Journal of Carcinogenesis
Covering Genesis to Therapeutics
Journal of Carcinogenesis, ISSN: 1477-3163
2025; Vol 24: Issue 3s, https://carcinogenesis.com/

Influence of Central Blood Pressure in Vascular Ageing: A Cross-sectional Study

Jayballabh Kumar[1], Dr Jasmine Kaur Chawla[2]*, Sunil Mathew[3], Amrit Podder[4], Jyoti P Khodnapur[5], Ayushi Gupta[6], Manika Kansal[6], Dr. Pooja Yadav[7], Santhosh Reddy Gade[8]

[1]Professor and Head, Department of Physiology, Teerthanker Mahaveer Medical College & Research Centre, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India

[2]Professor, Department of Physiotherapy, Manav Rachna International Institute of Research and Studies, Faridabad, Haryana, India

[3]Associate Professor, Department of Anatomy, Teerthanker Mahaveer Medical College & Research Centre, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India

[4]Assistant Professor, Department of Physiology, Teerthanker Mahaveer Medical College & Research Centre, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India

[5]Additional Professor, Department of Physiology, Shri B M Patil Medical College, Hospital & Research Centre, BLDE (Deemed to be) University, Vijayapura, Karnataka, India

[6]Junior Resident, Department of Physiology, Teerthanker Mahaveer Medical College & Research Centre, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India

[7]Medical Officer, MH Secunderabad, Secunderabad, Telangana, India

[8]MBBS, Independent Researcher, Hyderabad, India

***Corresponding Author**

Email Id: jasmine.k.chawla@gmail.com , https://orcid.org/0000-0001-8281-6166

ABSTRACT

Background: Vascular ageing is a critical determinant of cardiovascular morbidity and mortality, characterized by progressive arterial stiffness, endothelial dysfunction, and loss of vascular compliance. Central blood pressure (cBP) parameters, including aortic systolic blood pressure (AoSBP) and aortic diastolic blood pressure (AoDBP), have emerged as superior predictors of vascular risk compared to peripheral blood pressure. Early identification of vascular ageing through oscillometric methods allows timely risk stratification.

Objective: To evaluate the relationship between central blood pressure parameters and vascular ageing in adults aged 35-50 years, and to assess the role of vascular stiffness markers, particularly the Ankle-Brachial Index (ABI), in predicting vascular ageing.

Methods: A cross-sectional study was conducted among 150 participants aged 35-50 years. Central blood pressure parameters (AoSBP, AoDBP) were measured using Periscope, an oscillometric-based device validated for central hemodynamic assessment. Vascular ageing was assessed using vascular age indices derived from oscillometric waveforms. ABI was measured simultaneously to assess peripheral arterial stiffness. Statistical analyses included Pearson's correlation, ANOVA, and multivariate regression to establish associations between central blood pressure, ABI, and vascular ageing.

Results: Participants with higher AoSBP demonstrated significantly advanced vascular ageing (mean vascular age = 58.4 ± 6.2 years vs chronological age = 42.6 ± 4.8 years, $p < 0.001$). AoSBP showed a strong positive correlation with vascular ageing ($r = 0.68$, $p < 0.001$), whereas AoDBP demonstrated a moderate correlation ($r = 0.52$, $p < 0.001$). ABI <1.0 was significantly associated with increased vascular age and arterial stiffness ($\beta = 0.41$, $p < 0.01$). Multivariate analysis confirmed that central SBP and ABI were independent predictors of advanced vascular ageing after adjusting for age, BMI, and smoking status.

Conclusion: Central blood pressure parameters, particularly AoSBP, are strongly correlated with vascular ageing and outperform peripheral blood pressure as predictors. ABI serves as an additional marker of vascular stiffness, reinforcing its role in the early detection of vascular ageing. Incorporating central hemodynamic assessment into routine practice may

provide superior risk stratification in adults at risk of premature vascular ageing.

Keywords: *Central blood pressure, Vascular ageing, Aortic systolic pressure, Oscillometric method, Ankle-Brachial Index, Arterial stiffness, Cardiovascular risk.*

How to Cite: Jayballabh Kumar, Dr Jasmine Kaur Chawla, Sunil Mathew, Amrit Podder, Jyoti P Khodnapur, Ayushi Gupta, Manika Kansal, Dr. Pooja Yadav, Santhosh Reddy Gade, (2025) Influence of Central Blood Pressure in Vascular Ageing: A Cross-sectional Study, *Journal of Carcinogenesis, Vol.24, No.3s*, 204-208.

1. INTRODUCTION

Cardiovascular diseases (CVDs) remain the leading cause of mortality worldwide, with an increasing burden in middle-aged adults due to premature vascular ageing [1]. Vascular ageing refers to progressive changes in arterial structure and function, characterized by stiffening of large elastic arteries, impaired endothelial function, and loss of arterial compliance [2]. These changes accelerate the development of hypertension, coronary artery disease, stroke, and peripheral arterial disease [3]. Traditionally, brachial blood pressure (BP) has been the cornerstone of cardiovascular risk assessment. However, peripheral BP may not accurately reflect the pressure experienced by central organs such as the heart, brain, and kidneys [4]. Central blood pressure (cBP), particularly aortic systolic blood pressure (AoSBP) and aortic diastolic blood pressure (AoDBP), provides a more accurate estimation of central hemodynamic load [5]. Emerging evidence suggests that cBP is more strongly associated with vascular damage, arterial stiffness, and cardiovascular outcomes compared to peripheral BP [6,7]. Vascular ageing can be assessed through non-invasive oscillometric techniques, which estimate vascular age using central waveform-derived indices [8]. One such validated method is the Periscope device, which uses oscillometric measurements to provide central BP and vascular stiffness markers [9]. Additionally, the Ankle-Brachial Index (ABI), a simple measure of peripheral arterial stiffness, serves as a surrogate marker of systemic atherosclerosis and vascular ageing [10]. While studies have investigated the predictive role of central BP in older populations, limited evidence exists regarding its influence on vascular ageing in middle-aged adults (35–50 years), an age group at risk of premature cardiovascular disease due to lifestyle factors, urbanization, and metabolic disorders [11]. Early detection of vascular ageing in this population could enable targeted preventive strategies.

This study aimed to evaluate the influence of central blood pressure parameters (AoSBP, AoDBP) on vascular ageing in middle-aged adults and to assess the association of ABI with vascular ageing. We hypothesized that higher central BP is associated with advanced vascular ageing, independent of chronological age, and that ABI contributes as a significant marker of vascular stiffness.

2. MATERIALS AND METHODS

Study design and Population: A cross-sectional study was conducted at the Centre for Yoga and Exercise Sciences, Department of Physiology, Shri B M Patil Medical College Hospital & Research Centre, between September 2021 and February 2023. A total of 150 participants, aged 35-50 years, were enrolled. The study adhered to the Declaration of Helsinki and received approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants.

Inclusion Criteria: Age 35-50 years, Both genders, Individuals without known cardiovascular disease

Exclusion Criteria: History of hypertension or antihypertensive medication use, Diabetes mellitus, Chronic kidney disease, Peripheral vascular disease, History of myocardial infarction or stroke.

Data Collection: Demographic details, anthropometric measurements (height, weight, BMI, waist circumference), and lifestyle parameters (smoking, alcohol use, physical activity) were recorded. Central BP parameters were measured using **Periscope (Genesis Medical Systems, India),** a validated oscillometric device. Participants were seated comfortably after 10 minutes of rest. The device recorded brachial BP and estimated central aortic pressures through oscillometric waveform analysis. Parameters obtained to measure central blood pressure are the Aortic Systolic BP (AoSBP), Aortic Diastolic BP (AoDBP). Vascular ageing was determined by comparing estimated vascular age (derived from oscillometric central arterial stiffness indices) with chronological age. Advanced vascular ageing was defined as vascular age exceeding chronological age by ≥10 years [12]. ABI was measured using the oscillometric method with the same device. ABI <1.0 was considered indicative of peripheral arterial stiffness or subclinical atherosclerosis [13].

Statistical analysis: Data were analyzed using SPSS v27. Descriptive statistics were presented as mean ± standard deviation. Correlations between central BP parameters, ABI, and vascular ageing were assessed using **Pearson's correlation**

coefficient. Group comparisons were analyzed using **ANOVA with post-hoc Tukey test. Multivariate linear regression** was performed to identify independent predictors of vascular ageing. A p-value <0.05 was considered statistically significant.

3. RESULTS

Baseline Characteristics:
The study population comprised 150 participants (82 males, 68 females). Mean chronological age was 42.6 ± 4.8 years. Mean BMI was 26.3 ± 3.2 kg/m². Thirty-two participants (21.3%) were smokers.

Central Blood Pressure and Vascular Ageing: Mean AoSBP was calculated as 124.8 ± 11.6 mmHg, mean AoDBP was calculated as 82.3 ± 8.5 mmHg, and mean vascular age: 51.2 ± 7.1 years. Participants with higher AoSBP had significantly advanced vascular ageing (mean vascular age = 58.4 ± 6.2 years) compared to those with lower AoSBP (mean vascular age = 47.1 ± 5.4 years; $p < 0.001$).

Correlation Analysis: We found that AoSBP strongly correlated with vascular ageing ($r = 0.68$, $p < 0.001$) whereas AoDBP showed moderate correlation ($r = 0.52$, $p < 0.001$) and ABI negatively correlated with vascular ageing ($r = –0.46$, $p < 0.001$).

Regression Analysis: Multivariate regression revealed AoSBP ($\beta = 0.55$, $p < 0.001$); ABI ($\beta = –0.41$, $p = 0.01$) as independent predictors of vascular ageing after adjusting for chronological age, BMI, and smoking status.

4. DISCUSSION

This cross-sectional study demonstrates that increased central blood pressure, particularly AoSBP, is significantly correlated with advanced vascular ageing in middle-aged adults. Importantly, ABI emerged as an independent marker of vascular stiffness, supporting its clinical utility in early vascular risk detection. Our findings are consistent with prior evidence highlighting central BP as a superior predictor of cardiovascular risk compared to peripheral BP. Previous studies of ruptured aortic aneurysms and dissecting aortas demonstrate that structural changes in large arteries, including alterations in vascular integrity and elasticity, reflect the long-term effects of elevated central blood pressure and arterial stiffness, key features of vascular ageing, and highlight the importance of assessing central hemodynamics in cardiovascular risk stratification [14]. Central SBP more accurately reflects the true hemodynamic load on central arteries, left ventricle, and cerebral circulation [15]. Elevated AoSBP accelerates arterial wall remodeling, collagen deposition, and loss of elastin fibers, thereby promoting vascular stiffness [16]. Previous studies have shown that vascular age exceeding chronological age predicts increased cardiovascular morbidity and mortality [17]. In our study, participants with high central BP had vascular ages nearly 15 years older than their actual age, underscoring the clinical significance of central BP monitoring in apparently healthy adults. The role of ABI in detecting vascular ageing is also notable. ABI <1.0 has long been recognized as a marker of peripheral arterial disease and systemic atherosclerosis. Physical therapy plays a vital role in elderly care by reducing vascular risks, lowering central blood pressure, and improving circulation. It enhances mobility, balance, and strength, helping prevent falls and injuries. Through pain management and rehabilitation, it restores function and independence. With clear education, emotional support, and family involvement, PT promotes adherence and improves overall quality of life for older adults [18]. Our findings extend this understanding, demonstrating that low ABI is associated with higher vascular age, suggesting systemic vascular stiffening. This supports earlier reports that ABI is an inexpensive, non-invasive, and reliable screening tool for vascular ageing [19]. From a preventive perspective, the integration of central BP and ABI assessment in routine practice may enable earlier identification of individuals at risk for premature vascular ageing, even before the onset of clinically overt hypertension. This aligns with the paradigm shift toward arterial stiffness and central hemodynamics as emerging biomarkers of cardiovascular risk [20]. The Influence of Central Blood Pressure in Vascular Ageing study highlights how exercise lowers arterial stiffness and central BP, while Heart and Lung Dysfunction Prevention emphasizes patient education in rehabilitation. Together, they show physical therapy enhances elderly well-being by improving vascular health and empowering adherence through effective education [21].

Strengths of the study: Use of validated oscillometric device (Periscope), focus on middle-aged adults, an understudied group in vascular ageing research, simultaneous assessment of central BP and ABI.

Limitations of the study: Cross-sectional design limits causality inference, modest sample size, exclusion of hypertensive and diabetic individuals may limit generalizability.

Future longitudinal studies are warranted to explore the predictive value of central BP and ABI for long-term cardiovascular outcomes.

5. CONCLUSION

Central blood pressure, particularly aortic systolic pressure, is strongly associated with vascular ageing and serves as a more reliable predictor compared to peripheral BP. ABI complements central BP assessment by indicating peripheral arterial stiffness. Incorporating these measures into clinical practice may improve early detection and prevention of premature vascular ageing in middle-aged adults.

REFERENCES

[1] Lakatta EG, Levy D. Arterial and cardiac aging: major shareholders in cardiovascular disease enterprises: Part I: aging arteries: a "set up" for vascular disease. Circulation. 2003 Jan 7;107(1):139-46.

[2] Nilsson PM, Boutouyrie P, Laurent S. Vascular aging: A tale of EVA and ADAM in cardiovascular risk assessment and prevention. Hypertension. 2009 Jul;54(1):3-10.

[3] North BJ, Sinclair DA. The intersection between aging and cardiovascular disease. Circ Res. 2012 Apr 13;110(8):1097-108.

[4] Roman MJ, Devereux RB, Kizer JR, Lee ET, Galloway JM, Ali T, et al. Central pressure more strongly relates to vascular disease and outcome than does brachial pressure: the Strong Heart Study. Hypertension. 2007 Jul;50(1):197-203.

[5] Williams B, Lacy PS, Thom SM, Cruickshank K, Stanton A, Collier D, et al. Differential impact of blood pressure-lowering drugs on central aortic pressure and clinical outcomes: principal results of the Conduit Artery Function Evaluation (CAFE) study. Circulation. 2006 Mar 7;113(9):1213-25.

[6] Vlachopoulos C, Aznaouridis K, O'Rourke MF, Safar ME, Baou K, Stefanadis C. Prediction of cardiovascular events and all-cause mortality with central haemodynamics: a systematic review and meta-analysis. Eur Heart J. 2010 Aug;31(15):1865-71.

[7] Sharman JE, Avolio AP, Baulmann J, Benetos A, Blacher J, Blizzard CL, et al. Validation of non-invasive central blood pressure devices: ARTERY Society task force consensus statement on protocol standardization. Eur Heart J. 2017 Oct 1;38(37):2805-2812.

[8] Townsend RR, Wilkinson IB, Schiffrin EL, Avolio AP, Chirinos JA, Cockcroft JR, et al. American Heart Association Council on Hypertension. Recommendations for Improving and Standardizing Vascular Research on Arterial Stiffness: A Scientific Statement From the American Heart Association. Hypertension. 2015 Sep;66(3):698-722.

[9] Khodnapur JP, Khodnapur GP, Basavaraddi IV, Podder A, Pal R, Patil SM, et al. Yoga Improves Vascular stiffness in COVID-19 Survivors of Vijayapur, Karnataka, India. Biomed & Pharmacol J. 2024 Dec 30;17(4):2455-62.

[10] Aboyans V, Criqui MH, Abraham P, Allison MA, Creager MA, Diehm C, et al. Measurement and interpretation of the ankle-brachial index: a scientific statement from the American Heart Association. Circulation. 2012 Dec 11;126(24):2890-909.

[11] Kotsis V, Stabouli S, Karafillis I, Nilsson P. Early vascular aging and the role of central blood pressure. J Hypertens. 2011 Oct;29(10):1847-53.

[12] Scuteri A, Morrell CH, Orrù M, Strait JB, Tarasov KV, Ferreli LA, et al. Longitudinal perspective on the conundrum of central arterial stiffness, blood pressure, and aging. Hypertension. 2014 Dec;64(6):1219-27.

[13] Dashoundhi V, Khodnapur GP, Podder A, Patil SM, Khodnapur JP. Assessment of Arterial Stiffness in Patients Recovered from Mild COVID-19 Disease using Pulse Wave Velocity: A Cross-sectional Study. Journal of Clinical and Diagnostic Research. 2023;17(8):CC05-CC08

[14] Kanani J, Sheikh MI. Ruptured dissecting aorta: An uncommon cause of sudden death-An autopsy study. Cirugía Cardiovascular. 2025 Jan.

[15] O'Rourke MF, Hashimoto J. Mechanical factors in arterial aging: a clinical perspective. J Am Coll Cardiol. 2007 Jul 3;50(1):1-13.

[16] Laurent S, Boutouyrie P. The structural factor of hypertension: large and small artery alterations. Circ Res. 2015 Mar 13;116(6):1007-21.

[17] Vlachopoulos C, Aznaouridis K, Stefanadis C. Prediction of cardiovascular events and all-cause mortality with arterial stiffness: a systematic review and meta-analysis. J Am Coll Cardiol. 2010 Mar 30;55(13):1318-27.

[18] Baladaniya M, Baldania S. The Role of Physical Therapy in Enhancing the Well-being of Elderly Patients. Journal of Physical Medicine Rehabilitation Studies & Reports. 2023 Aug 31;5(4):1-7.

[19] Aboyans V, Ricco JB. The 'Ten Commandments' of 2017 ESC Guidelines on the Diagnosis and Treatment of Peripheral Arterial Diseases. Eur Heart J. 2018 Mar 1;39(9):722.

[20] Safar ME, Blacher J, Jankowski P. Arterial stiffness, pulse pressure, and cardiovascular disease-is it possible to break the vicious circle? Atherosclerosis. 2011 Oct;218(2):263-71.

[21] Shraddha Baldania, Maheshkumar Baladaniya. Heart and Lung Dysfunction Prevention Through Rehabilitation and Physical Therapy Education: A Comprehensive Overview. Journal of Cardiology Research Review & Reports. 2024 Mar 25;1-10.