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Original Article

# Frequency of Peripheral Arterial Disease in Patients with Type-2 Diabetes Mellitus: A single center experience from a Private Healthcare Facility of South Punjab, Pakistan

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## Abstract

**Objective:** To determine the frequency of peripheral arterial disease (PAD) and its associated factors in type-2 diabetes mellitus (T2DM) patients.

**Methods:** This cross-sectional study was conducted at the department of medicine, AVA Serene Hospital, Bahawalpur, Pakistan from May 2023 to October 2023. Patients of either gender, aged ≥ 18 years, and known cases of T2DM with minimum disease duration of 6 months were analyzed. "Ankle-Brachial Index (ABI)" measurements were carried out using a handheld doppler ultrasound device. A cutoff value of ≤0.9 was taken to label the existence of PAD.

**Results:** In a total of 897 patients, 507 (56.5%) were female. The mean age, and BMI were 50.68±11.65 years (ranging between 18-96 years), and 26.29±5.49 kg/m2, respectively. Concerning HbA1c levels, 202 (22.5%) exhibited values at or below 7%. Hypertension was diagnosed in 250 (27.9%) patients, whereas 126 (14.0%) reported a family history of diabetes. Additionally, 69 (7.7%) patients reported a history of smoking. The mean ABI was 1.11±0.17. PAD (ABI ≤ 0.9) was diagnosed in 90 (10.0%) patients. Among those with PAD, 76 (84.5%) had a BMI ≥ 23 (p=0.001). Significant association of hypertension and PAD was noted (40.0% vs. 26.5%, p=0.007). Smoking was found to have significant association with PAD (17.8% vs. 6.6%, p <0.001).

**Conclusion:** The frequency of PAD among T2DM patients was high. Obesity, hypertension, and smoking history emerged as noteworthy risk factors of PAD.

**Keywords:** Ankle-Brachial Index, hypertension, peripheral arterial disease, smoking, type-2 diabetes mellitus.

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## Introduction

In 2019, the "International Diabetes Federation (IDF)" reported that over 463 million individuals globally had diabetes, and these numbers are expected to increase significantly and are projected to reach 700 million by the year 2045.[1] Recent local data has shown that approximately 17.0% of all Pakistani adults are estimated to have diabetes mellitus (DM).[2] "Peripheral arterial disease (PAD)" is an important complication of DM.[3] PAD is described by the constricting or blockage of blood vessels outside the heart and brain due to atherosclerosis.[4]

Globally, PAD has emerged as a widespread health issue, affecting more than 200 million individuals.[5] One contributing factor to the high prevalence of PAD is the often-silent nature of the condition, with fewer than 20% of patients experiencing typical PAD symptoms.[6] Additionally, individuals having DM are anticipated to have higher risk of asymptomatic PAD due to peripheral neuropathy, with nearly one-third of all diabetic patients estimated to be affected.[7]

The literature demonstrates an inverse connection between "Ankle-Brachial Index (ABI)" and the occurrence of cardiovascular and cerebrovascular diseases, as well as their associated risk factors.[8] A low ABI is closely linked to several risk factors, like DM, hypertension, dyslipidemia, a history of smoking, and chronic kidney disease.[9,10] Additionally, there is a noteworthy relationship between inflammatory markers, including "C-reactive protein", "interleukin-6", and "homocysteine" levels, and PAD.[11] A low ABI is strongly related to elevated risk of disease-related morbidity and mortality.[8] A recent study from Karachi showed the prevalence of PAD to be 29.0% among type-2 DM (T2DM) patients.[12]

Given the escalating burden of cardiovascular diseases (CVD), the utilization of a non-invasive approaches for early identification of related risk factors can become highly advantageous for the prevention and treatment of CVDs. This research was aimed to determine the frequency of PAD and its associated factors among T2DM patients.

## Methods

This cross-sectional study was performed at the department of medicine, AVA Serene Hospital, Bahawalpur, Pakistan from May 2023 to October 2023. Approval from "Institutional Ethical Committee" was obtained (letter number: HRC/6/2022). Considering the frequency of PAD in T2DM patients as 29.0%[12] with 95% confidence level and 3% margin of error, a sample size of 879 patients was calculated. Patients of either gender, aged above or equal to 18 years, and known cases of T2DM with minimum disease duration of 6 months were analyzed. Patients having type-1 DM or those unwilling to be part of this study were excluded. Patients on vasodilators, or having renal failure requiring dialysis were also not included. Informed and written consents were taken from all study participants.

ABI measurements were carried out using a handheld Doppler ultrasound device, following established protocols. In this study, the evaluation of arteries was conducted using both longitudinal and transverse approaches. The ABI calculation was carried out independently for each leg, involving the division of ankle pressure by the brachial pressure on the corresponding side. The final ABI value for an individual was determined by selecting the lower of the two ABI values obtained, one for each leg. This approach ensured that the most conservative ABI value was used for assessment. A cutoff value of ≤0.9 was taken to label PAD.13 Blood pressure was measured using a standard sphygmomanometer.

Data were analyzed using "IBM-SPSS Statistics", version 26.0. To describe quantitative data, we calculated both the mean and standard deviation. Qualitative variables, on the other hand, were represented using frequency and percentages. We used the chi-square test to make comparisons involving qualitative data. For comparing quantitative data, we employed the independent sample t-test. Additionally, to uncover potential correlations between age, HbA1c levels, and ABI, we utilized Pearson correlation analysis. P-value below 0.05 was taken as significant.

## Results

In a total of 897 patients, 507 (56.5%) were female. The mean age, and BMI were 50.68±11.65 years (ranging between 18-96 years), and 26.29±5.49 kg/m$^2$, respectively. Concerning HbA1c levels, 202 (22.5%) exhibited values at or below 7%. Hypertension was diagnosed in 250 (27.9%) patients, whereas 126 (14.0%) reported a family history of DM. Additionally, 69 (7.7%) patients reported a history of smoking (table-1).

**Table 1:** *Characteristics of Patients (n=897)*

| Characteristics | | Number (%) |
|---|---|---|
| **Gender** | Male | 390 (43.5%) |
| | Female | 507 (56.5%) |
| **Age (years)** | 18-30 | 34 (3.8%) |
| | 31-45 | 274 (30.5%) |
| | 46-60 | 446 (49.7%) |
| | >60 | 143 (15.9%) |
| **BMI (kg/m$^2$)** | <23 | 281 (31.3%) |
| | ≥23 | 616 (68.7%) |
| **HbA1c (%)** | ≤7 | 202 (22.5%) |
| | >7 | 695 (77.5%) |
| **Hypertension** | | 250 (27.9%) |
| **Family history of diabetes** | | 126 (14.0%) |
| **History of smoking** | | 69 (7.7%) |

The mean ABI was calculated to be 1.11±0.17. PAD (ABI ≤0.9) was diagnosed in 90 (10.0%) patients. Among those with PAD, 14 (15.5%) had a BMI of less than 23, while 76 (84.5%) had a BMI of 23 or higher (p=0.001). Significant association of hypertension and PAD was noted (40.0% vs. 26.5%, p=0.007). Smoking was found to have significant association with PAD (17.8% vs. 6.6%, p<0.001). Details about the stratification of PAD with respect to different study variables are shown in table-2.

Negatively weak and insignificant correlation of age and ABI was found (r=-0.033, p=0.321) as shown in figure-1. Relatively weak and negative, but significant correlation was found between HbA1c and ABI (r=-0.070, p=0.036) as shown in figure-2.

**Table 2:** *Stratification of PAD with respect to Study Variables (n=897)*

| Characteristics | | PAD | | P-value |
|---|---|---|---|---|
| | | Yes (n=90) | No (n=807) | |
| **Gender** | Male | 31 (34.4%) | 359 (44.5%) | 0.068 |
| | Female | 59 (65.6%) | 448 (55.5%) | |
| **Age (years)** | 18-30 | 5 (5.6%) | 29 (3.6%) | 0.136 |
| | 31-45 | 19 (21.1%) | 255 (31.6%) | |
| | 46-60 | 47 (52.2%) | 399 (49.4%) | |
| | >60 | 19 (21.1%) | 124 (15.4%) | |
| **BMI (kg/m²)** | <23 | 14 (15.5%) | 267 | 0.001 |
| | ≥23 | 76 (84.5%) | 540 | |
| **HbA1c (%)** | ≤7 | 13 (14.4%) | 189 (23.4%) | 0.053 |
| | >7 | 77 (85.6%) | 618 (76.6%) | |
| **Hypertension** | | 36 (40.0%) | 214 (26.5%) | 0.007 |
| **Family history of diabetes** | | 18 (20.0%) | 108 (13.4%) | 0.087 |
| **History of smoking** | | 16 (17.8%) | 53 (6.6%) | <0.001 |

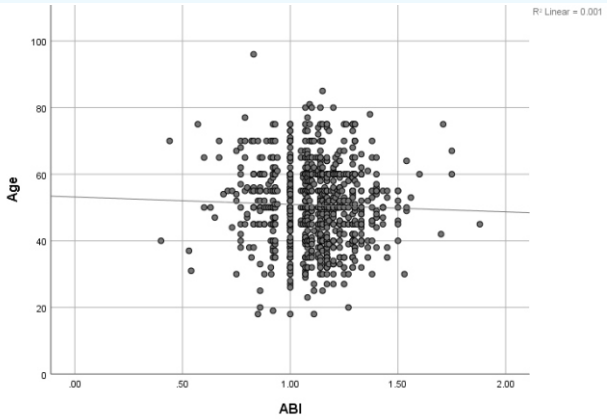


**Figure 1:** *Correlation between Age and ABI (n=897)*

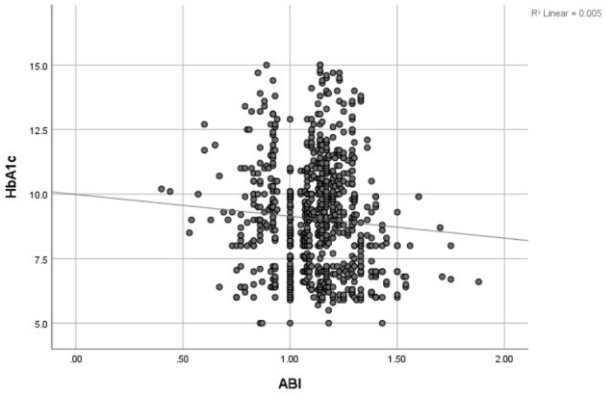


**Figure 2:** *Correlation between HbA1c and ABI (n=897)*

## Discussion

PAD contributes significantly to the high incidence of amputations and cardiovascular-related deaths, underscoring the enhanced risk of morbidity and mortality related with DM related cardiovascular conditions.[3,7] In the present study, PAD as defined by an ABI ≤ 0.9 was present in 10% of the patients, emphasizing its notable prevalence in patients with T2DM. Data from Brazil reported the frequency of PAD in T2DM patient as 21.1%, based upon ABI as the diagnostic tool.[14] Okello et al reported the frequency of PAD as 24% among adult DM patients.[15] Taking ABI as the diagnostic modality, Lange et al found that the frequency of PAD as 26.3% in patients of DM (both type-1 and 2).[16] A study by Agarwal et al from neighboring India revealed the frequency of PAD in T2DM patients to be 14.4% which is somewhat closer to the present study.[17] Others have reported the prevalence of PAD between 9.5-13.6%[18,19] among T2DM patients versus 4%20 in the general population. In comparison to the present study, local data from Lahore revealed relatively higher proportion of PAD among T2DM patients (41.0%). Farooqui et al noted the prevalence of PAD as 58% among university students aged 18-25 years but they took a more relaxed criteria for PAD (ABI<1.0).[21] A study from Lahore showed that 31.6% T2DM patients had PAD. In comparison to most of the local data, the proportion of PAD in this study was relatively low.[22] The estimated prevalence of PAD may be dependent upon geographies, overall disease burden and diagnostic criteria employed.

Several risk factors for PAD were identified in this study. BMI (p=0.001), hypertension (p=0.007), and smoking (p <0.001) were found to have significant affiliation with PAD. Moreover, relatively weak and negative, but significant correlation was found between HbA1c and ABI (r=-0.070, p=0.036). Regional data reported age, duration of DM, smoking, hypertension and HbA1c >7% to be significant predictors of PAD.[17] Smoking was highlighted to be an independent predictor of PAD in T2DM (odds ratio:2.7). Data from Sri Lanka showed dyslipidemia and smoking to have significant association with PAD.[23] Age above 60 years, hypertension and presence of foot ulcer were found to be independent predictor of PAD among black African diabetic patients.[24] The study sought to establish associations between PAD and various factors. Our study highlights the significance of managing the modifiable risk factors of PAD to prevent and manage T2DM patients. Local data has shown that vast majority of T2DM patients have poor glycemic control.[25] Additionally, glycemic control remains a crucial aspect of PAD management, as higher HbA1c levels were correlated with PAD in this research. Further research and longitudinal studies are warranted to explore the relationships of various aspects of T2DM patients and their implications for clinical practice.

Relatively large sample size is one of the strengths of this study. However, there were few limitations of the

present research. The accuracy of data on variables like smoking history, and family history of DM relied on self-reporting, potentially introducing recall or reporting bias. The study did not address other health conditions (like dyslipidemia) or medications that could influence the frequency of PAD in T2DM patients.

## Conclusion

The frequency of PAD among T2DM patients was high. Obesity, hypertension, and smoking history emerged as noteworthy risk factors of PAD. This research provided important insights into the burden and associated factors of PAD among individuals with T2DM.

**Conflict of Interest:** *None*

**Funding Source:** *None*

## References

1. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. Diabetes Res Clin Pract. 2019; doi:10.1016/j.diabres.2019.107843
2. Aamir AH, Ul-Haq Z, Mahar SA, Qureshi FM, Ahmad I, Jawa A, et al. Diabetes Prevalence Survey of Pakistan (DPS-PAK): prevalence of type 2 diabetes mellitus and prediabetes using HbA1c: a population-based survey from Pakistan. BMJ Open. 2019;9(2):e025300.
3. Ali QM, Anjum S, Shafique S, Hamza H, Imran A, Khan R, et.al. Risk of diabetic foot ulcer in Patients of diabetes mellitus visiting a private setting of South Punjab, Pakistan. J Pak Soc Intern Med. 2022;3(4):301-305.
4. GBD 2019 Peripheral Artery Disease Collaborators. Global burden of peripheral artery disease and its risk factors, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet Glob Health. 2023;11(10):e1553-65.
5. Shu J, Santulli G: Update on peripheral artery disease: epidemiology and evidence-based facts. Atherosclerosis. 2018;doi: 10.1016/j.atherosclerosis.2018.05.033
6. Jelani QU, Petrov M, Martinez SC, Holmvang L, Al-Shaibi K, Alasnag M. Peripheral Arterial Disease in Women: an Overview of Risk Factor Profile, Clinical Features, and Outcomes. Curr Atheroscler Rep. 2018; 20(8):40.
7. Hicks CW, Selvin E. Epidemiology of Peripheral Neuropathy and Lower Extremity Disease in Diabetes. Curr Diab Rep. 2019;19(10):86.
8. Zheng ZJ, Rosamond WD, Chambless LE, Nieto FJ, Barns RW, Hutchinson RG, et al. Lower extremity arterial disease assessed by ankle-brachial index in a middle-aged population of African Americans and whites: the Atherosclerosis Risk in Communities (ARIC) Study. Am J Prev Med. 2005;29(5 Suppl 1):42-9.
9. Berkovitch A, Iakobishvili Z, Fuchs S, Atar S, Braver O, Eisen A, et al. Peripheral artery disease, abnormal ankle-brachial index, and prognosis in patients with acute coronary syndrome. Front Cardiovasc Med. 2022; doi:10.3389/fcvm.2022.902615
10. Alves-Cabratosa L, Comas-Cufí M, Ponjoan A, Maria G, Ruth M, Jordi B, et al. Levels of ankle-brachial index and the risk of diabetes mellitus complications. BMJ Open Diabetes Res Care. 2020;8(1):e000977.
11. Comşa HI, Zdrenghea D, Man SC, Pop D. The role of novel atherosclerosis markers in peripheral artery disease: is there a gender difference?. Cardiovasc J Afr. 2018;29(5):322-30.
12. Naveed S, Ali Z, Nageen A, Ahmed SM, Fatima M, Zehra F. Relationship between Ankle Brachial Index (ABI) and Cardiovascular Risk Factors in Diabetes Type II. Pak Heart J 2020;53(04):337–42.
13. Cáceres-Farfán L, Moreno-Loaiza M, Cubas WS. Ankle-brachial index: more than a diagnostic test?. Arch Peru Cardiol Cir Cardiovasc. 2021;2(4):254-62.
14. da Silva FPJ, Teodoro ECM, Pereira ECA, dos Reis MVC. Prevalence of peripheral arterial disease and associated factors in people with type 2 diabetes. Fisioter Mov. 2021;doi: 10.1590/fm.2021.34122
15. Okello S, Millard A, Owori R, et al. Prevalence of lower extremity peripheral artery disease among adult diabetes patients in southwestern Uganda. BMC Cardiovasc Disord. 2014; doi:10.1186/1471-2261-14-75
16. Lange S, Diehm C, Darius H, Haberl R, Allenberg JR, Pittrow D, et al. High prevalence of peripheral arterial disease and low treatment rates in elderly primary care patients with diabetes. Exp Clin Endocrinol Diabetes. 2004;112(10):566-73.
17. Agarwal AK, Singh M, Arya V, Garg U, Singh VP, Jain V. Prevalence of peripheral arterial disease in type 2 diabetes mellitus and its correlation with coronary artery disease and its risk factors. J Assoc Physicians India. 2012;60(7):28-32.
18. Gregg EW, Sorlie P, Paulose-Ram R, Gu Q, Eberhardt MS, Wolz M, et al. Prevalence of lower-extremity disease in the US adult population >=40 years of age with and without diabetes: 1999-2000 national health and nutrition examination survey. Diabetes Care. 2004; 27(7):1591-7.
19. Norman PE, Davis WA, Bruce DG, Davis TM. Peripheral arterial disease and risk of cardiac death in type 2 diabetes: the Fremantle Diabetes Study. Diabetes Care. 2006;29(3):575-80.
20. Selvin E, Erlinger TP. Prevalence of and risk factors for peripheral arterial disease in the United States: results from the National Health and Nutrition Examination Survey, 1999-2000. Circulation. 2004;110(6):738-43.
21. Umer A, Khan KA, Naz S, Mushtaq S, Khan SN, RazaT, et al. frequency of peripheral arterial disease in high risk type 2 diabetes mellitus using ankle-brachial index and its association with the risk factors among patients presenting in jinnah hospital, lahore: Peripheral arterial disease in high risk type-2 diabetes mellitus. Pak Armed Forces Med J. 2018;68(4):761–66.

22. Akram J, Aamir A, Basit A, Qureshi MS, Mehmood T, Shahid SK, et al. Prevalence of peripheral arterial disease in type 2 diabetics in Pakistan. J Pak Med Assoc. 2011;61(7):644-648.

23. Weragoda J, Seneviratne R, Weerasinghe MC, Wijeyaratne SM. Risk factors of peripheral arterial disease: a case control study in Sri Lanka. BMC Res Notes. 2016; 9(1):508.

24. Weledji EP, Alemnju NT, Nouediou C. The use of ankle brachial pressure indices in a cohort of black African diabetic patients. Ann Med Surg (Lond). 2018; doi: 10.1016/j.amsu.2018.09.009

25. Ali QM , Akram M, Imran A, Shafique S, Ullah HMK, Khan R, et al. Factors associated with poor glycemic control: A real world data from a private outpatient clinic of South Punjab, Pakistan. J Pak Soc Intern Med. 2022; 3(3):210-5.