Section: Cardiology

JAMP

Original Research Article

ROLE OF ANKLE BRACHIAL PRESSURE INDEX AND CAROTID INTIMA MEDIA THICKNESS IN EARLY DETECTION OF SYSTEMIC ATHEROSCLEROSIS IN HIGH-RISK INDIVIDUALS

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Received : 11/04/2026
Received in revised form : 20/05/2026
Accepted : 05/06/2026

Keywords:
Ankle Brachial Index; Atherosclerosis; Carotid Intima-Media Thickness; Cardiovascular Risk; Peripheral Arterial Disease.

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DOI: 10.47009/jamp.2026.8.3.212

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2026; 8 (3); 1188-1192

ABSTRACT

Background: Systemic atherosclerosis is a major cause of cardiovascular morbidity and mortality worldwide. Early detection of subclinical atherosclerosis in high-risk individuals is important for preventing future cardiovascular events. Ankle Brachial Pressure Index (ABPI) and Carotid Intima Media Thickness (CIMT) are simple non-invasive markers used to assess vascular changes associated with atherosclerosis. **Materials and Methods:** This cross-sectional observational study was conducted among 35 high-risk individuals aged ≥30 years attending a tertiary care teaching hospital. Participants with one or more cardiovascular risk factors including diabetes mellitus, hypertension, smoking, dyslipidemia, or obesity were included. ABPI was measured using sphygmomanometer and handheld Doppler, while CIMT was assessed using B-mode ultrasonography. Data were analysed using SPSS version 22.0. **Result:** Among the study participants, 34.3% belonged to the 51–60 years age group and 62.9% were males. Diabetes mellitus (60.0%) and hypertension (51.4%) were the most common cardiovascular risk factors. The mean ABPI was 0.89 ± 0.14, while the mean CIMT was 0.91 ± 0.18 mm. Abnormal ABPI (≤0.9) was observed in 54.3% participants, and increased CIMT (≥0.9 mm) was noted in 48.6% participants. A significant moderate negative correlation was observed between ABPI and CIMT ($r = -0.46$, $p = 0.005$). Participants with ABPI ≤0.9 had significantly higher mean CIMT values compared to those with ABPI >0.9 (1.02 ± 0.16 mm vs 0.78 ± 0.11 mm, $p = 0.001$). **Conclusion:** ABPI and CIMT showed a significant inverse relationship among high-risk individuals. Reduced ABPI values were associated with increased CIMT measurements, suggesting the presence of subclinical vascular changes.

INTRODUCTION

Atherosclerosis is a chronic and progressive vascular disorder characterised by the accumulation of lipids, inflammatory cells, and fibrous tissue within the arterial wall, leading to narrowing and hardening of blood vessels. It is one of the major underlying causes of cardiovascular diseases such as coronary artery disease, cerebrovascular disease, and peripheral arterial disease, which remain leading causes of morbidity and mortality worldwide. The global burden of atherosclerotic cardiovascular disease has increased considerably over the past two decades, particularly in developing countries due to rapid urbanization, sedentary lifestyle, unhealthy dietary habits, smoking, obesity, diabetes mellitus, hypertension, and dyslipidemia.[1,2]

Atherosclerosis usually develops silently over several years before becoming clinically evident. During this asymptomatic phase, vascular changes continue to progress and eventually result in complications such as myocardial infarction, stroke, and peripheral arterial disease. Therefore, early identification of subclinical atherosclerosis in high-risk individuals is important for timely intervention and prevention of future cardiovascular events. Recent studies in the Indian population have also demonstrated a high burden of subclinical atherosclerosis among asymptomatic individuals with cardiovascular risk factors.[2,3]

High-risk individuals with diabetes mellitus, hypertension, smoking, dyslipidemia, obesity, and advancing age are more susceptible to the development of systemic atherosclerosis. Hence, non-invasive vascular assessment methods have gained increasing importance in identifying early vascular changes before the onset of overt cardiovascular disease.[3]

Ankle Brachial Pressure Index (ABPI) is a simple, inexpensive, and non-invasive method used to assess peripheral arterial disease by comparing systolic blood pressure measured at the ankle and brachial arteries. Reduced ABPI values indicate impaired arterial perfusion and are associated with increased cardiovascular morbidity and mortality. Previous studies have shown that low ABPI is closely associated with systemic atherosclerosis and adverse cardiovascular outcomes.[3,4]

Carotid Intima Media Thickness (CIMT) is another widely accepted non-invasive marker used for the assessment of subclinical atherosclerosis. CIMT measured using B-mode ultrasonography reflects structural changes in the carotid arterial wall and serves as an indicator of early atherosclerotic vascular disease. Increased CIMT has been associated with coronary artery disease, stroke, and future cardiovascular events.[4,5]

Several studies have demonstrated an inverse relationship between ABPI and CIMT, suggesting that reduced peripheral arterial blood flow is associated with increased carotid arterial wall thickness.[6-10]

However, limited data are available regarding the combined assessment of ABPI and CIMT among high-risk individuals in routine clinical practice, particularly in the Indian population. Hence, the present study was undertaken to evaluate the role of ABPI and CIMT in the early detection of systemic atherosclerosis among high-risk individuals.

Objectives

1. To assess ABPI and CIMT among high-risk individuals.
2. To determine the prevalence of abnormal ABPI and increased CIMT.
3. To evaluate the correlation between ABPI and CIMT.

MATERIALS AND METHODS

This cross-sectional observational study was conducted among high-risk individuals attending the Department of General Medicine at a tertiary care teaching hospital. Approval from the Institutional Ethics Committee was obtained. Written informed consent was obtained from all participants prior to enrolment in the study.

Study Population and Sampling: The study included 35 high-risk individuals aged ≥30 years with one or more cardiovascular risk factors such as diabetes mellitus, hypertension, smoking, dyslipidemia, or obesity. A convenient sampling method was used, and all eligible participants presenting during the study period were enrolled.

Sample Size: A total of 35 high-risk individuals fulfilling the inclusion criteria were enrolled during the study period. As this was a preliminary cross-sectional observational study conducted within the available study duration, all eligible participants presenting during the study period were included.

Inclusion and Exclusion Criteria

Individuals aged ≥30 years with one or more cardiovascular risk factors including diabetes mellitus, hypertension, smoking, dyslipidemia, or obesity, and willing to participate in the study were included. Individuals with a history of peripheral vascular surgery or limb amputation, known carotid artery disease or previous carotid intervention, ABI >1.3 suggestive of non-compressible vessels, severe systemic illness, or unwillingness to participate were excluded.

Methods: Detailed demographic and clinical data including age, gender, and cardiovascular risk factors were recorded using a structured proforma. All participants underwent clinical examination and relevant investigations.

ABPI was measured using a standard sphygmomanometer and handheld Doppler device after the participant rested in the supine position for at least 10 minutes. Systolic blood pressure was recorded in both brachial arteries and at the dorsalis pedis and posterior tibial arteries of both lower limbs. The higher ankle systolic pressure was divided by the higher brachial systolic pressure to calculate ABPI. The lower value obtained from either limb was considered for analysis. An ABPI value ≤0.9 was considered abnormal.

CIMT was assessed using B-mode ultrasonography with a high-frequency linear transducer by an experienced radiologist. Measurements were obtained from the distal common carotid artery proximal to the carotid bifurcation on both sides. CIMT was measured as the distance between the lumen-intima and media-adventitia interfaces, and the average value was recorded. CIMT ≥0.9 mm was considered increased

Statistical Analysis: Data were entered and analysed using SPSS software version 22.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequency and percentage. Pearson's correlation coefficient was used to assess the relationship between ABPI and CIMT. Comparison of mean CIMT between ABPI groups was performed using Student's t-test. A p-value <0.05 was considered statistically significant.

RESULTS

The majority belonged to the 51–60 years age group (34.3%), followed by 41–50 years (31.4%). Males constituted 62.9% of the study population, while females accounted for 37.1%. Diabetes mellitus was the most common risk factor (60.0%), followed by hypertension (51.4%), dyslipidemia (40.0%), smoking (31.4%), and obesity (25.7%) [Table 1].

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Table 1: Baseline characteristics of study participants

Category	Variable	n (%)
Age Group (Years)	30–40	6 (17.1%)
	41–50	11 (31.4%)
	51–60	12 (34.3%)
	>60	6 (17.1%)
Gender	Male	22 (62.9%)
	Female	13 (37.1%)
Risk Factors	Diabetes Mellitus	21 (60.0%)
	Hypertension	18 (51.4%)
	Smoking	11 (31.4%)
	Dyslipidemia	14 (40.0%)
	Obesity	9 (25.7%)

The mean ABPI among the study participants was 0.89 ± 0.14, while the mean CIMT was 0.91 ± 0.18 mm. Abnormal ABPI (≤0.9) was observed in 54.3% participants, and increased CIMT (≥0.9 mm) was noted in 48.6% participants [Table 2].

Table 2: ABPI and CIMT profiles among study participants

Parameter	Value Mean±SD/n(%)
Mean ABPI	0.89 ± 0.14
Mean CIMT (mm)	0.91 ± 0.18
ABPI ≤0.9	18 (54.3%)
CIMT ≥0.9 mm	17 (48.6%)

A significant moderate negative correlation was observed between ABPI and CIMT ($r = -0.46$, $p = 0.005$) [Table 3].

Table 3: Correlation between ABPI and CIMT

Variables	Correlation Coefficient (r)	p-value
ABPI vs CIMT	-0.46	0.005

Participants with ABPI ≤0.9 had significantly higher mean CIMT values compared to those with ABPI >0.9 (1.02 ± 0.16 mm vs 0.78 ± 0.11 mm, $p = 0.001$) (Table 4).

Table 4: Comparison of CIMT according to ABPI groups

ABPI Group	Mean CIMT (mm)	p-value
ABPI >0.9	0.78 ± 0.11	0.001
ABPI ≤0.9	1.02 ± 0.16	

DISCUSSION

Systemic atherosclerosis is a major contributor to cardiovascular morbidity and mortality, and early detection in high-risk individuals is essential for timely intervention. ABPI and CIMT are simple non-invasive markers used to assess subclinical atherosclerosis.5,6 The present study aimed to evaluate the role of ABPI and CIMT in detecting systemic atherosclerosis among high-risk individuals. The study demonstrated reduced ABPI, increased CIMT, and a significant inverse relationship between both parameters, suggesting their usefulness in identifying subclinical vascular changes associated with systemic atherosclerosis.

In the present study, most participants were middle-aged males, with diabetes mellitus and hypertension being the predominant cardiovascular risk factors. Similarly, Lisowska et al. reported a mean age of 48.64 ± 15.24 years, with males comprising 45.5% of the study population. Carotid atherosclerotic plaques were observed in nearly half of the participants, predominantly in the 41–60 year age group. Patients with carotid atherosclerosis more commonly had hypertension, diabetes mellitus, and hypercholesterolemia.[11] Similarly, Ramírez-Torres et al. found that smoking, duration of hypertension, and elevated creatinine were associated with atherosclerosis burden; 65% of patients had total atherosclerosis burden, and 42% were reclassified into the very high-risk cardiovascular category.[12] The findings indicate that middle-aged males with multiple cardiovascular risk factors, particularly diabetes mellitus and hypertension, are more likely to have subclinical systemic atherosclerosis.

The study population demonstrated reduced ABPI values and increased CIMT measurements, with a considerable proportion showing abnormal vascular parameters suggestive of subclinical atherosclerosis. Similarly, Suwannasom et al. reported that among 4,332 patients with multiple cardiovascular risk factors, those with ABI ≤0.9 had a significantly higher rate of hard cardiovascular events compared to those with ABI >0.9 (3.7% vs 1.3%, $p < 0.001$).[13] Similarly, Zhao et al. reported a mean CIMT that correlated significantly with established cardiovascular risk scoring systems including the Framingham Risk Score and the Pooled Cohort Equation ($r = 0.64$, $p < 0.001$).[14] Similarly, Mashaba et al. on CIMT in type 2 diabetes mellitus patients,

ISSN (O): 2687-5365; ISSN (P): 2753-6556

reported a significantly higher pooled mean CIMT in T2DM patients compared to controls.[15] These reduced ABPI and increased CIMT observed among participants suggest the presence of early vascular changes and subclinical atherosclerosis in high-risk individuals.

An inverse and significant relationship was observed between ABPI and CIMT, indicating that lower ABPI values were associated with greater carotid arterial wall thickness. Similarly, Vila et al. showed a significant inverse association between ABI and CIMT, particularly among men, even after adjustment for cardiovascular risk factors.[16] Similarly, Weir-McCall et al. showed that ABPI correlated significantly with global atherosclerotic burden ($\beta = -0.39$, $p = 0.012$) and that on multiple linear regression ABPI remained an independent predictor of systemic atheroma burden ($\beta = -0.45$, $p = 0.005$).[17] This significant inverse relationship between ABPI and CIMT suggests an association between lower peripheral arterial perfusion and increased carotid arterial wall thickness.

Higher CIMT values were observed among participants with abnormal ABPI, suggesting an association between peripheral arterial disease and carotid atherosclerosis. Similarly, Yang et al. reported that low ABI was associated with increased cardiovascular risk and adverse vascular outcomes.[18] Likewise, Kärberg et al. demonstrated that lower ABI values were significantly associated with increased carotid IMT and carotid plaque, even after adjustment for cardiovascular risk factors and age.8 Higher CIMT values among participants with abnormal ABPI suggest that low ABPI may serve as an indicator of increased carotid atherosclerosis and systemic vascular disease.

Overall, the study findings suggest that ABPI and CIMT are associated markers of subclinical systemic atherosclerosis in high-risk individuals. Reduced ABPI values were associated with increased CIMT measurements, indicating a relationship between peripheral arterial disease and carotid atherosclerotic changes. The presence of multiple cardiovascular risk factors among participants further highlights the importance of non-invasive vascular assessment for identifying early atherosclerotic changes in individuals at increased cardiovascular risk.

Limitations: The present study had certain limitations including a relatively small sample size and single-center design, which may limit the generalizability of the findings. Convenience sampling may have introduced selection bias. In addition, the cross-sectional nature of the study prevents assessment of long-term cardiovascular outcomes and causal relationships between ABPI, CIMT, and subclinical atherosclerosis. Multivariate analysis adjusting for potential confounding cardiovascular risk factors was not performed.

CONCLUSION

The present study demonstrated a significant inverse association between ABPI and CIMT among high-risk individuals. Lower ABPI values were associated with increased CIMT measurements, suggesting the presence of subclinical vascular changes. These findings indicate that ABPI and CIMT may serve as useful non-invasive markers for assessment of subclinical atherosclerosis in high-risk individuals. Further large-scale prospective studies are required to validate these findings.

REFERENCES

1. Raghupathy AK, Sundaresan M, Arun P, Kumbhani DJ, Baskar MK, Thambi H, et al. Burden of subclinical coronary atherosclerosis among asymptomatic adults: the REACH-Rural India Study. Lancet Reg Health Southeast Asia 2026;45:100726. https://doi.org/10.1016/j.lansea.2026.100726.
2. Bytyçi I, Shenouda R, Wester P, Henein MY. Carotid atherosclerosis in predicting coronary artery disease: A systematic review and meta-analysis: A systematic review and meta-analysis. Arterioscler Thromb Vasc Biol 2021;41:e224–37. https://doi.org/10.1161/ATVBAHA.120.315747.
3. Full KM, Huang T, Shah NA, Allison MA, Michos ED, Duprez DA, et al. Sleep irregularity and subclinical markers of cardiovascular disease: The Multi-Ethnic Study of atherosclerosis. J Am Heart Assoc 2023;12:e027361. https://doi.org/10.1161/JAHA.122.027361.
4. Mitu O, Crisan A, Redwood S, Cazacu-Davidescu I-E, Mitu I, Costache I-I, et al. The relationship between cardiovascular risk scores and several markers of subclinical atherosclerosis in an asymptomatic population. J Clin Med 2021;10:955. https://doi.org/10.3390/jcm10050955.
5. Kelkar R, K N S, K P, Kelkar R, Barve NA. Association between low ankle-brachial index and high common carotid artery intima-media thickness in ischemic stroke. Cureus 2025;17:e83246. https://doi.org/10.7759/cureus.83246.
6. Liu T, Zeng J, Zhao X, Fu R, Peng L, Li X, et al. Relationship between vascular aging and left ventricular geometry in patients with obstructive sleep apnea hypopnea syndrome-related hypertension. Sci Rep 2025;15:6191. https://doi.org/10.1038/s41598-025-89964-4.
7. Tamaki N, Fukui M, Kitamura M, Fukuda H, Furugen R, Yamanashi H, et al. Longitudinal relationship between atherosclerosis and progression of periodontitis in community-dwelling people in Nagasaki Islands Study. Sci Rep 2025;15:13437. https://doi.org/10.1038/s41598-025-98377-2.
8. Kärberg K, Lember M. Subclinical atherosclerosis in the carotid artery: can the ankle-brachial index predict it in type 2 diabetes patients? Scand J Clin Lab Invest 2021;81:237–43. https://doi.org/10.1080/00365513.2021.1904279.
9. Nedkoff L, Briffa T, Zemedikun D, Herrington S, Wright FL. Global trends in atherosclerotic cardiovascular disease. Clin Ther 2023;45:1087–91. https://doi.org/10.1016/j.clinthera.2023.09.020.
10. Sekar A, Amir AP, Seeni Mohamed AM, Natarajan P. Decoding cardiovascular health: Carotid intima-media thickness and its association with coronary artery disease in the Indian population. Cureus 2024;16:e55836. https://doi.org/10.7759/cureus.55836.
11. Lisowska A, Dubatówka M, Chlabicz M, Jamiołkowski J, Kondraciuk M, Szyszkowska A, et al. Disparities in the prevalence and risk factors for carotid and lower extremities atherosclerosis in a general population-Bialystok PLUS study. J Clin Med 2023;12:2627. https://doi.org/10.3390/jcm12072627.
12. Ramírez-Torres JM, López-Téllez A, Ariza MJ, Rioja J, García-Casares N, Rodríguez EEG, et al. Subclinical atherosclerosis burden in non-diabetic hypertensives treated in

ISSN (O): 2687-5365; ISSN (P): 2753-6556

primary care center: the IMTABI study. BMC Prim Care 2023;24:43. https://doi.org/10.1186/s12875-023-01997-8.
13. Suwannasom P, Phinyo P, Leemasawat K, Chichareon P, Nantsupawat T, Osataphan N, et al. Prognostic value of ankle-brachial index in prediction of cardiovascular events in an Asian population with multiple atherosclerotic risk factors. Angiology 2023;74:848–58. https://doi.org/10.1177/00033197221124772.
14. Zhao R, Yuan C, Zhang G, Ma F. Reliability of B-mode ultrasound measurement of carotid intima-media thickness in assessing cardiovascular risk: a cross-sectional study. Front Cardiovasc Med 2026;13:1740930. https://doi.org/10.3389/fcvm.2026.1740930.
15. Mashaba RG, Phoswa W, Maimela E, Lebelo S, Modjadji P, Mokgalaboni K. Systematic review and meta-analysis assessing the status of carotid intima-media thickness and lipid profiles in type 2 diabetes mellitus. BMJ Open 2024;14:e087496. https://doi.org/10.1136/bmjopen-2024-087496.
16. Vila MDM, Igual L, Remeseiro B, Elosua R, Ramos R, Valdivielso JM, et al. Polyvascular subclinical atherosclerosis: Correlation between ankle brachial index and carotid atherosclerosis in a population-based sample. Angiology 2023;74:443–51. https://doi.org/10.1177/00033197221110720.
17. Weir-McCall JR, Khan F, Lambert MA, Adamson CL, Gardner M, Gandy SJ, et al. Common carotid intima media thickness and ankle-brachial pressure index correlate with local but not global atheroma burden: a cross sectional study using whole body magnetic resonance angiography. PLoS One 2014;9:e99190. https://doi.org/10.1371/journal.pone.0099190.
18. Yang M-C, Huang Y-Y, Hsieh S-H, Sun J-H, Wang C-C, Lin C-H. Ankle-brachial index is independently associated with cardiovascular outcomes and foot ulcers in Asian patients with type 2 diabetes mellitus. Front Endocrinol (Lausanne) 2021;12:752995. https://doi.org/10.3389/fendo.2021.752995.