

FREQUENCY OF PERIPHERAL ARTERY DISEASE DETECTED ON DOPPLER ULTRASOUND AMONG ASYMPTOMATIC DIABETIC PATIENTS IN THE LOCAL POPULATION.

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Abstract: *Background:* Peripheral artery disease (PAD) is a type of vascular disease and common among diabetic patients. PAD often begins with a long-term inflammatory process that starts with the formation of fatty streaks and leads to fibrous atheroma. Diabetes Mellitus speeds up this process. Patients with Diabetes Mellitus and PAD often have reduced blood flow to the lower legs, which people refer to as “poor circulation.” *Objective:* To study the frequency of peripheral artery disease on Ankle Brachial Index (ABI) and Doppler ultrasound in patients with Diabetes Mellitus *Methods:* It was Cross-sectional study conducted from August 2023 to February 2024. Total of 200 patients were enrolled after fulfilling inclusion criteria. Demographic data and informed consent were obtained. After that, patients had their ABI evaluated. The brachial artery pressure was divided by the higher of the two ankle pressures. Compared to established screening methods, the ABI study’s mean error of 6.5% among or between observers was lower. PAD was identified if $ABI \leq 0.90$, as verified by Doppler ultrasound.

Results: The mean age of the patients was 59.33 ± 8.38 years, to female-to-male ratio of the patients was 1.4:1. The mean duration of DM was 8.0550 ± 3.21 years, and the frequency of PAD was observed in 67 (33.5%) patients. There is significant association between ABI values and PAD on Doppler (p-value 0.00). *Conclusion:* The frequency of peripheral arterial disease is higher than expected in asymptomatic diabetics. Further studies are needed in this domain.

Keywords: Peripheral Artery Disease, Diabetes Mellitus, Ankle Brachial Index, Doppler ultrasounds.

INTRODUCTION

Diabetes is a long-term condition that requires continuous medical care, persistent self-management, and support from patients to avert serious complications and reduce the risk of long-term problems. Managing diabetes is a complex process that requires attention to multiple factors beyond just blood sugar control. Plenty of evidence supports various methods to improve diabetes outcomes.¹

Peripheral artery disease is now the preferred term for a partial or complete blockage of one or more peripheral arteries.² This condition, which poses a significant health issue, involves atherosclerosis and/or thromboembolism that affects the aorta, its visceral branches, and the arteries in the lower extremities. Intermittent claudication, characterized by pain in the leg muscles during ambulation, is the initial symptom in patients with peripheral artery disease (PAD).³

Patients with diabetes often experience two types of vascular diseases: a nonocclusive microcirculatory dysfunction that affects the small blood vessels in the kidneys, eyes, and nerves, and a macroangiopathy marked by large blood vessel issues due to

atherosclerosis. Diabetes increases the risk of developing PAD.⁴

Peripheral artery disease is a condition characterized by atherosclerotic occlusive disease in the lower limbs. The chances of developing this condition increase with age, smoking, diabetes, abnormal lipid levels, and high blood pressure.⁵

Peripheral artery disease is a major risk factor for coronary and cerebrovascular events, including heart attacks, strokes, and death due to widespread atherosclerosis.⁶ Although simple and non-invasive diagnostic tests are available, peripheral artery disease often goes undiagnosed and untreated, mainly because many people do not show symptoms, and screening tools are underused.⁷

The American Diabetes Association suggests screening for peripheral artery disease using the ankle-brachial index (ABI) in diabetes patients who have symptoms or signs of the disease.⁸ However, the reliability of the ABI is debated when used to assess hardened and less compressible vessels in older patients with medial sclerosis.⁹

It was found that 39% of diabetic patients had peripheral artery disease detected by a Doppler device when their ABI was below 0.9. 10 Another study reported a 31.6% prevalence of peripheral artery disease among diabetic patients.¹¹

The rationale of this study is to determine the frequency of peripheral artery disease detected on Doppler ultrasound among asymptomatic diabetic patients. Peripheral artery disease is strongly associated with coronary artery disease. If peripheral artery disease is detected in its early stages, it can help prevent the development of atherosclerosis in cardiac arteries and reduce the risk of cardiac events. Diabetes itself is a risk factor for cardiac diseases. In the presence of diabetes, the chances of peripheral artery disease rise. But in routine, diabetic patients are not screened for the detection of peripheral artery disease until the patient becomes symptomatic. Literature showed a high rate of peripheral artery disease among diabetics. But still, it is not screened routinely in asymptomatic patients. This study was conducted to find the extent of the problem in the local population and implement the practice of screening of diabetic patients for peripheral artery disease, whether they develop symptoms or not. This can help us plan management and preventive strategies for cardiovascular events among diabetic patients.

MATERIALS AND METHODS

This cross-sectional study was carried out in the Department of Cardiology of Sheikh Zaid Hospital, Lahore from June 2023 to January 2024. A non-probability, consecutive sampling technique was used. The sample size of 200 participants, determined using a 95% confidence level and a 6.5% margin of error, with

RESULTS

The mean age of the patients was 59.3 ± 8.3 years. The minimum age was 35 years, and the maximum age was 76 years. The sample consisted of 117 (58.5%) males and 83 (41.5%) females, with a mean BMI of 26.1 ± 2 kg/m². Most of the participants, 116(58%) patients, belonged to the age category of 26-29 years

Out of 200 participants, 193 (96.5%) had type 2 diabetes, with a mean duration of 8 ± 3.2 years. Most of the patients, 125(62.5%), were hypertensive as well. A total of 35(17.5%) were smokers. The mean of the Arterial brachial index (ABI) was 0.68 ± 0.09 , the minimum index was 0.5, and the maximum index was 0.8. out of the total patients, 67(33.5%) were positive on Doppler that they have PAD. Table 1

There is a strong and statistically significant association between ABI values and PAD on Doppler (p-value 0.00). Lower ABI values (0.50 and 0.60) are much more common in patients with PAD. Hypertension also shows a significant relationship with PAD (p-value 0.04). Type I vs Type II diabetes had no significant effect on PAD status. Most patients without PAD were non-smokers, with a p-value of 0.00. Table 2.

an anticipated percentage of peripheral artery disease being 31.6% among patients with type II diabetes mellitus. Patients aged 40-80years, either gender, presenting with diabetes mellitus (as per operational definition) with ankle brachial index < 0.9 were included in this study. Patients who were already diagnosed with peripheral artery disease, with valvular heart diseases, and diabetic or non-diabetic neuropathy were excluded.

DATA COLLECTION PROCEDURE

200 patients fulfilling the selection criteria were included in this study. Informed consent was obtained from attendants. A questionnaire was used to collect the data. Demographic variables included name, age, gender, BMI, duration of diabetes, type of diabetes treatment, hypertension ($BP \geq 140/90$ mmHg), smoking, and ankle brachial index were also noted. Patients underwent a Doppler ultrasound of the peripheral region. If there was a partial or complete obstruction, then peripheral artery disease was labelled. Patients with peripheral artery disease were managed according to the hospital protocol.

DATA ANALYSIS

Data entered and analyzed by using SPSS version 25. Quantitative variables, such as age, BMI, and duration of diabetes, were presented as mean and standard deviation. Qualitative variables, including gender, hypertension ($BP \geq 140/90$ mmHg), smoking, diabetes treatment, ankle-brachial index at presentation, and peripheral artery disease, were presented as frequency and percentage. Data stratified for age, gender, BMI, duration of diabetes, type of diabetes treatment, hypertension, smoking, and ankle brachial index. Chi-square test was applied to compare the frequency of peripheral artery disease in stratified groups.

Table 1: Demographic and Clinical Parameters

Variables	Mean ± SD
Age (years)	59.33 ± 8.38
BMI	26.17 ± 2.01
Duration of DM	8.05 ± 3.21
Arterial Branchial Index (ABI)	0.68 ± 0.09
Gender	n (%)
Male	117 (58.5)
Female	83 (41.5)
BMI	
22-25	71 (35.5)
26-29	116 (58)
30-33	13 (6.5)
Type of Diabetes Mellitus	
Type I	7 (3.5)
Type II	193 (96.5)
Hypertension	
Yes	125 (62.5)
No	75 (37.5)
Smoking	
Yes	35 (17.5)
No	165 (82.5)
PAD on Doppler	
Yes	67 (33.5)
No	133 (66.5)

Numeric data was represented as Mean and Standard Deviation, and categorical data as frequencies and percentages

Table 2: Association of Peripheral Artery Disease (PAD) on Doppler with other independent variables

Variables	PAD on Doppler		p-value
	Yes (n=67)	No (n=133)	
Ankle Brachial Index (ABI)			0.00*
0.50	19 (28.3)	2 (1.6)	
0.60	30 (44.8)	5 (3.7)	
0.70	17 (25.4)	75 (56.4)	
0.80	1 (1.5)	51 (38.3)	
HTN			0.04*
Yes	48 (71.6)	77 (57.8)	
No	19 (28.4)	56 (42.2)	
Smoking Status			0.00*
Yes	23 (34.3)	12 (9.1)	
No	44 (65.7)	121 (90.9)	
BMI			0.26
22-25	21 (31.4)	50 (37.6)	
26-29	42 (62.6)	74 (55.6)	
30-33	4 (6)	9 (6.8)	
Age			0.51
35-50	15 (22.4)	21 (15.8)	
51-65	36 (53.8)	78 (58.6)	
66-80	16 (23.8)	34 (25.6)	
Duration of Diabetes			0.34
1-10	57 (85.1)	112 (84.2)	
11-20	9 (13.4)	21 (15.8)	
Above 20	1 (1.5)	-	
Type of Diabetes Mellitus			0.56

Type I	2 (3)	5 (3.8)	
Type II	65 (97)	128 (96.2)	
Gender			0.15
Male	43 (64.2)	74 (55.6)	
Female	24 (35.8)	59 (44.4)	

Chi-square test applied to check the significance

*Indicates significance of association

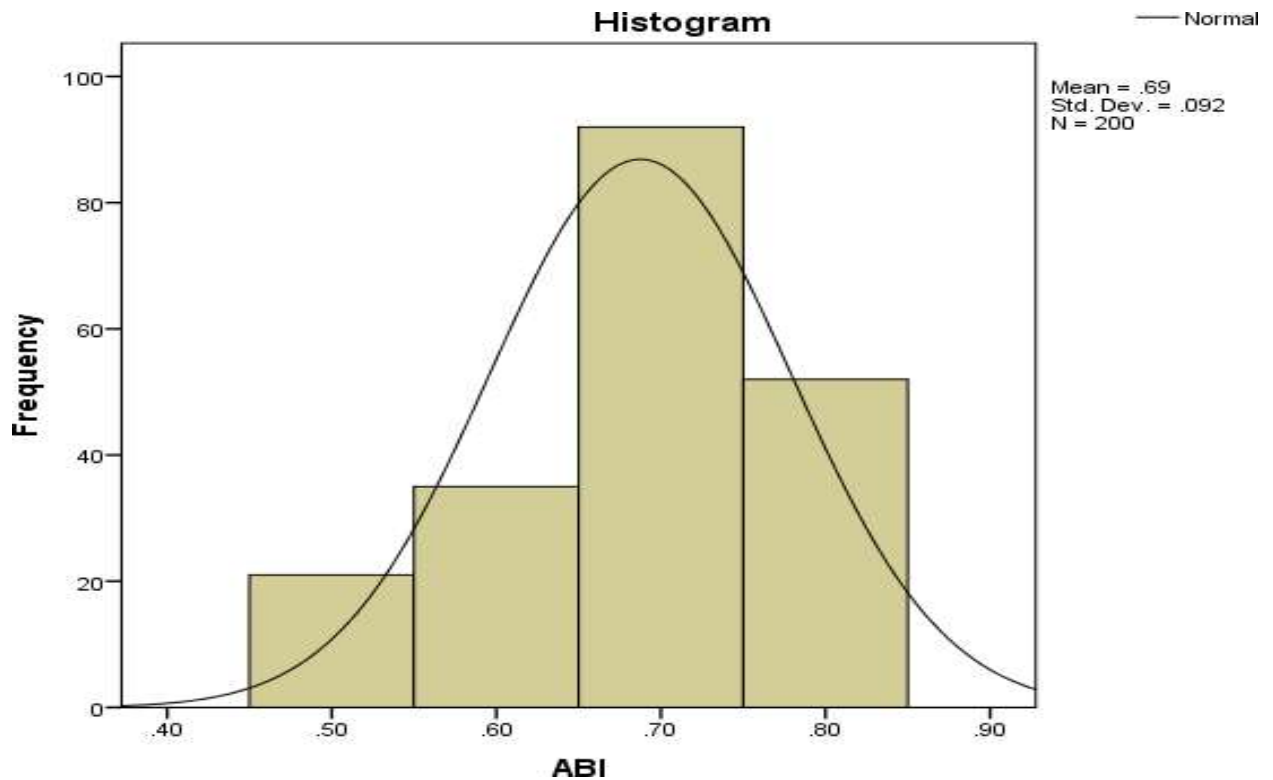


Figure 1: Graphical Representation of Ankle Brachial Index (ABI)

DISCUSSION

This study was conducted to determine the frequency of asymptomatic conditions in asymptomatic diabetic patients. Few studies have explored the link between asymptomatic PAD and diabetes, while many have focused on symptomatic cases. PAD is caused by atherosclerotic and thromboembolic processes affecting the arteries in the legs. Both symptomatic and asymptomatic PAD pose a significant risk for heart-related issues and death.¹²

In this study, the mean of Ankle-Brachial Index (ABI) was 0.6875 ± 0.091 , the average time period of diabetes was 8.0550 ± 3.21 years, and PAD was found in 67 patients, representing 33.5%. Arambhan PA et al. concluded that 19% of diabetics had asymptomatic PAD, compared to just 3% in non-diabetics. Low levels of High-Density Lipoprotein (HDL), high triglycerides, and metabolic syndrome were correlated with a higher risk of PAD.¹³

In another study, PAD was found in 152(39.28%) diabetic patients. The mean age of participants was 57.6 ± 10.4 years, and the mean duration of diabetes was 8.31 ± 5.9 years. Women showed a higher incidence of PAD at 46.71% compared to men at 24.22%. This study focused on the frequency of PAD in Asian countries.¹⁴

In the Edinburgh artery study, Fowkes et al. reported a prevalence of 16.6% in the general population, and Walters D. et al. found that 23.5% of Type 2 diabetics had PAD.¹⁵ Achim A. et al. concluded that PAD is more common and severe in people with diabetes. In our study, 38.4% of diabetic patients with high blood pressure had PAD, showing that hypertensive patients are at a greater risk since high blood pressure itself is a risk factor for PAD.¹⁶

A Study by Zhang, Y. et al. showed that the occurrence of PAD in patients with hypertension is higher than in people without hypertension.¹⁷ In the elderly trial frequency of PAD was 25.5% out of the 1537 participants with systolic hypertension.¹⁸ Multiple

studies have shown a strong association of hypertension with PAD.¹⁵ A study by Zhang Y. et al. demonstrated a higher prevalence of PAD in hypertensive patients than in those without high blood pressure.¹⁷

In a recent trial involving older adults, the frequency of PAD was 25.5% among 1,537 participants with systolic hypertension. Multiple studies have shown a strong link between high blood pressure and PAD since hypertension significantly contributes to the worsening of PAD. We recommend treating it aggressively. Our findings also indicate a strong link between PAD and smoking. Among the 35 smokers in our study, 23 had PAD, a rate of 65.7%.¹⁹

Other research has shown that current smokers are 2-3 times more likely to have PAD. There were more male smokers than female smokers, contributing to a higher incidence of PAD in men. The association between smoking and PAD is even stronger than that between smoking and heart disease.²⁰

This obesity paradox is also observed in other studies. Lin DS. et al. observed low incidence and good prognosis of PAD in patients with high BMI. Another study indicated that BMI does not relate to PAD, but there was a strong connection between abdominal fat distribution and PAD. Conversely, other studies have linked PAD with a high BMI. In our study, no significant relationship between BMI and asymptomatic PAD.²¹ symptomatic PAD is a critical, yet often overlooked, clinical tool for predicting future heart problems, strokes, and amputations, as it is a marker for atherosclerotic risk factors and other vascular issues. Many patients may not show symptoms even when blood flow is significantly limited. We believe all diabetes patients should have their ABI measured during check-ups. The prevalence of PAD is notably high in our population. Preventive efforts should concentrate on controlling diabetes, managing blood pressure, and quitting smoking. There are no clear guidelines for treating these patients, so more studies are necessary in this area to develop screening and treatment criteria.²²

As a marker of future cardiovascular events, stroke events, and amputations, asymptomatic peripheral arterial disease (PAD) is an important clinical tool; however, it is often underused. PAD indicates the presence of atherosclerotic risk factors and other vascular diseases. Many patients may not be diagnosed because they show no signs or symptoms, even when their blood flow is significantly limited. All patients with diabetes should have their ABI measured during their diagnostic evaluation. The prevalence of PAD is relatively high in our population. Preventive measures should focus on controlling diabetes, managing blood pressure, and quitting smoking.²² There are no clear guidelines for treating these patients. Therefore, we believe more studies are needed in this area, along with the development of criteria to ensure appropriate

screening and treatment. We only measured ABI and Doppler at rest. However, our ability to detect asymptomatic PAD might have improved if we had used other methods, such as post-exercise ABI or a reactive hyperemia test, since ABI/Doppler results can be normal at rest but may change with exercise.

CONCLUSION

This study concluded that the frequency of asymptomatic PAD on ABI (Ankle Brachial Index) and Doppler in patients presenting with Diabetes is 33.5%. The frequency is not ignorable. So, we recommend the screening of diabetics for PAD with ABI (confirmation on Doppler ultrasound) to identify it earlier and prevent its complications

Conflict of Interest:

None

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REFERENCES

1. Gregg EW, Buckley J, Ali MK, Davies J, Flood D, Mehta R, Griffiths B, Lim LL, Manne-Goehler J, Pearson-Stuttard J, Tandon N. Improving health outcomes of people with diabetes: target setting for the WHO Global Diabetes Compact. *the lancet.* 2023 Apr 15;401(10384):1302-12.
2. Shamaki GR, Markson F, Soji-Ayoade D, Agwuegbo CC, Bamgbose MO, Tamunoinemi BM. Peripheral artery disease: a comprehensive updated review. *Current problems in cardiology.* 2022 Nov 1;47(11):101082.
3. Leutzinger TJ, Koutakis P, Fuglestad MA, Rahman H, Despiegelare H, Hassan M, Schieber M, Johanning JM, Stergiou N, Longo GM, Casale GP. Peripheral artery disease affects the function of the legs of claudicating patients in a diffuse manner irrespective of the segment of the arterial tree primarily involved. *Plos one.* 2022 Jul 13;17(7):e0264598.
4. Cade WT. Diabetes-related microvascular and macrovascular diseases in the physical therapy setting. *Phys Ther.* 2008 Nov;88(11):1322-35. doi: 10.2522/ptj.20080008.
5. Aboyans V, Canonico ME, Chastaingt L, Anand SS, Brodmann M, Couffinhal T, Criqui MH, Debus ES, Mazzolai L, McDermott MM, Bonaca MP. Peripheral artery disease. *Nature Reviews Disease Primers.* 2025 Sep 18;11(1):68.
6. Shamaki GR, Markson F, Soji-Ayoade D, Agwuegbo CC, Bamgbose MO, Tamunoinemi BM. Peripheral artery disease: a comprehensive updated review. *Current problems in cardiology.* 2022 Nov 1;47(11):101082.
7. Allison MA, Armstrong DG, Goodney PP, Hamburg NM, Kirksey L, Lancaster KJ, Mena-Hurtado CI,

- Misra S, Treat-Jacobson DJ, White Solaru KT, American Heart Association Council on Peripheral Vascular Disease; Council on Hypertension; and Council on Lifestyle and Cardiometabolic Health. Health disparities in peripheral artery disease: a scientific statement from the American Heart Association. *Circulation.* 2023 Jul 18;148(3):286-96.
8. Virani, S. S., Alonso, A., Benjamin, E. J., Bittencourt, M. S., Callaway, C. W., Carson, A. P., ... & American Heart Association Council on Epidemiology and Prevention Statistics Committee and Stroke Statistics Subcommittee Heart disease and stroke statistics—2020 update: a report from the American heart association. *Circulation.* 2020;141(9):e139–e596. doi: 10.1161/CIR.0000000000000757.
 9. Poredos P, Stanek A, Catalano M, Boc V. Ankle-brachial index: Diagnostic tool of peripheral arterial disease and predictor of cardiovascular risk—An update of current knowledge. *Angiology.* 2025 Nov;76(10):937-45.
 10. Chuter V, Schaper N, Mills J, Hinchliffe R, Russell D, Azuma N, Behrendt CA, Boyko EJ, Conte MS, Humphries M, Kirksey L. Effectiveness of bedside investigations to diagnose peripheral artery disease among people with diabetes mellitus: a systematic review. *Diabetes/metabolism research and reviews.* 2024 Mar;40(3):e3683.
 11. Woleli DA, Tsegaye GW, Abuhay T, Teshome AT, Alemu GG. The incidence and predictors of peripheral arterial disease among type 2 diabetes mellitus patients at Felege Hiwot Comprehensive Specialized Hospital, Northwest Ethiopia, 2023: A retrospective follow-up study. *PloS one.* 2025 Apr 1;20(4):e0320948.
 12. Haider R. Peripheral vascular disease. *Cardiology Research and Reports.* 2023;5(4):01-13.
 13. Arambhan PA, Belsare HV, Armstrong DG, Cooper L, Weiss D. An Investigative Approach to the Correlation and Prevalence of Peripheral Artery Disease in Diabetics in India. In *International Conference on e-Health and Bioengineering 2023* Nov 9 (pp. 575-593). Cham: Springer Nature Switzerland.
 14. Awal GL, Techato K, Gyawali S, Dahal BP, Malakar IM. Health-Seeking Behavior and Community Perception of Chhaupadi Practices. *Journal of Nepal Health Research Council.* 2024 Dec 20;22(3):592-601.
 15. Adou C, Magne J, Gazere N, Aouida M, Chastaingt L, Aboyans V. Global epidemiology of lower extremity artery disease in the 21st century (2000–21): a systematic review and meta-analysis. *European journal of preventive cardiology.* 2024 May;31(7):803-11.
 16. Achim A, Stanek A, Homorodean C, Spinu M, Onea HL, Lazăr L, Marc M, Ruzsa Z, Olinic DM. Approaches to peripheral artery disease in diabetes: are there any differences?. *International Journal of Environmental Research and Public Health.* 2022 Aug 9;19(16):9801.
 17. Zhang Y, Cai X, Song S, Hu J, Zhou P, Cai K, Ma R, Ma H, Shen D, Yang W, Zhang D. Association of plasma aldosterone concentration with peripheral artery disease in hypertensive patients: insights from a large cross-sectional analysis. *Frontiers in Cardiovascular Medicine.* 2025 Mar 25;12:1549878.
 19. Piechocki M, Przewłocki T, Pieniążek P, Trystuła M, Podolec J, Kabłak-Ziembicka A. A non-coronary, peripheral arterial atherosclerotic disease (carotid, renal, lower limb) in elderly patients—A review PART II—Pharmacological approach for management of elderly patients with peripheral atherosclerotic lesions outside coronary territory. *Journal of Clinical Medicine.* 2024 Mar 5;13(5):1508.
 20. Abraham AT, Mojaddedi S, Loseke IH, Bray C. Hypertension in patients with peripheral artery disease: An updated literature review. *Cureus.* 2024 Jun 12;16(6).
 21. Xu Y, Pouncey AL, Zhou Z, Woodward M, Harris K. Smoking as a risk factor for lower extremity peripheral artery disease in women compared to men: A systematic review and meta-analysis. *Plos one.* 2024 Apr 24;19(4):e0300963.
 22. Lin DS, Lo HY, Yu AL, Lee JK, Chien KL. Mortality risk in patients with underweight or obesity with peripheral artery disease: a meta-analysis including 5,735,578 individuals. *International Journal of Obesity.* 2022 Aug;46(8):1425-34.
 23. Nunez J, De La Espriella R, Rossignol P, Voors AA, Mullens W, Metra M, Chioncel O, Januzzi JL, Mueller C, Richards AM, De Boer RA. Congestion in heart failure: a circulating biomarker-based perspective. A review from the Biomarkers Working Group of the Heart Failure Association, European Society of Cardiology. *European Journal of Heart Failure.* 2022 Oct;24(10):1751-66.