



Research Article

Peripheral Arterial Disease Among Diabetic Patients Admitted to Surgical Wards of a Tertiary Care Hospital: A Cross-Sectional Study

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Abstract: Background: Peripheral arterial disease (PAD) is a common macrovascular complication of diabetes mellitus and an important cause of foot ulceration and amputation. Examination of the foot alone detects it poorly. The ankle-brachial index (ABI) is the most accurate noninvasive test, and it is recommended for every diabetic patient older than 50 years. **Objectives:** To find the frequency of PAD in diabetic patients admitted to the surgical wards of Ayub Teaching Hospital, Abbottabad, and to look at its association with age, sex, duration of diabetes, hypertension, smoking, family history of PAD and compliance with anti-diabetic medication. **Materials and Methods:** This cross-sectional study was carried out in the Department of Surgery, Ayub Teaching Hospital, Abbottabad, from 1 March 2025 to 28 February 2026. A total of 105 patients with type 2 diabetes were enrolled by consecutive sampling after informed consent. Trained researchers interviewed and examined each patient and measured ABI with a handheld Doppler, PAD was diagnosed when the ABI was below 0.9 in either leg. Associations were tested with the chi-square test (Fisher's exact test where an expected count was below 5) in SPSS version 25, and $p < 0.05$ was considered significant. **Results:** PAD was present in 27 of 105 patients (25.7%, 95% CI 18.3–34.8%). It increased with the duration of diabetes: 6.9% (2/29) for <10 years, 8.8% (3/34) for 10–20 years and 52.4% (22/42) for >20 years ($p < 0.001$). It was more frequent in smokers than in non-smokers (43.3% (13/30) vs 18.7% (14/75), $p = 0.009$, OR 3.3, 95% CI 1.3–8.4) and in poorly compliant than in well-compliant patients (57.1% (16/28) vs 14.3% (11/77), $p < 0.001$, OR 8.0, 95% CI 3.0–21.4). No significant association was found with age (10.0% in 18–40 years' vs 27.4% in 41–83 years, $p = 0.447$), sex (28.3% in men vs 23.7% in women, $p = 0.598$), hypertension (26.2% vs 25.0%, $p = 0.887$) or family history of PAD (22.4% with vs 28.6% without, $p = 0.474$). **Conclusion:** About one in four diabetic patients admitted to our surgical wards had PAD. Longer duration of diabetes, smoking and poor compliance with anti-diabetic medication were significantly associated with it. ABI screening, especially in patients with long-standing diabetes, smokers and poor adherers, may allow earlier detection of PAD, but larger multicentre studies with multivariable analysis are needed to confirm these findings.

Keywords: Peripheral Arterial Disease, Diabetes Mellitus, Ankle-Brachial Index, Frequency, Medication Compliance

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INTRODUCTION

Diabetes mellitus (DM) is a metabolic condition in which blood glucose is raised because of defective insulin action. Type 1 DM accounts for 5–10% of cases. It is autoimmune, leads to insulin deficiency and mostly starts in younger people. Type 2 DM makes up the other 90–95%, is driven by insulin resistance and usually appears in adult life [1]. Worldwide, the number of people with diabetes rose from 151 million in 2000 to 463 million in 2019 [2]. Pakistan followed the same course, with prevalence going up from 11.77% in 2016 to 17.1% in 2019 [2-3]. The complications are either macrovascular, such as coronary artery disease and peripheral arterial disease, or microvascular, namely neuropathy, nephropathy and retinopathy [4].

Many studies have shown that peripheral arterial disease (PAD) is common in people with diabetes [5-7], and one estimate puts its prevalence in type 2 diabetes at about 27.1% [6]. PAD is narrowing of the arteries of the lower limbs. It carries a high risk of cardiovascular death, reduces blood flow to the feet, makes them easier to injure and slows the healing of wounds [8-9]. Together with diabetic neuropathy [10], it is one of the main causes of diabetic foot disease, which includes ulceration and gangrene [11].

Diabetic foot disease, to which PAD contributes, carries a heavy burden of illness and death. In a national Scottish cohort of people with diabetes and a high-risk foot, 2-year amputation-free survival was 84.5%, among those who had an event, 90.0% died and 10.0% had an amputation [12]. A 2005 Lancet study described the economic and clinical cost of treating foot ulcers in developing countries, where resources for complex foot care are limited and amputation is common [13]. A major amputation also means lifelong use of a prosthesis, which takes more energy and is linked with higher mortality [13-15].

Pakistan is a lower middle income country with a high prevalence of diabetes. A recent meta-analysis found that foot ulcers among people with diabetes in Pakistan have become more frequent over the last three decades, adding to the strain on the health system [16]. It included no studies from Khyber Pakhtunkhwa, so data on diabetic foot complications from this province are scarce. We therefore set out to estimate the frequency of PAD in diabetic patients admitted to the surgical wards of Ayub Teaching Hospital, one of the largest tertiary care hospitals in the province, and to look at the factors associated with it.

MATERIALS AND METHODS

This cross-sectional study was conducted in the Department of Surgery, Ayub Teaching Hospital, Abbottabad, from 1 March 2025 to 28 February 2026. It was approved by the chairperson of the Institutional Review Board (IRB) and the hospital ethical committee. Patients were enrolled by consecutive sampling after the purpose and details of the study had been explained to them and their informed consent obtained.

A total of 105 patients with type 2 diabetes mellitus admitted to the Department of Surgery were included. To limit confounding, we excluded patients with type 1 diabetes, those with a history of percutaneous transluminal coronary angioplasty, myocardial infarction, coronary artery bypass grafting or stroke, those taking anticoagulants, vasodilators, lipid-lowering agents or antiplatelet therapy, and those with hypovolaemia or renal failure requiring dialysis.

Data were collected by researchers who had completed a 3-day training workshop on data collection and ABI measurement. Every patient was interviewed and examined, and the findings were entered on a pre-designed proforma. We recorded age, sex, duration of diabetes, hypertension, smoking, family history of PAD and compliance with anti-diabetic medication. Hypertension was defined as a diagnosed case of at least five years' standing, and a patient was counted as a smoker if he or she had smoked at least one pack a day for three or more years. Compliance was assessed by self-report at interview: patients who had taken at least 80% of their prescribed anti-diabetic doses over the preceding month were classed as having good compliance, and those who had taken less than 80% as having poor compliance.

ABI was measured by the trained researchers with a handheld Doppler and a sphygmomanometer. Patients lay supine for 10 minutes first. Systolic pressure was taken in both brachial arteries and the higher reading was used as the arm pressure. In each leg, systolic pressure was taken over the posterior tibial and dorsalis pedis arteries, and the higher of the two was used as the ankle pressure. ABI was calculated for each leg as ankle pressure divided by arm pressure. A value below 0.9 was considered abnormal, and a patient was diagnosed with PAD when the ABI was below 0.9 in either leg. Patients were then grouped as PAD present or absent.

Data were analysed with IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA). Age was expressed as mean±standard deviation, and categorical variables as frequencies and percentages. The 95% confidence interval for the overall frequency of PAD was calculated by the Wilson method. The association of PAD with each categorical variable was tested with the chi-square test, or with Fisher's exact test when any expected cell count was below 5. For the variables that were significantly associated with PAD we also calculated odds ratios with 95% confidence intervals (for duration of diabetes, more than 20 years against 20 years or less). A p-value below 0.05 was taken as significant.

RESULTS

The study included 105 patients: 46 men (43.8%) and 59 women (56.2%). Their ages ranged from 18 to 83 years (55.6±16), and 10 (9.5%) were aged 40 years or younger. Diabetes had been present for less than 10 years in 29 patients (27.6%), for 10 to 20 years in 34 (32.4%) and for more than 20 years in 42 (40.0%), the largest group. Hypertension was present in 61 patients (58.1%), 49 (46.7%) had a family history of PAD, 30 (28.6%) were smokers, and 77 (73.3%) complied well with their anti-diabetic medication (Table 1).

PAD, defined as an ABI below 0.9 in either leg, was found in 27 of the 105 patients (25.7%, 95% CI 18.3–34.8%), while 78 (74.3%) did not have it (Figure 1).

Three factors were significantly associated with PAD (Table 2). The frequency rose steeply with the duration of diabetes: 2 of 29 patients (6.9%) with diabetes for less than 10 years, 3 of 34 (8.8%) with 10 to 20 years and 22 of 42 (52.4%) with more than 20 years had PAD ($p<0.001$). The odds of PAD were nearly 13 times higher beyond 20 years

Table 1: Baseline Characteristics of the Participants (N = 105)

Characteristic	Category	n (%)
Age	18–40 years	10 (9.5%)
	41–83 years	95 (90.5%)
Sex	Male	46 (43.8%)
	Female	59 (56.2%)
Duration of diabetes	<10 years	29 (27.6%)
	10–20 years	34 (32.4%)
	>20 years	42 (40.0%)
Hypertension	Yes	61 (58.1%)
	No	44 (41.9%)
Family history of PAD	Yes	49 (46.7%)
	No	56 (53.3%)
Smoking	Yes	30 (28.6%)
	No	75 (71.4%)
Medication compliance	Good	77 (73.3%)
	Poor	28 (26.7%)

Values are n (%)

Table 2: Association of PAD with Patient Characteristics

All patients		105	27 (25.7%)	
Age	18–40 years	10	1 (10.0%)	0.447 ^a
	41–83 years	95	26 (27.4%)	
Sex	Male	46	13 (28.3%)	0.598
	Female	59	14 (23.7%)	
Duration of diabetes	<10 years	29	2 (6.9%)	<0.001*
	10–20 years	34	3 (8.8%)	
	>20 years	42	22 (52.4%)	
Hypertension	Yes	61	16 (26.2%)	0.887
	No	44	11 (25.0%)	
Family history of PAD	Yes	49	11 (22.4%)	0.474
	No	56	16 (28.6%)	
Smoking	Yes	30	13 (43.3%)	0.009*
	No	75	14 (18.7%)	
Medication compliance	Good	77	11 (14.3%)	<0.001*
	Poor	28	16 (57.1%)	

Percentages are the proportion of patients with PAD within each category. p-values are from the chi-square test, ^a Fisher's exact test (expected count below 5). * Statistically significant (p<0.05)

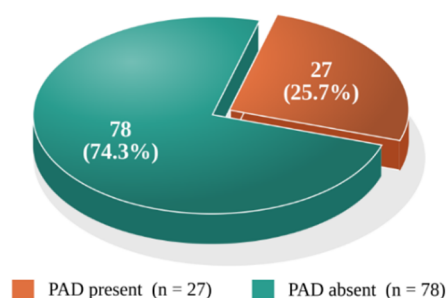


Figure 1: Frequency of Peripheral Arterial Disease Among 105 Diabetic Patients

than at 20 years or less (OR 12.8, 95% CI 4.3–38.2). PAD was also more frequent in smokers than in non-smokers (13 of 30, 43.3%, vs 14 of 75, 18.7%, $p = 0.009$, OR 3.3, 95% CI 1.3–8.4) and in poorly compliant than in well-compliant patients (16 of 28, 57.1%, vs 11 of 77, 14.3%, $p < 0.001$, OR 8.0, 95% CI 3.0–21.4). PAD was more frequent in patients aged 41–83 years than in those aged 18–40 years (27.4% vs 10.0%), but this was not significant ($p = 0.447$). Sex, hypertension and family history of PAD were not associated with PAD (Table 2).

DISCUSSION

Type 2 diabetes is a chronic illness that often leads to complications such as PAD [17]. Reported prevalence in diabetic populations varies widely, however. We found PAD in about one of every four patients admitted to our surgical wards

(25.7%). Majid Khan *et al.* working in the same hospital, reported 19.9% [18]. Most of our patients (90.5%) were older than 40 years, so the age range cannot explain the higher figure. Differences in setting (surgical rather than medical admissions), in exclusion criteria and in the way ABI was measured are more likely reasons [18].

PAD was less frequent in the 18–40 group (1 of 10 patients, 10.0%) than in those aged 41–83 years (26 of 95, 27.4%), but with only ten younger patients the difference was not significant (Fisher's exact test, $p = 0.447$). Other studies have found that PAD becomes more common with age [19], and our figures point the same way. A sample with a better spread of ages would be needed to settle the question.

PAD was similar in men (28.3%) and women (23.7%, $p = 0.598$). Some earlier studies reported a higher prevalence in women [20–21], and our sample was probably too small to pick up a modest difference.

PAD was uncommon in patients who had had diabetes for less than 10 years (6.9%) or for 10 to 20 years (8.8%), but more than half of those with diabetes for over 20 years had it (52.4%, $p < 0.001$). Other studies have also linked PAD with a longer duration of diabetes [22]. A likely explanation is the cumulative damage that years of hyperglycaemia do to the vessel wall. Hypertension, in contrast, made no difference (26.2% vs 25.0%, $p = 0.887$), possibly because our sample was small and our exclusion criteria removed many high-risk patients.

Smoking is a well-recognised risk factor for PAD, and it was significantly associated with the disease in our series: 43.3% of smokers had PAD against 18.7% of non-smokers ($p = 0.009$), an odds ratio of 3.3 (95% CI 1.3–8.4). The wide interval means the strength of the association is uncertain. A family history of PAD was not associated with the disease (22.4% with and 28.6% without, $p = 0.474$).

Compliance showed the strongest association. PAD was present in 57.1% of patients who took their medication poorly and in 14.3% of those who took it well ($p < 0.001$), and the odds of PAD were eight times higher in the poorly compliant group (95% CI 3.0–21.4). This agrees with earlier reports [23]. The interval is wide, though, and compliance was self-reported, so recall bias is possible. Because the study is cross-sectional, reverse causation cannot be excluded. Duration of diabetes, smoking and compliance may also be related to one another, and without a multivariable analysis we cannot tell which of them is independently associated with PAD.

Study Implications

The study gives recent local data on PAD in diabetic patients admitted to a tertiary care hospital in Khyber Pakhtunkhwa. With one patient in four affected, ABI is a cheap bedside test that could be added to the routine assessment of diabetic patients on the surgical wards, particularly those who have had diabetes for more than 20 years and those who smoke. The association with poor compliance suggests that adherence to anti-diabetic treatment deserves attention in these patients, although our data cannot show that improving it prevents PAD.

Study Limitations

This was a single-centre, cross-sectional study of 105 patients. It cannot show cause and effect, and the results may not apply to diabetic patients in the community or in other hospitals. The sample was small and some subgroups were too small to compare reliably, only 10 patients were aged 18–40 years. We excluded patients with established cardiovascular disease and those on antiplatelet, lipid-lowering or vasodilator drugs, which probably made us underestimate the frequency of PAD. ABI can be falsely normal when calcified vessels cannot be compressed, and we did not measure the toe-brachial index. Compliance was self-reported, and HbA1c and lipid profile were not reported. All associations were tested one variable at a time. With only 27 cases of PAD a multivariable model was not feasible, so confounding between duration of diabetes, smoking and compliance cannot be excluded.

Future Directions

Larger multicentre studies with probability sampling and a more even spread of ages are needed. Community-based studies would show the burden among diabetic patients who never reach a tertiary hospital. Future work should also record HbA1c, lipid profile and body mass index, measure compliance with a validated tool, and use multivariable analysis to separate the effect of duration of diabetes, smoking and compliance from one another.

CONCLUSION

Roughly one in four diabetic patients admitted to the surgical wards of our hospital had PAD. Longer duration of diabetes, smoking and poor compliance with anti-diabetic medication were significantly associated with it. ABI screening, especially in patients with long-standing diabetes, smokers and poor adherers, may allow earlier detection of PAD, but this needs confirmation in larger multicentre studies.

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Conflict of Interest

The authors declare that they have no conflict of interest related to the conduct of this study.

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Ethics Approval and Consent to Participate

Ethical approval was obtained from the Institutional Ethical Review Committee of Ayub Teaching Hospital, Abbottabad.

Informed consent was obtained from all participants before their enrolment in the study.

REFERENCES

1. Kerner, W. and J. Brückel. "Definition, Classification and Diagnosis of Diabetes Mellitus." *Experimental and Clinical Endocrinology & Diabetes*, vol. 122, no. 7, 2014, pp. 384–386. <https://doi.org/10.1055/s-0034-1366278>.
2. Azeem, S. *et al.* "The Increasing Rate of Diabetes in Pakistan: A Silent Killer." *Annals of Medicine and Surgery*, vol. 79, 2022, article 103901.
3. Islam, U. *et al.* "Frequency of Peripheral Arterial Disease in Type-II Diabetic Patients Presenting with Diabetic Retinopathy." *APMC*, vol. 16, no. 4, 2022, pp. 326–329. <https://doi.org/10.29054/APMC/2022.940>.
4. Deshpande, A.D. *et al.* "Epidemiology of Diabetes and Diabetes-Related Complications." *Physical Therapy*, vol. 88, no. 11, 2008, pp. 1254–1264. <https://doi.org/10.2522/ptj.20080020>.
5. Faglia, E. "Characteristics of Peripheral Arterial Disease and Its Relevance to the Diabetic Population." *The International Journal of Lower Extremity Wounds*, vol. 10, no. 3, 2011, pp. 152–166. <https://doi.org/10.1177/1534734611417352>.
6. Ghimire, M.R. *et al.* "Screening of Peripheral Arterial Disease in Patients with Diabetes." *Journal of Nepal Health Research Council*, vol. 21, no. 1, 2023, pp. 46–49. <https://doi.org/10.33314/jnhrc.v21i1.4402>.
7. Zia-Ur-Rehman and N. Ram. "Peripheral Arterial Disease (PAD) in Diabetics: Diagnosis and Management—A Narrative Review." *Journal of the Pakistan Medical Association*, vol. 73, no. 3, 2023, pp. 621–626. <https://doi.org/10.47391/JPMA.4590>.
8. Conte, S.M., and P.R. Vale. "Peripheral Arterial Disease." *Heart, Lung and Circulation*, vol. 27, no. 4, 2018, pp. 427–432. <https://doi.org/10.1016/j.hlc.2017.10.014>.
9. Bevan, G.H. and K.T. White Solaru. "Evidence-Based Medical Management of Peripheral Artery Disease." *Arteriosclerosis, Thrombosis, and Vascular Biology*, vol. 40, no. 3, 2020, pp. 541–553. <https://doi.org/10.1161/ATVBAHA.119.312142>.
10. Pop-Busui, R. *et al.* "Diabetic Neuropathy: A Position Statement by the American Diabetes Association." *Diabetes Care*, vol. 40, no. 1, 2017, pp. 136–154. <https://doi.org/10.2337/dc16-2042>.
11. Bandyk, D.F. "The Diabetic Foot: Pathophysiology, Evaluation, and Treatment." *Seminars in Vascular Surgery*, vol. 31, nos. 2–4, 2018, pp. 43–48. <https://doi.org/10.1053/j.semvasc.2019.02.001>.
12. Vadiveloo, T. *et al.* "Amputation-Free Survival in 17,353 People at High Risk for Foot Ulceration in Diabetes: A National Observational Study." *Diabetologia*, vol. 61, no. 12, 2018, pp. 2590–2597. <https://doi.org/10.1007/s00125-018-4723-y>.
13. Boulton, A.J. *et al.* "The Global Burden of Diabetic Foot Disease." *The Lancet*, vol. 366, no. 9498, 2005, pp. 1719–1724. [https://doi.org/10.1016/S0140-6736\(05\)67698-2](https://doi.org/10.1016/S0140-6736(05)67698-2).
14. Fortington, L.V. *et al.* "Short- and Long-Term Mortality Rates after a Lower Limb Amputation." *European Journal of Vascular and Endovascular Surgery*, vol. 46, no. 1, 2013, pp. 124–131. <https://doi.org/10.1016/j.ejvs.2013.03.024>.
15. Qaarie, M.Y. "Life Expectancy and Mortality after Lower Extremity Amputation: Overview and Analysis of Literature." *Cureus*, vol. 15, no. 5, 2023. <https://doi.org/10.7759/cureus.38944>.
16. Akhtar, S. *et al.* "The Prevalence of Foot Ulcers in Diabetic Patients in Pakistan: A Systematic Review and Meta-Analysis." *Frontiers in Public Health*, vol. 10, 2022, article 1017201. <https://doi.org/10.3389/fpubh.2022.1017201>.
17. Galicia-Garcia, U. *et al.* "Pathophysiology of Type 2 Diabetes Mellitus." *International Journal of Molecular Sciences*, vol. 21, no. 17, 2020, article 6275. <https://doi.org/10.3390/ijms21176275>.
18. Khan, A.M. *et al.* "Risk Factors of Peripheral Vascular Disease in Diabetes Mellitus in Abbottabad, Pakistan: A Cross-Sectional Study." *Cureus*, vol. 13, no. 8, 2021. <https://doi.org/10.7759/cureus.17556>.
19. Escobar, C. *et al.* "Prevalence, Clinical Profile and Management of Peripheral Arterial Disease in Elderly Patients with Diabetes." *European Journal of Internal Medicine*, vol. 22, no. 3, 2011, pp. 275–281.
20. Eshcol, J. *et al.* "Prevalence, Incidence and Progression of Peripheral Arterial Disease in Asian Indian Type 2 Diabetic Patients." *Journal of Diabetes and Its Complications*, vol. 28, no. 5, 2014, pp. 627–631.

21. Ali, Z. *et al.* "Peripheral Artery Disease in Type II Diabetes." *Journal of the College of Physicians and Surgeons Pakistan*, vol. 22, no. 11, 2012, pp. 686–689.
22. Escobedo, J. *et al.* "Association between Albuminuria and Duration of Diabetes and Myocardial Dysfunction and Peripheral Arterial Disease among Patients with Stable Coronary Artery Disease in the BARI 2D Study." *Mayo Clinic Proceedings*, vol. 85, no. 1, 2010, pp. 41–46.
23. Charles, M. *et al.* "Prevalence of Neuropathy and Peripheral Arterial Disease and the Impact of Treatment in People with Screen-Detected Type 2 Diabetes: The ADDITION-Denmark Study." *Diabetes Care*, vol. 34, no. 10, 2011, pp. 2244–2249.