CIMT b/n males and females

	Male	Female	*P* value
Control Group	0.494	0.4757	*0.001*
Study Group	0.5134	0.4756	
Study+control	0.5025	0.4756	

Majority of females had cIMT between 0.35 and 0.49 mm where as majority of males had cIMT between 0.50 and 0.59 mm, denoting that males are having a higher cIMT than females.

Figure 5 and Table 4 demonstrate the comparison of the mean cIMT between males and females. Males had a statistically significant more cIMT than the females.

All study participants had a normal lipid profile, systolic blood pressure, diastolic blood pressure, and pulse.

Discussion Increased cIMT is found to be associated with several cardiovascular risk factors, suggesting that its measurement may be effective in detecting atherosclerosis in young adults. In young adults, triglycerides, HDL-C, DBP, BMI, and waist/hip ratio had significantly stronger associations with cIMT [13].

There are only a few other studies that measured cIMT, and these were predominantly conducted in neonates and children. There are no such studies done in comparison of cIMT in young adult offsprings of diabetic and/or hypertensive parents with young adults without family history of diabetes and hypertension. Our study demonstrated no significant difference in cIMT in study and control group except with subjects having diabetic father (P=0.036). However, family history of both diabetes and hypertension in parents appears to have a significant influence on cIMT in offsprings, but is not statistically significant in our study due to very small sample size. This aspect needs to be further evaluated.

Recent reports indicate that the presence of obesity in childhood is associated with increased adult cIMT [11, 12]. In our study, we measured the IMT in normal weight and overweight subjects. We found that IMT in overweight young adults was significantly increased (P=0.011) as compared with normal weight young adults of similar age, which was in accordance with other studies [14, 15]. Our study provides further support for the importance of childhood obesity in premature atherosclerosis.

Our study also demonstrates a significant increase in cIMT in males compared to females (P=0.001).

Deficiencies still exist in our study. First, our sample size was not large enough, especially for subjects with family history of both diabetes and hypertension. Second, the age of onset and duration of diabetes and hypertension in the parents was not considered which might probably influence the cIMT. Finally, the IMT may also probably be influenced by other risk factors which have not been tested in our study.

In conclusion, atherosclerosis begins early in overweight young adults and males even in the absence of other risk factors. The family history of diabetes in father and history of both diabetes and hypertension in parents appears to have strong influence on cIMT of offspring's. This needs further confirmation in large sample size.

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Our study was performed after approval from JSS University Ethical Committee.

Written consent was taken from all the study participants.