

AN ANALYSIS OF THE RELATIONSHIP BETWEEN FOOT CARE BEHAVIOUR AND THE ANKLE BRACHIAL INDEX IN PATIENTS WITH DIABETES MELLITUS: A CROSS-SECTIONAL STUDY AT THE DLANGGU COMMUNITY HEALTH CENTRE

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ABSTRACT

Introduction: Diabetes mellitus is a chronic metabolic disease that can lead to vascular complications, including peripheral artery disease (PAD) and diabetic foot ulcers. One preventive measure is self-management of foot care, the effectiveness of which needs to be objectively assessed using the Ankle-Brachial Index (ABI) test a simple, non-invasive method for the early detection of the risk of vascular complications. This study aims to determine the relationship between foot care behaviour and ABI values in patients with diabetes mellitus at the Dlanggu Community Health Centre (UPTD Puskesmas Dlanggu). **Method:** The study design was a quantitative analytical cross-sectional study. A sample of 30 respondents was selected using total sampling. The instruments used were the Nottingham Assessment of Functional Foot Care (NAFF) questionnaire and a digital sphygmomanometer, with data analysed using Fisher's Exact Test. **Results:** The findings showed that amongst respondents with poor foot care behaviour, 16 respondents (69.6 %) had normal ABI values and 7 respondents (30.4 %) had high ABI values. Meanwhile, amongst respondents with good foot care behaviour, 6 respondents (85.7%) had normal ABI values and 1 respondent (14.3%) had a low ABI value. Fisher's Exact Test yielded a p-value of 0.096 ($p > 0.05$), which means there is no significant association between foot care behaviour and ABI values. **Discussion:** ABI values are thought to be more strongly influenced by other factors, such as age, duration of diabetes, and smoking habits, than by daily preventive foot care. Nevertheless, foot care remains important for preventing complications such as diabetic ulcers; it should therefore be integrated into diabetes education programmes in primary healthcare, alongside regular ABI checks for the early detection of PAD risk.

Keywords: *Ankle Brachial Index (ABI), Diabetes Mellitus, Foot Care Behavior*

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterised by hyperglycaemia resulting from impaired insulin secretion or function, with a prevalence that is steadily increasing worldwide Widiastuti et al., (2024). International Diabetes Federation (IDF) Atlas (2021) records 6.7 million deaths due to diabetes among people aged 20–79 globally, equivalent to one death every five seconds, with Indonesia ranking fifth in the world with 19.47 million people living with diabetes. National data also show an upward trend, with prevalence rising from 10% in 2018 to 11.7 % in 2023 (Kementerian Kesehatan RI, 2023, in Tiyyara, Witriyani, & Mulyono, 2025). At provincial level, 882,315 residents of East Java aged 15 and over have diabetes (Dinas Kesehatan Provinsi Jawa Timur, 2025). Meanwhile, Mojokerto Regency has recorded 8,654 cases, with the Dlanggu Community Health Centre (UPTD Puskesmas Dlanggu) ranking among the top five with 1,637 cases (Dinas Kesehatan Kabupaten Mojokerto, 2024).

If not managed effectively, chronic hyperglycaemia can lead to vascular complications such as peripheral artery disease (PAD) and diabetic foot ulcers Widiastuti et al., (2024), with the risk of non-traumatic amputation reaching 70% in type 2 diabetes and a

recurrence rate of 17–60% within three years, primarily triggered by a low ABI due to impaired peripheral circulation (Widyanata et al., 2023). The burden of these complications is also reflected in the one-year post-amputation mortality rate of 14.8% (Yalini et al., 2024). The effectiveness of foot care practices in preventing these complications needs to be assessed objectively through a non-invasive test known as the Ankle-Brachial Index (ABI), which enables healthcare professionals to quickly assess the vascular status of the lower limbs so that risks can be anticipated at an early stage (Widiastuti, Liza, Yusraini, & Soni, 2022).

The literature consistently shows that foot care practices are a key pillar of the prevention of diabetic foot ulcers (Ariyani, Arwani, & Budi, (2023) and Firda, 2023). (Ayu, Supono, & Ira, 2022) emphasises that failure to prevent the condition at an early stage has adverse effects not only physically, but also on the social, economic and psychological well-being of patients following amputation. However, the majority of these studies have focused on patients who have already experienced severe complications in hospital; consequently, the correlation between self-care behaviour and objective vascular status in primary care patients who do not yet have ulcers (the pre-ulcer phase) remains a gap in the evidence.

The novelty of this study lies in the integration of foot care behaviour assessment using the NAFF questionnaire with concurrent ABI measurement in primary care settings, in order to identify vascular risk before physical ulcers develop a preventative approach that has not yet been widely explored in the pre-ulcer population (Ayu, et al (2022)). Based on the above, this study aims to analyse the relationship between foot care behaviour and the Ankle-Brachial Index (ABI) in patients with diabetes mellitus who have not yet developed foot ulcers at the Dlanggu Community Health Centre (UPTD Puskesmas Dlanggu), as part of early detection and preventive measures at the primary care level.

METHOD

This study employed an analytical quantitative design using a cross-sectional approach, in which the independent variable (foot care behaviour) and the dependent variable (Ankle-Brachial Index/ABI value) were measured simultaneously at a single point in time to determine the relationship between the variables (Abduh, Tri, Gio, Rusdy, & Win, 2023). The study population comprised all patients with diabetes mellitus who were actively enrolled in the Prolanis programme within the catchment area of the Dlanggu Community Health Centre (UPTD Puskesmas Dlanggu) and who had not developed diabetic foot ulcers at the time of data collection, totalling 30 individuals according to the summary data for April 2026. Foot care behaviour in this study was measured using the 29-item Nottingham Assessment of Functional Footcare (NAFF) questionnaire. This standardised instrument is recognised nationally and internationally with a reliability coefficient of 0.83; therefore, no further validity and reliability testing was conducted. The total score (range 0–87) was categorised as poor (0–43) and good (44–87). The ABI was measured using a digital sphygmomanometer by comparing the systolic blood pressure of the brachial artery to that of the dorsalis pedis/posterior tibial artery, and was classified as low risk (<0.9), normal (0.9–1.4) and high risk (>1.4) (McClary & Massey, 2023, in Rasyadi, 2024).

This study received ethical approval from the Ethics Committee of Bina Sehat PPNI University, Mojokerto, under No. 237/KEP/UBS-PPNI/VII/2026, as well as research authorisation from Bina Sehat PPNI University, Mojokerto, and the Mojokerto Regency.

Health Office. Each respondent signed an informed consent form prior to data collection. Data collection was carried out through blood glucose testing, observation of foot condition to ensure there were no active ulcers, measurement of the ABI using a digital sphygmomanometer, and structured interviews using the NAFF questionnaire. The data were analysed using the Chi-Square test to examine the relationship between foot care behaviour and ABI values. Where the Chi-Square assumptions were not met (>20% of cells with an expected count <5, violating Cochran's rule), the analysis continued using Fisher's Exact Test as an alternative test for contingency tables with small cell frequencies. The results were analysed at a 95% confidence level ($\alpha = 0.05$) and presented in the form of frequency distributions and percentages.

FINDING AND DISCUSSION

RESEARCH RESULT

Based on the research carried out, the characteristics of the respondents are as follows:

Table 1. Characteristics of Respondents (n = 30)

No	Data	Frequency (f)	Percentage (%)
1.	Age		
	40-59 year	17	56,7
	60-74 year	13	43,3
	75-90 year	0	0
	> 90 year	0	0
	Total	30	100,0
2.	Gender		
	Men	2	6,7
	Women	28	93,3
	Total	30	100,0
3.	Highest level of education		
	Not in education	1	3,3
	Primary school	7	23,3
	Lower secondary school	12	40,0
	Upper secondary school	9	30,0
	Higher education	1	3,3
	Total	30	100,0
4.	Employment Status		
	Not in employment	24	80,0
	Self-employed	2	6,7
	Civil servant	1	3,3
	Other	3	10,0
	Total	30	100,0

5.	Comorbidities		
	High blood pressure	15	50,0
	Stroke	0	0
	Other conditions	1	3,3
	No history of other conditions	14	46,7
	Total	30	100,0
6.	Smoking Habits		
	Yes	1	3,3
	No	29	96,7
	Total	30	100,0
7.	Duration of Diabetes Mellitus		
	3–12 months	3	10,0
	≤ 5 years	15	50,0
	> 5 years	12	40,0
	Total	30	100,0
8.	Blood Sugar Levels		
	Uncontrolled	23	76,7
	Controlled	7	23,3
	Total	30	100,0

Source : Primary Data, 2026

According to Table 1, the majority of respondents were aged 40–59 years, totalling 17 people (56.7 %), whilst the remainder were aged 60–74 years, totalling 13 people (43.3 %). By gender, the majority of respondents were female (28 people, 93.3 %), whilst a small proportion were male (2 people, 6.7 %). In terms of educational attainment, the largest group had completed lower secondary education (SMP), comprising 12 respondents (40.0%), followed by upper secondary education (SMA) with 9 respondents (30.0%), primary education (SD) with 7 respondents (23.3%), and one respondent each (3.3%) who had not attended school and those with a university education. In terms of employment status, the majority of respondents were unemployed (24 people, 80.0%), followed by ‘other’ (3 people, 10.0%), self-employed (2 people, 6.7%), and civil servants (1 person, 3.3%). Based on comorbidities, the majority of respondents had hypertension (15 people, 50.0 %); 14 people (46.7 %) had no history of other illnesses; and 1 person (3.3 %) had other comorbidities. In terms of smoking habits, almost all respondents were non-smokers (29 people, 96.7 %), whilst 1 person (3.3 %) was a smoker. Based on the duration of diabetes, the majority of respondents had had diabetes for ≤5 years (15 people, 50.0%), followed by >5 years (12 people, 40.0%) and 3–12 months (3 people, 10.0%). Based on blood glucose levels, the majority of respondents had uncontrolled blood glucose levels (23 people, 76.7 %), whilst 7 people (23.3 %) had controlled levels.

Table 2. Distribution of Foot Care Behaviour and ABI Values (n = 30)

Variable	Category	Frequency (f)	Percentage (%)
Foot Care Practices	Not	23	76,7
	Very Good	7	23,3
	Total	30	100,0
Ankle Brachial Index (ABI)	Low	1	3,3
	Normal	22	73,3
	High	7	23,3
	Total	30	100,0

Source : Primary Data, 2026

According to Table 2, the majority of respondents exhibited ‘poor’ foot care behaviour (23 people, 76.7 %), whilst 7 people (23.3 %) exhibited ‘good’ foot care behaviour. Meanwhile, the ABI values of the majority of respondents fell into the ‘normal’ category (22 people, 73.3 %), the ‘high’ category (7 people, 23.3 %) and the ‘low’ category (1 person, 3.3 %).

Table 3. Cross-tabulation of foot care behaviour by ABI value

Foot Care Practices	Nilai Ankle Brachial Index (ABI)						Total		P-value
	Low		Normal		High				
	F	%	F	%	F	%	F	%	
Not	0	0,0	16	69,6	7	30,4	23	100,0	0,096
Very Good	1	14,3	6	85,7	0	0,0	7	100,0	
Total	1	3,3	22	73,3	7	23,3	30	100,0	

Source : Primary Data, 2026

According to Table 3, of the 23 respondents with ‘poor’ foot care behaviour, 16 (69.6%) had a normal ABI reading, 7 (30.4%) had a high ABI reading, and none had a low ABI reading. Of the 7 respondents with ‘good’ foot care behaviour, 6 (85.7%) had a normal ABI value and 1 (14.3%) had a low ABI value, whilst none had a high ABI value. Given that 3 cells (50.0%) in the contingency table had an expected count below 5, meaning the assumptions for the Pearson Chi-Square test were not met, the analysis was continued using Fisher’s Exact Test, yielding a p-value of 0.096.

DISCUSSION

The results of the study showed that the majority of respondents exhibited poor foot care behaviour (76.7%), whilst the majority of ABI values fell within the normal range (73.3%). The results of Fisher’s Exact Test indicated that there was no statistically significant association between foot care behaviour and ABI values ($p = 0.096$). These findings provide an important insight: although foot care behaviour was classified as poor among the majority of respondents, the vascular condition measured via the ABI did not show a direct correlation. This can be understood from a physiological perspective. The ABI reflects the structural condition of macrovascular blood vessels, such as atherosclerosis or arterial stiffness, which develop progressively and cumulatively as a result of long-term exposure to chronic

hyperglycaemia, rather than as a result of short-term daily behaviours such as foot examination or hygiene. In other words, foot care behaviour plays a greater role in preventing the risk of physical injury and infection (the pathway leading to ulcers), whilst the ABI describes a different pathophysiological pathway: macrovascular circulatory impairment that is more influenced by chronic factors such as the duration of diabetes, hypertension and smoking habits.

These findings are consistent with research Aini, Tauriana, & Setiyo, (2026) which also found no significant association between foot care behaviour and ABI values Trisnadewi, Ni Putu, & I Made, (2021) reported that some patients with fairly good foot care behaviour still had low ABI values due to other vascular risk factors such as advanced age and hypertension, reinforcing the argument that the ABI is influenced by determinants other than daily foot care behaviour Rahmawati & Diah (2023) also emphasised that ABI is more sensitive in detecting peripheral arterial disease associated with chronic hyperglycaemia than in reflecting the quality of self-care of the feet.

Nevertheless, the age characteristics that predominate in part of the study population (the majority aged 40–59 and 60–74 years) need to be considered as potential confounding variables that have not been controlled for in this bivariate analysis. Theoretically, advanced age is associated with a decline in functional capacity for self-care of the feet (Dewi, 2014; Sari et al., 2021 in Manungkalit, Ni Putu, & Agustina, 2024) as well as the physiological process of atherosclerosis, which independently affects the ABI value (Thendria, Ivan, & Diana, 2014). This possibility is consistent with the lack of a significant association found; foot care behaviour and ABI values may both be influenced by age, but do not directly influence one another.

This study has several limitations. Firstly, blood glucose measurements were not standardised across respondents (some used fasting blood glucose, others random blood glucose), which may have affected the consistency of the data, even though the coding was adjusted to the thresholds of each method. Secondly, foot care behaviour was measured using the self-report NAFF questionnaire, which may introduce bias as respondents' answers were based on personal perceptions that do not necessarily reflect actual behaviour. Thirdly, the non-significance of the results of the Fisher's Exact Test may also have been influenced by the small sample size in the 'good' foot care behaviour group ($n = 7$), which reduced the statistical power to detect a relationship that may actually exist. Fourthly, this study employed a bivariate analysis design without controlling for potential confounding variables such as age and duration of diabetes, meaning that the possible indirect influence of these factors on the relationship between the two main variables cannot yet be confirmed.

In practical terms, these findings confirm that foot care and ABI screening should continue to be carried out as two complementary strategies—rather than as substitutes for one another—in detecting the risk of vascular complications in patients with diabetes mellitus in primary care. The integration of foot care behaviour education with periodic ABI screening remains relevant as a comprehensive approach to the early detection of Peripheral Artery Disease (PAD), given that the two tools capture different dimensions of risk. For future research, it is recommended to use a design with a larger sample size and multivariate analysis to control for confounding variables such as age and duration of diabetes, as well as a longitudinal design to capture the cumulative impact of foot care behaviour on changes in

ABI values over time, given that vascular changes are progressive and may not yet be detectable in a cross-sectional design such as this study.

CONCLUSION

A study of 30 respondents with diabetes mellitus at the Dlanggu Community Health Centre (UPTD Puskesmas Dlanggu) showed that the majority of respondents had foot care behaviour classified as 'poor' (76.7 %) and an Ankle-Brachial Index (ABI) value in the 'normal' category (73.3 %). The results of Fisher's Exact Test showed no statistically significant association between foot care behaviour and ABI values ($p = 0.096$; $p > 0.05$). These findings suggest that ABI values are likely to be influenced more by other chronic factors beyond daily foot care behaviour, given that structural changes in blood vessels are progressive and develop over the long term. Although no significant association was found, foot care is still recommended as part of self-management of diabetes to prevent the risk of foot injuries and infections, whilst periodic ABI checks remain necessary as an independent screening tool for peripheral circulatory disorders. Healthcare professionals in primary care are advised to integrate foot care education with routine ABI screening as a comprehensive prevention strategy for patients with diabetes mellitus.

Further research is recommended to explore the relationship between foot care behaviour and foot assessment tools that are conceptually more relevant, such as indicators of diabetic ulcer risk or peripheral neuropathy sensation scores, rather than systemic vascular indicators such as the ABI. In addition, future researchers may wish to consider including other variables that influence the ankle-brachial index (ABI), such as HbA1c levels, body mass index, duration of hypertension, and patients' knowledge of foot care.

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