

## ORIGINAL ARTICLE

## ASSOCIATION BETWEEN CAROTID INTIMA-MEDIA THICKNESS AND PHYSICAL ACTIVITY SCORES IN MIDDLE AGED PAKISTANI ADULTS – A HOSPITAL BASED STUDY

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**Background:** The intima-media thickness of carotid arteries measured with B-mode ultrasound is a measurable index of the presence of atherosclerosis. Physical inactivity is known to be a risk factor for rapid onset and progression of atherosclerosis. Objective of the study was to evaluate the influence of leisure time physical activity on carotid intima media thickness in middle aged Pakistani population. **Methods:** This cross-sectional study was carried out at the Department of Diagnostic Radiology Holy Family Hospital in collaboration with the Department of Pathology and the Department of Internal Medicine from July to December 2009. Subjects were attendants of patients admitted to the Department of Internal Medicine. All individuals underwent B-mode carotid ultrasound and physical activity assessment was done by using IPA Questionnaires. **Results:** The study population consisted of 110 healthy men and women (male=64, mean age of 55.1±8.2 years and female=46, mean age of 58.6±6.7 years) with a mean physical activity of 438±97 (male=521±62 MET-minutes/weeks, female=394±162 MET-minutes/week). Results revealed that physical activity has significant association with the thickness of carotid intima media ( $p$ -value=0.042). A total of 11 individuals (10%) had a carotid intima media thickness that was classified as a localized carotid artery plaque (males n=6 and female n=5). **Conclusion:** The proportion of time and level of physical activities is associated with thickness of intima media of common carotid artery, independently of age and established atherosclerotic risk factors.

**Keywords:** Ultrasound, intima-media thickness, carotid intima-media, atherosclerosis

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### INTRODUCTION

Carotid intima media thickness (IMT), measured by a combination of B-mode and Doppler ultrasound, is an established marker of sub-clinical atherosclerosis.<sup>1-3</sup> It is a non-invasive investigation that has seen substantial use in large population studies on coronary artery disease risk stratification.<sup>3</sup> Low physical activity is known to be a risk factor for rapid onset and progression of atherosclerosis.<sup>4</sup> Significant work has been done to correlate physical activity levels with carotid intima media thickness internationally. No such studies are available for Pakistan. A recent international study which measured leisure time physical activity levels using accelerometer, failed to demonstrate a significant correlation between carotid intima media thickness and physical activity levels, however, the study was done in a population at low risk for development of coronary artery disease.<sup>5</sup> South Asia, of which Pakistan is a part, has a population which is hyper susceptible to the development of coronary artery disease<sup>6</sup> and hence, it is imperative that research should be carried out on risk factors for atherosclerosis and coronary artery disease. The results of such studies can provide data that can help in developing preventive strategies for cardiovascular disease. With this view, the present study has been planned to correlate ultrasonographically measured carotid intima-media thickness with physical activity scores obtained using a validated questionnaire

for measurement of physical activity, the International Physical Activity Questionnaire (IPAQ).<sup>7</sup> The *pro forma* allows calculation of physical activity scores (MET-minutes). The results of the study also have the potential to provide rationale for wider use of carotid intima media thickness measurement by ultrasonography, for the risk stratification of adults who are suspected to have subclinical atherosclerosis.

### MATERIAL AND METHODS

This cross sectional study was carried out at the Department of Diagnostic Radiology at Holy Family Hospital in collaboration with the Department of Pathology and the Department of Internal Medicine from July to December 2009. Non-probability, consecutive sampling of 110 subjects was done. The inclusion criteria were: individuals of both genders aged between 45 and 64 years. Those with known history of myocardial infarction, stroke, intermittent claudication, smokers, people with abnormal serum lipid levels, persons with known psychiatric disease, and inability to lie still for sonographic evaluation, were excluded.

Attendants of patients admitted to the medical wards of the hospital, who fulfilled the selection criteria were offered enrolment in the study. After obtaining informed consent, the subject was asked to report next morning after 8 hours of fasting. The IPAQ questionnaire administered by face-to-face interview

with the entire participant by radiology resident involved in the study. Resting blood pressure was recorded using a standard mercury sphygmomanometer, standing height and weight were measured and body mass index (BMI) calculated. Five ml of blood samples were taken for Lipid profile and fasting blood glucose levels and tested at the Department of Pathology.

Carotid IMT (CIMT) was measured at the far wall of both right and left common carotid arteries, at three points on each side, starting from immediately proximal to the carotid bifurcation using 7.5 Mhz linear array probe attached to a Doppler ultrasound machine (Toshiba Power Vision 6000). A carotid wall thickening  $>1.2$  mm was considered as a local plaque. Mean of all the values was taken as the carotid IMT value for the patient. The same ultrasonologist performed all the examinations to avoid bias. Data was recorded on a *pro forma* and analysed using SPSS-13.

Physical activity was divided into low, moderate or high based on established cut-offs. Frequencies were calculated for variables such as gender, physical activity category presence or absence of localized carotid plaque(s). Continuous variables such as age, CIMT, physical activity scores, BMI, fasting blood glucose levels, high density and low density lipoprotein levels and serum triglyceride levels were described as mean $\pm$ standard deviation. One way ANOVA was used to compare CIMT between low, medium and high physical activity categories with  $p \leq 0.05$  as statistically significant.

## RESULTS

Among the 110 individuals included in the study, 64 (58.2%) were males. The mean age for males was  $55.1 \pm 8.2$  years while the mean age for females was  $58.6 \pm 6.7$  years. Mean BMI for all individuals were  $30.0 \pm 21.6$  kg/m<sup>2</sup>. The mean BMI for men was  $31.4 \pm 26.0$  kg/m<sup>2</sup> while the mean BMI for females was  $28.5 \pm 15.4$  kg/m<sup>2</sup>.

The mean systolic blood pressure for all individuals was  $125 \pm 17$  mmHg, while the mean diastolic blood pressure was  $84 \pm 11$  mmHg. Among women, the mean systolic and diastolic blood pressure was  $124 \pm 16$  mmHg and  $84 \pm 11$  mmHg, respectively. In men, the mean systolic and diastolic blood pressure was  $125 \pm 18$  mmHg and  $84 \pm 11$  mmHg, respectively.

The mean fasting glucose levels for all individuals was  $130 \pm 74$  mg/dl. The mean fasting glucose levels in females was  $117 \pm 58$  mg/dl. The mean fasting glucose level for males was  $146 \pm 86$  mg/dl.

A total of 11 individuals (10%) had a carotid intima media thickness that was classified as a localized carotid artery plaque. This included 6 males and 5 female participants.

The mean physical activity score for all domains of the IPAQ questionnaires for all the participants was  $438 \pm 97$  MET-minutes/week. Mean

physical activity score for all domains of the IPAQ questionnaires among women was  $394 \pm 162$  MET-minutes/week. While mean physical activity scores for all domains of the IPAQ questionnaires among men was  $521 \pm 62$  MET-minutes/weeks.

There were no individuals in the 'high' category of physical activity. There were 48 individuals (43.6%) who reported 'moderate' amount of physical activity, while the rest 62 individuals (56.4%) reported 'low' levels of physical activity.

Among the 48 who were noted as having moderate amount of physical activity, 31 (64.6%) were males. Among the 62 who were found to have low levels of physical activity, 33 (53.2%) were men.

Mean carotid artery intima media thickness among those individuals who were in the category of 'moderate' physical activity was  $0.61 \pm 0.17$  mm, while the mean carotid artery intima media thickness among those individuals who were in the category of 'low' physical activity was  $0.73 \pm 0.21$  mm ( $p=0.042$ )

## DISCUSSION

Sedentary life style is a major risk factor for atherosclerosis, causing vascular intimal injury and leads to coronary heart disease and stroke.<sup>3</sup> But it is also recognized that with advanced age the thickness of carotid intima media increases even in the normal population.<sup>9</sup> Though, this increase is more pronounced in persons having different cardiovascular risk factors e.g. sedentary life style, smoking.<sup>10</sup> This intimal insult, caused by decreased level of physical activity through the development of atherosclerotic plaques ends up with various macro and micro-vascular complications.<sup>11</sup> Various epidemiological studies have also confirmed that individuals with sedentary life style have a faster progression of atherosclerosis as measured by carotid IMT.<sup>8</sup> This strong association between IMT and level of physical activity has been utilized by several studies for the assessment of the risk factors in various diseases like stroke, diabetes, hypertension and atherosclerosis.<sup>12-15</sup>

In this study, we have found that physical activity is strongly associated with the thickness of intima media of carotid artery. This study showed that increased levels of activity are related with reduced intima media thickness as compared to the low levels of physical activity. This is first study of this category in Pakistan. It shows the importance of usage of simple sonographic equipment for the measurement of carotid intima media thickness as simple screening procedures. Sonographic evaluation of the carotid intima-media thickness is a validated and well known procedure for cardiovascular risk stratification. It can be used for the estimation and stratification of patients into high and low risks categories for suitable anticipation and intervention.

Intima media thickness of carotid artery has been used as a vascular marker in several studies because

it is an important tool to measure the long-term effects of to vascular risk factor exposure especially in hypertensive patients. The IMT of carotid artery can be measured noninvasively with the help of ultrasound which has good reproducibility.

In the present study we have used IPAQ questionnaire for the assessment of Physical activity categories by dividing it into three categories, i.e. high, medium, and low by measuring upon level of MET-minutes/week. The population of our study was normal healthy individuals who were performing different levels of physical activity.

This study has its limitations due to its cross sectional design and small sample size. Population based cohort and longitudinal studies with large sample size need to be done. Moreover, we tried to control confounders like smoking, and metabolic syndromes (diabetes, hyperlipidemias, and hypertension). Other diseases that can lead to carotid intima-media thickening (such as systemic lupus erythematosus and rheumatoid arthritis) were not controlled and these can act as confounding factors. But these conditions may have minimal influence on the final results of the study as these are very rare disorders.

On the other hand despite its shortcomings, this study is important for the clinical practice related to atherosclerosis, coronary heart disease and stroke in the domains of diagnostic radiology and internal medicine. This procedure can be performed in local settings at a low cost and may prevent the use of prolonged, complicated and sometimes dangerous procedures like magnetic resonance angiography, CT angiography or coronary angiography in the normal healthy individuals. The results of this study will also help researchers to use this procedure in large, community based surveys. The study has also demonstrated that in our population low physical activity is associated with a substantially thickened carotid intima-media layer, which predisposes these individuals to various metabolic and non-metabolic diseases. Therefore, a combined work should be carried out by clinicians and health educators to inform the public and patients regarding the advantages of increased physical activity and to acquire an improved life style in order to minimize the risk of cardiovascular diseases, stroke and diabetes etc.

## CONCLUSION

This study has shown that physical activity is strongly related to Common Carotid Intimal Medial Thickness (CCA-IMT) even in the healthy, young-to-middle age

population. The higher level of physical activity corresponds to decreased thickness of intima media of common carotid artery while lower level of physical activity is associated with increased thickness of intima media of common carotid artery and these results also confirm previous published data.

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