Journal of Rare Cardiovascular Diseases
ISSN: 2299-3711 (Print) | e-ISSN: 2300-5505 (Online)
www.jrcd.eu
RESEARCH ARTICLE

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

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Article History
Received: 22.07.2025
Revised: 09.08.2025
Accepted: 16.09.2025
Published: 27.09.2025

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≤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 August 2023 to February 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 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≥140/90mmHg), 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 ≥ 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.

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**

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

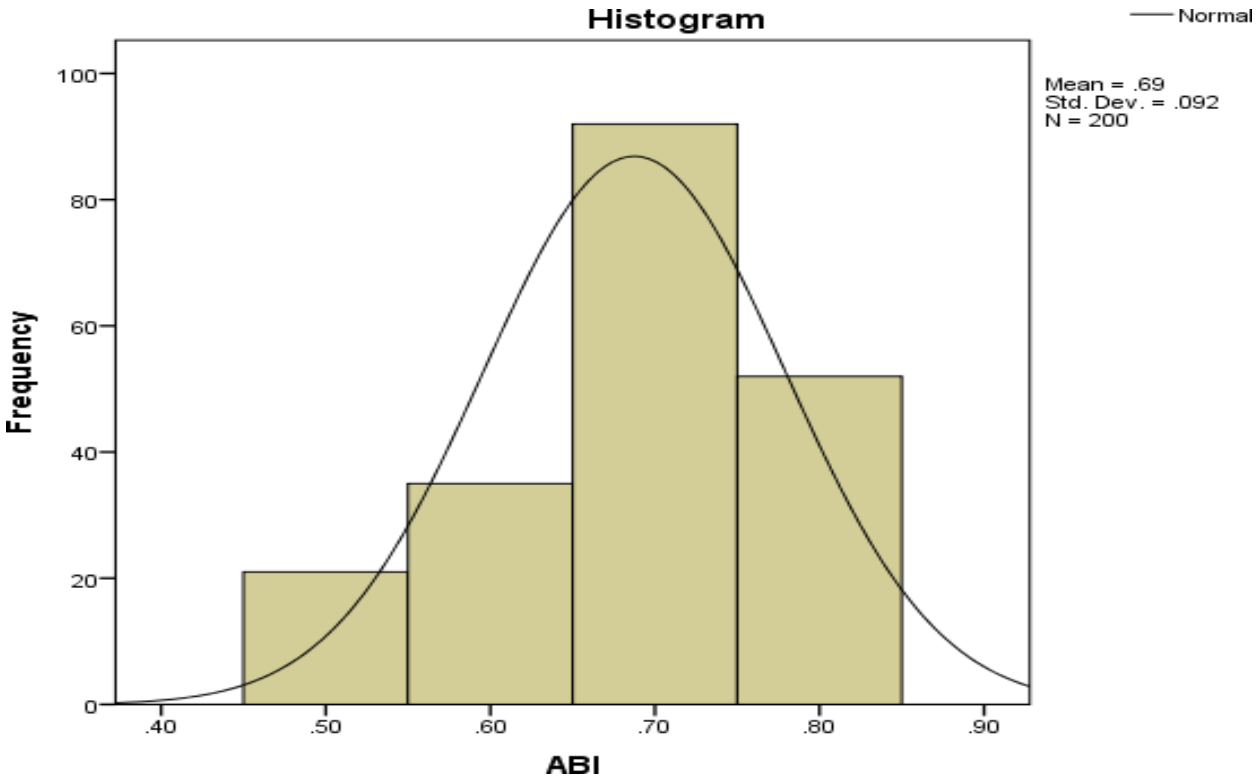

Figure 1: Graphical Representation of Ankle Brachial Index (ABI)

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
Funding Statement:
None
Acknowledgments:
I would like to thanks Miss. Saba Sardar and Rameen Nisar for their assistance.

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