



GRADE ANKLE BRACHIAL INDEX (ABI) AS A PREDICTOR OF PERIPHERAL ARTERY DISEASE (PAD) IN DIABETES MELLITUS PATIENTS

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ABSTRACT	Keywords
Peripheral Artery Disease (PAD) often occurs in diabetes mellitus patients. PAD can be detected early by measuring the Ankle Brachial Index (ABI). ABI measurement should be important for all Diabetes Mellitus (DM) clients and all clients at risk of DM, but is often ignored, causing PAD. The purpose of this study was to determine the Ankle Brachial Index (ABI) as a predictor of Peripheral Artery Disease (PAD) in patients with diabetes mellitus. The design of this study was descriptive with an observational study approach. The population in this study was all 113 diabetes mellitus clients in July 2024. The sampling technique used was purposive sampling, so that 100 people were obtained who met the inclusion and exclusion criteria. The research instrument used a digital tensiometer and an observation sheet. Data analysis used a frequency distribution. The results showed that the normal ankle brachial index value was 40 people (40%), respondents who experienced moderate PAD were 28 people (28%), mild PAD 16 people (16%), ABI tolerated 15 people (15%), and hardening of the arteries 1 person (1%). Data analysis suggested that almost half of the respondents had ankle brachial index PAD values consisting of moderate PAD and mild PAD. Moderate PAD occurs in obese diabetes mellitus patients and those who have suffered from diabetes mellitus for ≥ 5 years, and mild PAD occurs in those who have suffered from diabetes mellitus for ≥ 5 years and have a history of hypertension.	ABI, PAD, Diabetes Mellitus

INTRODUCTION

Peripheral Artery Disease (PAD) is a disease that causes reduced blood flow through the peripheral arteries. PAD disease can reduce blood flow to the extremities, which manifests as thigh or calf pain during

activity. PAD is one of the many complications of Diabetes Mellitus (DM). Patients with high-risk PAD have high rates of morbidity and mortality, which are associated with major economic declines and reduced quality of life (Tjandra et al.,

2023). PAD, which often occurs in DM clients, can be detected early by using Ankle Brachial Index (ABI) measurements (Hariyono, 2020). ABI measurement should be important for all DM clients and for all clients at risk of DM, but is often ignored, resulting in PAD (Nasution et al., 2019). The phenomenon that occurs in Jatidukuh Village is that early detection of PAD has never been carried out by measuring ABI in diabetes mellitus patients.

WHO data for 2022 states that the prevalence of diabetes in the world is 10.5% (536.6 million) (WHO, 2022). The Indonesian Ministry of Health stated that in 2022, the prevalence of diabetes mellitus patients will be 19.47 million (Indonesian Ministry of Health, 2021). Data from the East Java Health Office in 2020 shows that the number of diabetes mellitus patients in East Java was 875,745 people, while in Mojokerto City itself, it was 4,936 people (East Java Provincial Health Service, 2021).

The results of research (Ismail et al., 2021) in Yogyakarta showed that the prevalence of PAD in type 2 diabetes mellitus patients was 16%. Subsequent research by Tjandra et al (2023) in Manado showed that the prevalence of PAD in diabetes mellitus patients was 55.8%. Another study was also conducted by (Puspitasari et al., 2023) in Surakarta, which showed that the prevalence of PAD in diabetes mellitus patients was 32.3%.

The results of a preliminary study in Jatidukuh Village on March 27 2024, on 10 diabetes mellitus clients showed an ABI value of >1.40 (hardening of the arteries) for 1 person (10%), ABI 1.01-1.40 (normal) for 5 people (50%), ABI 0.91-1.00 (tolerable) in 2 people (20%), ABI 0.81-0.90 (mild PAD) in 2 people (20%). ABI examinations have never been carried out before on diabetes mellitus clients in Jatidukuh Village.

Factors that influence the ABI value are gender, age, smoking, hypertension,

diabetes mellitus, and dyslipidemia (Supriyadi et al., 2019). The ABI method can be used for diabetic clients who are suspected of having PAD with the characteristics of complaining of pain in the leg area during activities, and the wound healing process showing no progress, a history of smoking (Bubun et al., 2020). Undetected peripheral artery disease (PAD) can cause claudication, which is a series of symptoms in the form of fatigue, heaviness, cramps in the leg muscles (buttocks, thighs or calves) that occur during activities such as walking or climbing stairs, pain in the legs and/or that interfere with sleeping, wounds on the toes or feet that heal slowly, get worse, or don't heal at all (Sirait & Mustofa, 2021).

The nurse's efforts that are very important in providing nursing care with diabetes mellitus include in terms of promotive, curative, and rehabilitative services by providing counseling to DM clients about meal planning, physical exercise, and consumption of hypoglycemic drugs (Nurarif & Kusuma, 2016). One of the short-term management of diabetes is to prevent complications by doing sports, one of which is foot gymnastics (Hoda et al., 2019). ABI examination must be performed on every DM client to prevent PAD (Nasution et al., 2019). Based on this background, researchers are interested in examining the description of the Ankle Brachial Index (ABI) as a predictor of Peripheral Artery Disease (PAD) in diabetes mellitus patients.

METHOD

This research uses a descriptive research design. The population in this study was all diabetes mellitus clients in Jatidukuh Village, Gondang District, Mojokerto Regency in July 2024, totaling 113 people. This research uses purposive sampling, a sampling technique that is by the

researcher's considerations 100 respondents (Hidayat, 2021). The sample used in this research is some of the diabetes mellitus clients in Jatidukuh Village, Gondang District, Mojokerto Regency, in August 2024, who met the inclusion and exclusion criteria were 100 people.

RESULTS

Table 1. Respondents Characteristic's

<i>Peripheral Artery Disease</i>	Frekuensi	Persentase (%)
PAD heavy	0	0
PAD currently	28	28,0
PAD slight	16	16,0
Ditoleransi	15	15,0
Normal	40	40,0
Hardening of the Blood Vessels	1	1,0
Total	100	100

Based on **Table 1.** showed that the majority of respondents were aged ≥ 40 years, namely 72 people (72%). Based on gender, it shows that almost all of them are women, namely 84 people (84%). Most respondents had a BMI > 27.0 , namely 51 people (51%). Most respondents had suffered from diabetes mellitus for > 5 years, namely 53 people (53%). showed that the majority of respondents did not have a history of hypertension, namely 54 people (54%).

Table 2. Frequency Distribution of Respondents Based on Peripheral Artery Disease in Jatidukuh Village, Gondang District, Mojokerto Regency, 2024

Characteristics	n	%
Age		
<40 years	28	28,0
≥ 40 years	72	72,0
Gender		
Man	16	16,0
Woman	84	84,0
IMT		
IMT <18,5	2	2,0
IMT 18,5-24,9	32	32,0
IMT 25,0-27,0	15	15,0
IMT $> 27,0$	51	51,0
History DM		
<5 years	47	47,0
≥ 5 years	53	53,0
History Hypertension		
Yes	46	46,0
No	54	54,0
Total	100	100,0

Based on **Table 2** Showed that almost half of the respondents had normal ankle brachial index values so they did not experience PAD, namely 40 people (40%), 28 people (28%) experienced moderate PAD, 16 people (16%) had mild PAD, 15 people had tolerable ABI (15%), and hardening of the arteries in 1 person (1%).

DISCUSSION

The research show that almost half of the respondents had normal ankle brachial index values so they did not experience PAD, namely 40 people (40%).

ABI is a non-invasive examination that is carried out easily using a hand Doppler and a blood pressure monitor with a normal value of 0.9-1. Factors that influence the ABI results are intrinsic factors, namely edema, diabetes mellitus which can cause potential calcification of the tunica media so that the ABI value is high, rheumatoid arthritis, and extrinsic factors, namely the

self-confidence and ability of nurses in carrying out procedures, patients cannot relax, brachial systole will be high because of the results of vascular activity, the patient's position can affect the ABI results, accuracy of cuff insertion, rapid deflation of the cuff, excessive pressure on the probe placed on the artery, causing blockage, errors in calculating results, and poor maintenance/damage to the device (Maryunani, 2018).

Researchers assume that the average ABI value of respondents is within the normal range, this is because the difference in ankle and brachial systolic pressure is not too large. The normal ABI value was also caused by the research respondents suffering from diabetes mellitus for less than 6 years, so the effect of high blood sugar levels on the arteries in the ankle area did not appear significant. Respondents with abnormal ABI can be caused by various factors such as age, obesity and smoking habits.

The research show that 28 people (28%) experienced moderate PAD. Patients with moderate PAD consisted of 26.7% of obese respondents and 29.4% of obese respondents, 50.9% of respondents with diabetes mellitus for > 5 years, and 37% of respondents with a history of hypertension. A person who is obese and insulin resistant will experience hyperplasia in perivascular adipose tissue (PVAT) and infiltration of proinflammatory immune cells which contribute to vascular inflammation and impaired endothelial function. Endothelial dysfunction accompanied by adipocyte activity in someone who is obese will encourage chronic sub-inflammatory conditions which will have an impact on the development of cardiovascular disease, including the process of atherosclerosis. Atherosclerosis that occurs in diabetes mellitus sufferers will result in poor blood circulation in the peripheral area, resulting in a decrease in ABI values (Priyantini et al.,

2022). DM patients will experience ABI abnormalities after the course of the disease is >5 years. This pathomechanism occurs due to long-term conditions of glucotoxicosis, causing endothelial dysfunction which triggers the formation of atherosclerosis. This can be exacerbated by other risk factors such as an increase in the lipid profile which causes ankle blood pressure abnormalities and has an impact on ABI (Kartikadewi et al., 2022).

Researchers assume that the higher the BMI of diabetes mellitus sufferers, the greater the chance of experiencing a decrease in ABI values. This can be caused by overweight and obese patients experiencing decreased blood flow to the legs due to fat accumulation in the blood vessels so that the systolic pressure value at the ankle is lower than at the brachial. In addition, the longer you suffer from diabetes mellitus, the higher the chance of experiencing ABI abnormalities. Conditions of high blood sugar levels cause sorbitol deposits in the endothelium and damage the lumen of blood vessels, thereby affecting peripheral vascularization, causing atherosclerosis. Thick blood due to high blood sugar levels carries free radicals in the blood vessels which then accumulate and form plaque. This will cause obstruction of blood flow to the legs so that the ABI decreases. This can cause peripheral artery disease which results in neuropathy and diabetic ulcers.

The research show that 16 respondents (16%) experienced mild PAD. Patients with mild PAD were 30.2% of respondents with a history of diabetes mellitus > 5 years, and 17.8% of respondents with a history of hypertension. The longer a person suffers from Diabetes Mellitus, the greater the risk of developing peripheral arterial disease. This happens because high blood glucose levels can weaken and damage the walls of capillary blood vessels

(Purwandari et al., 2022). Hypertension can cause thickening of the arteries, causing the diameter of the blood vessels to narrow. Narrowing of blood vessels will affect metabolic transport in the blood, so that glucose levels in the blood will be disturbed. The risk of PAD will increase in hypertensive DM sufferers with blood pressure $\geq 130/80$ mmHg (Widiastuti et al., 2022).

Researchers assume that long-term diabetes and a history of hypertension cause mild PAD in diabetes mellitus sufferers. This is because the long time you have had diabetes for more than 5 years, the longer the blood vessels are traversed by thick blood, so that they become weaker over time, which causes blood flow to decrease further. Hypertension will make this condition worse, because to drain thick blood, the blood vessels compensate by thickening. This thickening will cause the lumen to become narrower so that blood flow to the legs decreases so that ankle pressure is lower than brachial, which causes PAD.

There was 1 respondent who experienced hardening of the arteries, namely a male respondent who was thin, aged > 40 years, had suffered from hypertension for more than 5 years, the respondent also smoked. As a person's age increases, the risk of atherosclerosis increases, where plaque attaches to the blood vessels, which often occurs in old age, where the blood vessels become harder or stiffer (Rahayu, 2023). High blood glucose levels over a long period of time cause an oxidation process in the blood vessel walls resulting in the production of Advanced Glycosylated Endoproducts (AGEs) which can cause destruction and buildup of cholesterol in the blood vessel walls. Other materials such as platelets and leukocytes that accumulate cause hardening and stiffness of blood vessel walls (Hati & Muchsin, 2021). Cigarettes contain more than 4000 chemicals and other

active ingredients, one of the active ingredients is nicotine which plays a role in stimulating the release of adrenaline, increasing heart rate and blood pressure. Apart from nicotine, cigarette smoke also contains carbon monoxide (CO₂), which is produced as much as 3-6% in a cigarette. Carbon monoxide can bind hemoglobin more strongly than oxygen, so that body cells and heart muscle experience a lack of oxygen and over time the blood vessels will harden because they are not properly nourished (Tampubolon et al., 2023).

Old age combined with long-standing diabetes and smoking makes respondents experience stiff arteries, this can make blood flow to the body's organs become less smooth, thus disrupting the function of these organs. This hardening of the blood vessels does not only occur in the legs but almost throughout the body so that blood flow is not smooth and causes the ABI to increase.

The research show that the majority of respondents were ≥ 40 years old, namely 72 people (72%). ABI values are thought to increase with age as a result of arterial stiffness. ABI values decrease with increasing age, possibly due to the increasing prevalence and progression of PAD (Nadrati & Supriatna, 2021). Researchers assume that high ABI values can be found in older respondents because the arteries are stiff, causing differences in blood flow in the legs and arms, and some are decreased because the respondents are smokers.

The research show that almost all of them are women, namely 84 people (84%). According to Beckman (2005), women are more likely to suffer from DM due to premenstrual syndrome and post menopause which causes the distribution of fat in the body to accumulate due to estrogen hormonal disorders. A decrease in the hormone estrogen results in vasoconstriction

in blood vessels, increasing levels of low-density lipoprotein (LDL), the process of forming fatty streaks, which is a precursor of atheroma, to the formation of atherosclerosis in the visceral branch arteries, resulting in impaired circulation of blood vessels in the lower extremities, known as PAD (Widiastuti et al., 2022). Researchers assume that with increasing age, women lose the protective hormone estrogen, causing high levels of CRP and fibrinogen, which increase blood viscosity, causing thrombus formation in the blood vessels, which causes the blood vessels to narrow and blood flow is not smooth, resulting in PAD.

The majority of respondents did not have a history of hypertension, namely 54 people (54%). Hypertension plays a major role in abnormal ABI values. This is because in hypertensive sufferers there is vascular blockage which causes a progressive increase in systolic blood in the lower extremities, causing abnormal ABI values (Kartikadewi et al., 2022). Researchers assume that respondents who do not have a history of hypertension tend to have a normal ABI, while those who have a history but normal ABI values could be because the patient has recently suffered from diabetes mellitus so that the effects of ABI abnormalities have not yet been detected, even though there are indications that the systolic value in the ankle area is lower. from the brachial, due to blockage of blood vessels leading to the lower extremities.

CONCLUSIONS

The ankle brachial index value in diabetes mellitus patients in Jatidukuh Village, Gondang District, Mojokerto Regency, almost half of the respondents experienced PAD, namely 44 people (44%), consisting of moderate PAD as many as 28 people (28%) and mild PAD 16 people (16%).

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