RESEARCH PAPER

Measurement of Ankle Brachial Pressure Index in Diabetic Patients and Diabetic Foot Ulcer Patients and its Value to Assess the Degree of Ischemia in Peripheral Arterial Disease

D. Monisha Devi[1*], S. Padma[2], S.K. Manoj[3], Vinoth Kanna D[4], N. Sathish[5], M. Malathi[6], P. Karthick[7]

[1*]Postgraduate Resident, Department of General Surgery, Trichy SRM Medical College Hospital and Research Centre, Irungalur, Tamil Nadu, India.
Email: Monishadevi0007@gmail.com

[2]Professor, Department of General Surgery, Trichy SRM Medical College Hospital and Research Centre, Irungalur, Tamil Nadu, India.
Email: sri.padma1960@gmail.com

[3]Professor, Department of General Surgery, Trichy SRM Medical College Hospital and Research Centre, Irungalur, Tamil Nadu, India.
Email: dr.esskaymanoj@gmail.com

[4]Assistant Professor, Department of General Surgery, Trichy SRM Medical College Hospital and Research Centre, Irungalur, Tamil Nadu, India.
Email: devavinothkanna@gmail.com

[5]Senior Resident, Department of General Surgery, Trichy SRM Medical College Hospital and Research Centre, Irungalur, Tamil Nadu, India.
Email: drnsathish23@gmail.com

[6]Senior Resident, Department of General Surgery, Trichy SRM Medical College Hospital and Research Centre, Irungalur, Tamil Nadu, India.
Email: malathimaruthu21@gmail.com

[7]Head of Department, Department of General Surgery, Trichy SRM Medical College Hospital and Research Centre, Irungalur, Tamil Nadu, India.
Email: drpkarthickms@gmail.com

Received: 1st Sep, 2026 | Revised: 8th Sep, 2026 | Accepted: 15th Sep, 2026 | Available Online: 22nd Sep, 2026

Abstract

Background: Diabetic foot ulcers (DFUs) are a common and severe illness frequently linked to peripheral artery disease (PAD), resulting in compromised wound healing and increased vulnerability to infection and necrosis. The Ankle–Brachial Pressure Index (ABPI) is an easy, non-invasive instrument utilized to assess peripheral artery circulation. This study intended to examine the Ankle-Brachial Pressure Index (ABPI) values of diabetic patients with and without foot ulcers, as well as to evaluate vascular insufficiency in patients with diabetic foot ulcers using the ABPI and Doppler. **Material and Methods:** A comparative observational study was done among patients with Diabetic foot ulcers (n = 45) and patients without foot ulcers (n = 45). Their Ankle Brachial Pressure Index was measured, and they were subjected to Doppler ultrasonography. A comparative analysis was carried out among both groups **Results:** The average ABPI for patients with diabetic foot ulcers was 1.018 ± 0.2949, while diabetic patients without ulcers exhibited a significantly elevated average ABPI of 1.216 ± 0.1107. Doppler waveform analysis indicated that 40.00% of diabetic foot ulcer patients displayed a biphasic waveform, 31.11% exhibited a triphasic waveform, and 28.88% presented a monophasic waveform. Conversely, among patients devoid of ulcers, 91.11% exhibited a triphasic waveform, 8.88% displayed a biphasic waveform, and none presented a monophasic flow. **Conclusion:** The research indicates that diabetic individuals with foot ulcers exhibit notably reduced ABPI values and a higher prevalence of abnormal Doppler waveform patterns in comparison to patients without ulcers. Lower ABPI values and monophasic Doppler waveforms exhibit a significant correlation with peripheral arterial disease in patients with diabetic foot ulcers. The combination of ABPI and Doppler ultrasonography represents a reliable, non-invasive approach for the early identification of vascular insufficiency in diabetic patients.

Keywords: Doppler, Ankle Brachial Pressure Index, Diabetic foot ulcer, Observational study

How to cite this article: D. Monisha Devi1* S. Padma2 S.K. Manoj3 Vinoth Kanna D4 N. Sathish5 M. Malathi6 P. Karthick7. Measurement of Ankle Brachial Pressure Index in Diabetic Patients and Diabetic Foot Ulcer Patients and its Value to Assess the Degree of Ischemia in Peripheral Arterial Disease. Int J Drug Deliv Technol. 2026;16(80s):706-712. DOI: 10.25258/ijddt.16.80s.86.

Introduction

Atherosclerotic disorder, known as lower extremities peripheral arterial disease (PAD) results in arterial stenosis or occlusion in the lower limbs, causing symptoms such as ischemic discomfort, decreased movement, and intermittent claudication.[1] Age, smoking, diabetes, high blood pressure, high cholesterol, alcohol consumption, obesity, renal

impairment, and hyperfibrinogenemia are risk factors. 5.56% of individuals over 25 worldwide suffer from PAD, with a higher prevalence in low- and middle-income (LMIC) nations.[2] The diabetic foot arises from a complex interplay of various components. The components identified encompass disturbed metabolic and immune states, alongside the presence of co-existing peripheral neuropathy and peripheral arterial disease (PAD).8 to 9 Peripheral arterial disease is responsible for as much as 50% of diabetic foot ulcers and serves as an independent risk factor for the onset of these ulcers.[3] The incidence in India varies between 7.6% and 26.7%. The risk of cardiovascular morbidity and death, such as MI, and stroke, is increased by PAD.[4]

The great variations between patient presentations have led to the development of multiple categorization systems for the stratification of peripheral arterial disease (PAD). This heterogeneity is caused by a number of factors, including the presence of associated diseases like diabetes and the severity of the ischemia.[5] The degree of atherosclerosis, the intensity and acuity of limb ischemia, and the capacity to restore normal arterial circulation all affect the prognosis of the lower extremity in patients with peripheral artery disease (PAD).[6] The most popular non-invasive screening method for evaluating and diagnosing PAD is the resting Ankle-Brachial Index (ABI), which is determined by dividing the systolic blood pressure at the ankle by the brachial artery.[6] A systematic review analysed that multiple studies reported low ABI, which was 0.9 or below, was usually associated with future cardiac events.[7] The WIfI (Wound, Ischemia, and Foot Infection) categorization system was developed by the Society for Vascular Surgery to classify patients with threatened limbs based on their risk of limb loss, particularly in populations with peripheral artery disease (PAD) and diabetes. The WIfI classification uses ABI values to determine the severity of ischemia: Grade 0 (ABI $\geq$ 0.80), Grade 1 (ABI 0.60–0.79), Grade 2 (ABI 0.40–0.59), and Grade 3 (ABI $\leq$ 0.39). This classification provides a consistent method for determining limb abnormalities and guiding treatment decisions.[8]

In individuals with diabetes, PAD often appears more aggressively, typically impacts infra-genicular arteries, and is linked to medial arterial calcification, among other factors, which can make it more difficult to assess ABI accurately. The degree to which diabetes impacts ABI reliability remains unknown, however.[9] ABI inaccuracy is influenced by the pattern of atherosclerotic disease as well as medial arterial calcification. Lesions usually develop in the below-the-knee (BTK) arteries, which are parallel rather than serial, in diabetic foot patients. The ABI's capacity to identify pressure dips is restricted by this parallel distribution, which reduces its accuracy in assessing the actual severity of lower extremity atherosclerosis.[10] The purpose of this study is to examine the Ankle-Brachial Pressure Index (ABPI) values of diabetic patients with and without foot ulcers, as well as to evaluate vascular insufficiency in patients with diabetic foot ulcers using the ABPI and Doppler.

Objectives

- To assess the vascular insufficiency by ankle brachial pressure index and Doppler in Diabetic foot ulcer patients
- To compare the value of ABPI in patients with diabetic foot ulcer and diabetic patients without ulcer.

Material and Methods

The Ankle-Brachial Pressure Index (ABPI) was assessed and compared between diabetic patients with and without foot ulcers over the course of a year in a comparative cross-sectional study in a tertiary care facility. Patients between the ages of 40 and 70 were enrolled in the study and were split into two groups: cases, or diabetic patients with foot ulcers, and controls, or diabetic patients without foot ulcers. The study excluded smokers and patients with below-knee amputations to rule out any potential confounding variables.

A sample size of 40 per group was found to achieve 80% power at a 5% level of significance, based on a prior study by Mukta Varma et al. (2018) that indicated an 84% incidence of peripheral artery disease in patients with diabetic foot ulcers. For each group, a total of 45 individuals were gathered, taking into consideration a 10% dropout rate. A thorough clinical history, including the length of diabetes, ulcer features, and related systemic disorders, was documented following informed consent. A comprehensive, systematic, and local examination was conducted. Five milliliters of venous blood were used for laboratory tests, which comprised Fasting Blood Sugar (FBS), Postprandial Blood Sugar (PPBS), and HbA1c.

The brachial artery and both ankle arteries (dorsalis pedis and posterior tibial) had their systolic blood pressures recorded using a Doppler equipment. The ABPI was then computed by dividing the ankle systolic pressure by the brachial systolic pressure. Doppler studies of the lower extremities were performed on all diabetic foot ulcer patients to evaluate arterial patency. Diabetic patients without foot ulcers but with a severely low ABPI also had Doppler evaluations. The prevalence and severity of peripheral artery disease in diabetic individuals with and without foot ulcers were subsequently evaluated by comparing the two groups' ABPI values.

The concept behind an ABI assessment is to use the central aortic pressure, which is estimated through the brachial artery in the arms, to determine the extent to which blood flows to the lower extremities. The test is conducted with the patient in

a supine posture, and to ensure reliable readings, they are given ten minutes to relax. Systolic blood pressure is initially taken in both brachial arteries using a hand-held Doppler and a sphygmomanometer cuff of the appropriate size. The highest of the two readings is then employed. Likewise, the greater reading from each leg is obtained by measuring the systolic pressures at the posterior tibial artery and dorsalis pedis in both legs.[11]

The systolic pressure at the ankle (either the posterior tibial artery or the dorsalis pedis) is divided by the higher of the two brachial systolic pressures to determine the ABI.[12] The resulting ratio sheds light on arterial perfusion; no substantial arterial blockage is indicated by an ABI between 1.0 and 1.4, which is considered typical. ABI values below 0.9 indicate varied degrees of artery stenosis, whereas those between 0.91 and 0.99 are regarded as borderline. ABI values above 1.4 indicate non-compressible, calcified arteries, which are frequently observed in advanced age or chronic diabetes, whereas values below 0.4 indicate severe PAD.

A single radiologist conducted Doppler scans of the lower limbs to evaluate the vascular condition of the patient's extremities. After the data were gathered, it was imported into Microsoft Excel and subjected to statistical analysis using programs like SPSS (Statistical Package for the Social Sciences). The study population's demographic and clinical features, such as means, standard deviations, and proportions, were compiled using descriptive statistics. ABPI, FBS, PPBS, and HbA1c were among the continuous variables that were compared between the two groups using either the Mann-Whitney U test for non-parametric data or the independent t-test for normally distributed data. Fisher's exact test or the Chi-square test, if applicable, was used to evaluate categorical variables. Statistical significance was defined as a p-value of less than 0.05.

Results

The study included 90 individuals, consisting of 45 diabetic patients with foot ulcers and 45 diabetic patients without ulcers. The mean age in the ulcer group was 49.47 ± 8.77 years, whereas in the non-ulcer group, the mean age was 48.89 ± 8.86 years. The mean HbA1c level in the ulcer group was 8.569 ± 1.3292%, whereas in the non-ulcer group, it was 7.973 ± 1.0882%.

Table 1 delineates the baseline characteristics of the study participants. Ninety diabetic individuals were involved, comprising 45 in the ulcer group and 45 in the non-ulcer group. The predominant age category among participants in both groups was 51–60 years (46.7% in the ulcer group compared to 40% in the non-ulcer group), followed by the 41–50 years category (33.3% in both groups). Individuals aged 30–40 years represented 11.1% in the ulcer cohort and 13.3% in the non-ulcer cohort, whereas those over 60 years comprised 8.9% and 11.1%, respectively. The age distribution between the two groups was not statistically significant (p = 0.879), suggesting that both groups were equivalent in terms of age. Of the patients with diabetic foot ulcers, 32 (71.1%) were male, and 13 (28.9%) were female. In the group without ulcers, 28 (62.2%) were male, and 17 (37.8%) were female. The disparity in gender distribution among the groups was not statistically significant (p = 0.371). A markedly greater percentage of patients in the ulcer group had diabetes for ten or more years (62.2%) compared to the non-ulcer group (28.9%). In contrast, a length of less than 10 years was more prevalent in the group without ulcers (71.1%) compared to the ulcer group (37.8%). Longer duration of diabetes was highly linked with diabetic foot ulcer (p = 0.001).

Table 1: Baseline Characteristics of participants

SNo	Variables		Diabetes with ulcer (n = 45)	Diabetes without ulcer (n = 45)	p value
1	Age group	30 – 40 years	5 (11.1%)	6 (13.3%)	0.879
		41 – 50 years	15 (33.3%)	15 (33.3%)	
		51 – 60 years	21 (46.7%)	18 (40%)	
		> 60 years	4 (8.9%)	5 (11.1%)	
2	Gender	Male	32 (71.1%)	28 (62.2%)	0.371
		Female	13 (28.9%)	17 (37.8%)	
3	Duration of DM	≥ 10 years	28 (62.2%)	13 (28.9%)	0.001
		< 10 years	17 (37.8%)	32 (71.1%)	

Figure 1 shows the Wagner Grading among DFU patients. In Group DFU (n = 45), the predominant classification was Wagner Grade 2, comprising 30 patients (66.7%). Grade 4 ulcers were identified in 6 individuals (13.3%), while Grade 3 ulcers were noted in 4 patients (8.9%). Three

patients (6.7%) exhibited Grade 1 ulcers, while two patients (4.4%) presented with Grade 5 ulcers.

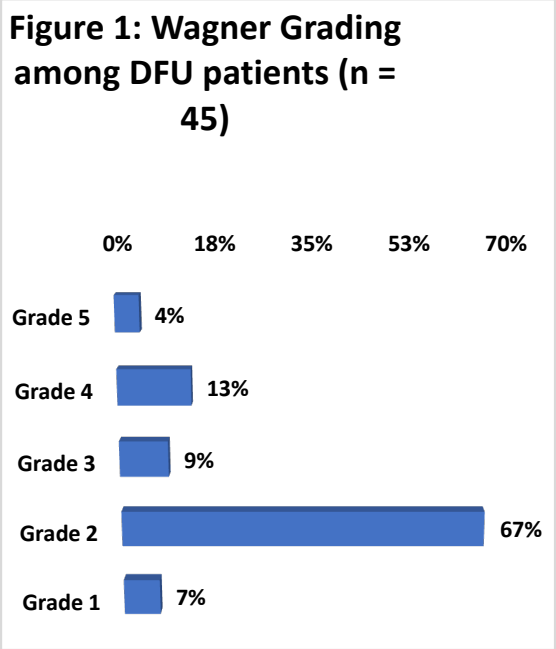

Figure 2 shows the comparison of mean values of Ankle- Brachial pressure Index among patients in both groups. The average Ankle–Brachial Pressure Index (ABPI) in individuals with diabetic foot ulcers was 1.018 ± 0.2949, while the average ABPI in diabetic patients without ulcers was 1.216 ± 0.1107.

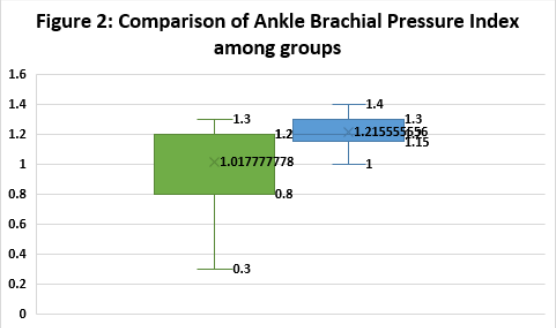

Table 1 shows the comparison of ABPI between the two groups. The independent samples t-test revealed a statistically significant difference in ABPI between patients with ulcers and those without ($t = -4.212$, $df = 56.159$, $p < 0.001$). The data demonstrate a significant relationship between reduced ABPI measurements and the risk of diabetic foot ulcers.

Table 2: Comparison of ABPI between both groups

S No	ABPI	Diabetes with ulcer (n = 45)	Diabetes without ulcer (n = 45)	p value
1	Mean	1.018	1.216	0.001
2	SD	0.294	0.110	

Among patients with DFU, 13 (28.9%) had ABPI values less than 0.9, and the rest (71.1%) had ABPI values of 0.9 or more. The patients without ulcers had ABPI values of 0.9 or more.

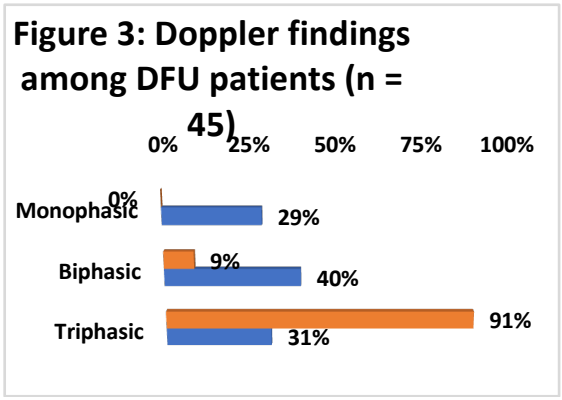

Figure 3 demonstrates the Doppler waveform patterns detected among individuals. In a cohort of diabetic patients presenting with foot ulcers (n = 45), the predominant waveform pattern identified was biphasic, occurring in 40.00% of the subjects. The triphasic waveform was observed in 31.11% of the patient population, whereas the monophasic waveform, indicative of a more severe degree of peripheral arterial compromise, was identified in 28.88% of patients. Conversely, in the cohort of diabetic patients without ulcers (n = 45), a predominant triphasic waveform was observed in 91.11% of cases, suggesting normal arterial flow. A biphasic waveform was identified in 8.88% of the patients, while no patients exhibited a monophasic waveform within this cohort.

The patients with ABPI less than 0.9 show monophasic waveforms in their Doppler findings.

Discussion

Diabetic foot ulcer (DFU) represents a significant consequence of diabetes mellitus, often linked with peripheral artery disease (PAD), neuropathy, and compromised wound healing. Decreased arterial perfusion significantly contributes to the onset and advancement of diabetic foot lesions. The Ankle–Brachial Pressure Index (ABPI) is a basic, non-invasive, and dependable screening instrument commonly employed to evaluate peripheral artery circulation in diabetic individuals. This study assessed the correlation between ABPI values, Doppler waveform patterns, and the incidence of diabetic foot ulcers in comparison to diabetic patients without ulcers. The mean Ankle-Brachial Pressure Index (ABPI) in individuals with diabetic foot ulcers was 1.018 ± 0.2949, but in diabetic patients without ulcers, it was higher at 1.216 ± 0.1107. An independent samples t-test indicated a significant difference between the two groups ($t = -4.212$, $p < 0.001$). The data demonstrate that a diminished ABPI is substantially correlated with the occurrence

of diabetic foot ulcers, implying that vascular insufficiency plays a role in ulcer development. Moreover, 28.9% of patients with diabetic foot ulcers had Ankle-Brachial Pressure Index (ABPI) values below 0.9, signifying peripheral artery dysfunction, while all patients without ulcers presented ABPI values beyond 0.9. This discovery underscores the clinical significance of vascular evaluation in diabetes patients, especially those exhibiting foot problems.

The findings of the current study align with those presented by Parekh et al[13]., who conducted research in Pune with 50 individuals suffering from diabetic foot ulcers. The study reported a mean ABPI of 0.86 ± 0.21, with values spanning from 0.4 to 1.4. A majority of the patients (76%) exhibited ABPI values below 0.9, signifying substantial peripheral artery dysfunction. While the percentage of patients with ABPI <0.9 was greater in their study than in ours, both investigations indicate that diminished ABPI is frequently linked to diabetic foot ulcers. The disparity in the occurrence of abnormal ABPI readings between studies may be ascribed to variations in sample size, disease severity, and demographic attributes of the study population. Yang et al[14]. from Taiwan also showed that a low ankle-brachial index (ABI) was independently linked to both cardiovascular events and diabetic foot ulcers in individuals with type II diabetes mellitus. This observation highlights the systemic characteristics of atherosclerosis in diabetic individuals and indicates that ABI may function as a significant predictor for both peripheral arterial disease and cardiovascular problems.

The results of this study align with the observations of Mathew S et al.[15] from Kerala, who assessed ABI in 236 diabetic patients and reported a mean ABI of 1.01 ± 0.15. In the study, 3.38% of patients had critical limb ischemia, and the Ankle-Brachial Index (ABI) was correlated with specific demographic and lifestyle variables. The mean ABI value documented in their study closely aligns with the mean ABI found in the ulcer group of the current investigation, hence reinforcing the significance of ABI in evaluating vascular status in diabetes patients. Aulia et al[16]. conducted a study in Indonesia with 41 patients suffering from diabetic foot ulcers, revealing ABI values between 0.85 and 1.33, with a mean of 1.14. Their research also investigated the correlation between ABI and Wagner categorization. Despite the lack of substantial statistical link, a higher percentage of patients with advanced Wagner grades (III–V) exhibited mildly diminished ABI values, indicating that deteriorating vascular health may exacerbate ulcer severity. The findings align with the current investigation, which revealed that a substantial percentage of patients with DFU exhibited reduced ABPI levels. A European study conducted by Aerden et al[17]. assessed 123 patients with diabetic foot ulcers and found a mean ABI of 0.92. Their investigation indicated that atherosclerotic lesions primarily affected below-the-knee arteries, especially the tibial vasculature. The relationship between ABI and angiographic peripheral artery disease was rather modest (r = −0.487), attributable to arterial calcification frequently observed in chronic diabetes. Arterial calcification can result in artificially inflated ABI values, therefore obscuring the severity of peripheral artery disease. This constraint is significant when analyzing ABI readings in diabetic individuals.

Raharinavalona et al[18]. from Madagascar assessed 109 individuals with type II diabetes mellitus, reporting a mean ABI of 1.06 ± 0.14, with 22.4% of patients exhibiting ABI ≤0.90 and 14.9% demonstrating ABI values exceeding 1.40. The findings reveal that both low and excessively high ABI values may signify vascular disease in persons with diabetes. A systematic study conducted by Abouhamda et al[19]. in Saudi Arabia underscored the clinical significance of ABI measurement. The research indicated that ABI values under 0.9 were an independent risk factor for lower limb amputation in diabetes patients. Abnormal ABI values were correlated with diabetic nephropathy, microalbuminuria, and renal failure, signifying extensive vascular involvement in diabetes.

The current study demonstrated notable disparities in Doppler waveform analysis between patients with foot ulcers and those without. In individuals with diabetic foot ulcers (DFU), the predominant waveform type was biphasic (40%), succeeded by triphasic (31.11%) and monophasic (28.88%) waveforms. Monophasic waves are typically indicative of significant arterial insufficiency. Conversely, among diabetic patients devoid of ulcers, 91.11% had typical triphasic flow, with no patients presenting monophasic waveforms. Moreover, patients with ABPI values below 0.9 displayed monophasic waveforms, signifying significant peripheral artery impairment. Parekh et al[13]. obtained analogous findings, noting an effective link between ABPI values and Doppler waveform patterns. In patients with an ABPI of less than 0.9, almost 30% had monophasic flow, whereas 16% demonstrated biphasic flow, signifying compromised arterial circulation. Nevertheless, almost 30% of patients exhibited triphasic waveforms despite a low Ankle-Brachial Pressure Index (ABPI), indicating that alterations in perfusion pressure may transpire prior to structural modifications in arterial waveform patterns. Additional investigations have emphasized the diagnostic significance of Doppler ultrasonography in identifying peripheral artery disease. Komut et al[20]. indicated that Doppler examination detected vascular anomalies in a greater number of patients than ABPI alone, hence illustrating its efficacy as a confirmatory diagnostic instrument. Asif et al[21]. from Kerala found that 56% of patients with diabetic

foot ulcers exhibited peripheral arterial disease, with Doppler investigations indicating predominant involvement of the tibial arteries and infrapopliteal segments. Ramaswami et al[22]. from Telangana corroborated these findings, reporting aberrant ABPI readings in 78% of patients, with severe artery blockage seen in 70% of instances using duplex ultrasonography. The findings of this study align with other research indicating that diminished ABPI and irregular Doppler waveform patterns are significantly correlated with diabetic foot ulcers and peripheral artery disease. The prevalence of biphasic and monophasic waveforms in DFU patients indicates varying degrees of arterial impairment, whereas the predominance of triphasic flow in patients without ulcers suggests a largely intact arterial circulation. A study conducted by Sartore et al.[23] in Italy revealed that cardiovascular risk was elevated in patients with pathological ABI values compared to those with normal ABI, suggesting that aberrant ABI signifies not just peripheral vascular disease but also systemic atherosclerosis. This underscores the significance of ABI as a crucial indicator for cardiovascular risk assessment in diabetic patients

This study emphasizes the clinical significance of combining ABPI measurements with Doppler ultrasonography to assess peripheral arterial disease in diabetic patients. The prompt identification of vascular insufficiency by these non-invasive methods can enable timely intervention, enhance ulcer healing, and diminish the likelihood of limb amputation.

Conclusion

The findings of this study emphasize the clinical significance of integrating ABPI measurement with Doppler waveform analysis for assessing peripheral artery disease in diabetic patients. Although ABPI functions as a proficient screening instrument, Doppler ultrasonography offers supplementary insights into the severity and characteristics of arterial flow irregularities. The prompt detection of vascular insufficiency by these non-invasive methods can enable timely intervention, mitigate the risk of ulcer advancement, and aid in the prevention of limb loss in diabetic patients.

Limitations

The nature of this study was cross-sectional, and it was conducted with a lower sample size. It was also single-centered, and it could only provide limited generalizability.

References

1. Kim MS, Hwang J, Yon DK, Lee SW, Jung SY, Park S, et al. Global burden of peripheral artery disease and its risk factors, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. The Lancet Global Health. 2023 Oct 1;11(10):e1553–65. doi:10.1016/S2214-109X(23)00355-8 PubMed PMID: 37734799.
2. Khanna NN, Krishna V, Manjunath CN, Tyagi S, Jindal R, Chadha M, et al. The Indian Consensus Statement for the Management of Lower Extremity Peripheral Artery Disease. JOURNAL OF INDIAN COLLEGE OF CARDIOLOGY. 2023 Aug;13(Special Suppl 1):S1. doi:10.4103/1561-8811.383634
3. Altoijry A, AlGhofili H, Alanazi SN, AlHindawi DA, AlAkeel NS, Julaidan BS, et al. Diabetic foot and peripheral arterial disease. Saudi Med J. 2021 Jan 1;42(1):49–55. doi:10.15537/smj.2021.1.25640 PubMed PMID: 33399171; PubMed Central PMCID: PMC7989311.
4. Horváth L, Németh N, Fehér G, Kívés Z, Endrei D, Boncz I. Epidemiology of Peripheral Artery Disease: Narrative Review. Life (Basel). 2022 Jul 12;12(7):1041. doi:10.3390/life12071041 PubMed PMID: 35888129; PubMed Central PMCID: PMC9320565.
5. Hardman RL, Jazaeri O, Yi J, Smith M, Gupta R. Overview of Classification Systems in Peripheral Artery Disease. Semin Intervent Radiol. 2014 Dec;31(4):378–88. doi:10.1055/s-0034-1393976 PubMed PMID: 25435665; PubMed Central PMCID: PMC4232437.
6. Guirguis-Blake JM, Evans CV, Redmond N, Lin JS. Screening for Peripheral Artery Disease Using the Ankle-Brachial Index: An Updated Systematic Review for the U.S. Preventive Services Task Force [Internet]. Rockville (MD): Agency for Healthcare Research and Quality (US); 2018 [cited 2025 Sep 12]. (U.S. Preventive Services Task Force Evidence Syntheses, formerly Systematic Evidence Reviews). Available from: http://www.ncbi.nlm.nih.gov/books/NBK526319/ PubMed PMID: 30260610.
7. Lin JS, Olson CM, Johnson ES, Senger CA, Soh CB, Whitlock EP. The Ankle Brachial Index for Peripheral Artery Disease Screening and Cardiovascular Disease Prediction in Asymptomatic Adults: A Systematic Evidence Review for the U.S. Preventive Services Task Force [Internet]. Rockville (MD): Agency for Healthcare Research and Quality (US); 2013 [cited 2025 Sep 12]. (U.S. Preventive Services Task Force Evidence Syntheses, formerly Systematic Evidence Reviews). Available from: http://www.ncbi.nlm.nih.gov/books/NBK164524/ PubMed PMID: 24156115.
8. Mills JL, Conte MS, Armstrong DG, Pomposelli FB, Schanzer A, Sidawy AN, et al. The Society for Vascular Surgery Lower Extremity Threatened Limb Classification

System: risk stratification based on wound, ischemia, and foot infection (WIfI). J Vasc Surg. 2014 Jan;59(1):220-234.e1-2. doi:10.1016/j.jvs.2013.08.003 PubMed PMID: 24126108.

9. Casey SL, Lanting SM, Chuter VH. The ankle brachial index in people with and without diabetes: intra-tester reliability. Journal of Foot and Ankle Research. 2020 May 12;13(1):21. doi:10.1186/s13047-020-00389-w
10. Aerden D, Massaad D, von Kemp K, van Tussenbroek F, Debing E, Keymeulen B, et al. The Ankle–Brachial Index and the Diabetic Foot: A Troublesome Marriage. Annals of Vascular Surgery. 2011 Aug 1;25(6):770–7. doi:10.1016/j.avsg.2010.12.025
11. Abouhamda A, Alturkstani M, Jan Y. Lower sensitivity of ankle-brachial index measurements among people suffering with diabetes-associated vascular disorders: A systematic review. SAGE Open Med. 2019 Mar 1;7:2050312119835038. doi:10.1177/2050312119835038 PubMed PMID: 30854203; PubMed Central PMCID: PMC6399753.
12. Ankle Brachial Index Collaboration, Fowkes FGR, Murray GD, Butcher I, Heald CL, Lee RJ, et al. Ankle brachial index combined with Framingham Risk Score to predict cardiovascular events and mortality: a meta-analysis. JAMA. 2008 Jul 9;300(2):197–208. doi:10.1001/jama.300.2.197 PubMed PMID: 18612117; PubMed Central PMCID: PMC2932628.
13. Parekh RA, Athavale V, Kelshikar S. The Value of Pressure Indexes in Predicting the Outcome of Diabetic Foot Ulcers as a Guide to Further Management. Cureus. 16(9):e69164. doi:10.7759/cureus.69164 PubMed PMID: 39398698; PubMed Central PMCID: PMC11469665.
14. Yang MC, Huang YY, Hsieh SH, Sun JH, Wang CC, Lin CH. Ankle-Brachial Index Is Independently Associated With Cardiovascular Outcomes and Foot Ulcers in Asian Patients With Type 2 Diabetes Mellitus. Front Endocrinol (Lausanne). 2021 Nov 18;12:752995. doi:10.3389/fendo.2021.752995 PubMed PMID: 34867797; PubMed Central PMCID: PMC8637053.
15. Mathew S, Elavally S, Madhavan I, Prabhakaran GV, Mathew S. Ankle brachial index and foot ulcer risk stratification among outpatients with type 2 diabetes mellitus at a public referral hospital in South India: a preventive perspective. International Surgery Journal. 2026;13(1):59–66. doi:10.18203/2349-2902.isj20254330
16. Aulia P, Rasjad C, Latief J, Seweng A, Prihantono P. Correlation of Ankle Brachial Index (ABI) with Degrees of Diabetic Ulcer. International Journal of Medical Reviews and Case Reports. 2020 Apr 25;3(7):386–386. doi:10.5455/IJMRCR.Correlation-Ankle-Brachial-Index
17. Aerden D, Massaad D, von Kemp K, van Tussenbroek F, Debing E, Keymeulen B, et al. The Ankle–Brachial Index and the Diabetic Foot: A Troublesome Marriage. Annals of Vascular Surgery. 2011 Aug 1;25(6):770–7. doi:10.1016/j.avsg.2010.12.025
18. Raharinavalona SA, Raherison RE, Razanamparany T, Rasoaniana D, Andrianasolo RL, Rakotomalala ADP. Contribution of ankle-brachial index measurement in screening for arteriopathy obliterans of the lower limbs in type 2 diabetics. Journal of Endocrinology, Metabolism and Diabetes of South Africa. 2022 Sep 2;27(3):117–23. doi:10.1080/16089677.2022.2074123
19. Abouhamda A, Alturkstani M, Jan Y. Lower sensitivity of ankle-brachial index measurements among people suffering with diabetes-associated vascular disorders: A systematic review. SAGE Open Med. 2019;7:2050312119835038. doi:10.1177/2050312119835038 PubMed PMID: 30854203; PubMed Central PMCID: PMC6399753.
20. Komut O, Nobin H, Singha B, Mibang N, Tamut O, Nyitan T. Effectiveness of Pulse Oximetry and Ankle Brachial Index in Detecting Peripheral Arterial Disease in Diabetic Foot Ulcer Patients. European Journal of Cardiovascular Medicine. 2025 Aug 14;15(8):368–74. doi:10.61336/ejcm/25-08-71
21. Asif M, Basheer B. Incidence of peripheral arterial disease in diabetic foot. International Journal of Research in Medical Sciences. 2026;14(1):57–61. doi:10.18203/2320-6012.ijrms20254088
22. B R, Prakash B, Hota PK, Kumar VP. Comparison of Duplex Ultrasound and Ankle-Brachial Pressure Index in Detecting Peripheral Vascular Disease in Diabetic Foot Ulcers: A Prospective Study. European Journal of Cardiovascular Medicine. 2025 Jul 19;15:418–21. doi:10.61336/ejcm/25-07-75
23. Sartore G, Caprino R, Ragazzi E, Bianchi L, Lapolla A, Piarulli F. The ankle-brachial index for assessing the prevalence of peripheral artery disease and cardiovascular risk in patients with type 2 diabetes mellitus. Nutrition, Metabolism and Cardiovascular Diseases. 2023 Mar 1;33(3):560–7. doi:10.1016/j.numecd.2022.11.019 PubMed PMID: 36646602.