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Review Article

Factors Affecting the Value of Ankle Brachial Index in Patients with Diabetes Mellitus Type 2: Literature Review

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Abstract

Aims: The purpose of this literature review is to determine the factors that affect the value of the Ankle Brachial Index (ABI) in patients with type 2 diabetes mellitus.
Methods: Search articles through Pubmed, Science Direct, Scopus and Researchgate. The articles obtained were filtered based on full text, 20 articles were found, and six articles were analyzed through analysis of objectives, suitability of topics, research methods used, characteristics of respondents, and the results of each article, published 2017-2021, in English and Indonesian.
Results: ABI value in people with diabetes is influenced by age with a lower prevalence of ABI higher in men, treatment with oral anti-diabetic or insulin, mean arterial pressure, the severity of diabetic foot, and the presence of symptoms of complications of diabetes mellitus such as diabetic retinopathy. However, the duration of suffering from diabetes mellitus did not affect the abnormal ABI value.
Conclusion: The Ankle Brachial Index (ABI) value can be influenced by Age, Gender, the severity of diabetic foot, and symptoms of complications, but the length of suffering from Diabetes Mellitus does not affect the ABI value.

Keywords :
Ankle Brachial Index, Type 2 Diabetes Melitus, Treatment, Arterial pressure

INTRODUCTION

Diabetes is a chronic disease associated with metabolic disorders with a standard marker of elevated blood glucose levels. Diabetes mellitus itself has several types, including type 1 and type 2. Diabetes mellitus type 2 is commonly found in insulin-resistant adults or even inadequate insulin production (1). Data from the Centers for Disease Control and Prevention (CDC) shows the percentage of people with type 2 Diabetes Mellitus is 90-95%. The disease develops over the years and is usually diagnosed in adults but is increasingly being found in children, adolescents, and young adults. Sufferers may not notice any symptoms, so it is important to have blood sugar tests done on those at risk. Type 2 diabetes can be prevented or delayed with healthy lifestyle changes, such as losing weight, eating healthy foods, and being active (2).

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The results of Basic Health Research (BHR) in 2018 showed that the prevalence of diabetes mellitus in Indonesia based on a doctor's diagnosis at the age of 15 was 2%. This figure shows an increase compared to the prevalence of diabetes mellitus in the population of 15 years in the results of BHR in 2013 of 1.5%. However, the prevalence of diabetes mellitus, according to the results of blood sugar examinations, increased from 6.9% in 2013 to 8.5% in 2018. This figure shows that only about 25% of people with diabetes know that they have diabetes (3). Long-standing diabetes has severe damaging effects on the heart, blood vessels, eyes, kidneys, and nerves. Diabetic complications are common in type 1 or type 2 diabetes patients with significant morbidity and mortality. Chronic complications of diabetes are broadly divided into micro-vascular and macro-vascular. Micro-vascular complications include neuropathy, nephropathy, and retinopathy, while macro-vascular complications include cardiovascular disease, stroke, and peripheral arterial disease (PAD) (4).

Ankle-brachial index (ABI) is a non-invasive tool for assessing vascular status. This measurement consists of the ratio between the systolic blood pressure of the lower extremities, specifically the ankles and the upper extremities. This ratio compares the vascular resistance, with one of the main factors being the diameter of the vessels. The ankle-brachial index has uses in screening, diagnosis, treatment, and prognosis, for example, for peripheral arterial disease (5). Fata (2017) in his research, showed that the ABI value in people with type 2 diabetes with the right and left extremity threshold ABI values and abnormal categories mainly were in women, did not regularly take anti-diabetic drugs, did not exercise regularly, had never received foot therapy nor a diet. Based on these issues, this study evaluates the factors that influence the ABI so that individual behavior can support the creation of an average ABI value through a literature review.

METHODS

The current review design used is a literature review, with article searches from several databases, including PubMed (80), science direct (124), research gate (204) and google scholar (468). The PICO in this study is P: patients with diabetes mellitus, I: factors that affect ABI, C: -, O: ABI value. We set inclusion criteria including diabetes mellitus respondents, quantitative cross-sectional design, English and Indonesian texts, factors influencing ABI as an outcome and published them between 2016-2021. Meanwhile, intervention studies to change the ABI value were excluded from this review. The keywords used were "Ankle Brachial Index AND Related Factor AND type 2 diabetes mellitus OR Associated Factor AND Ankle Brachial Index." The secondary search used the keywords "Factors that affect the value of the ankle brachial index in type 2 diabetes mellitus.

To complete the literature search, eligible article references were reviewed, article selection strategies can be seen in the image.

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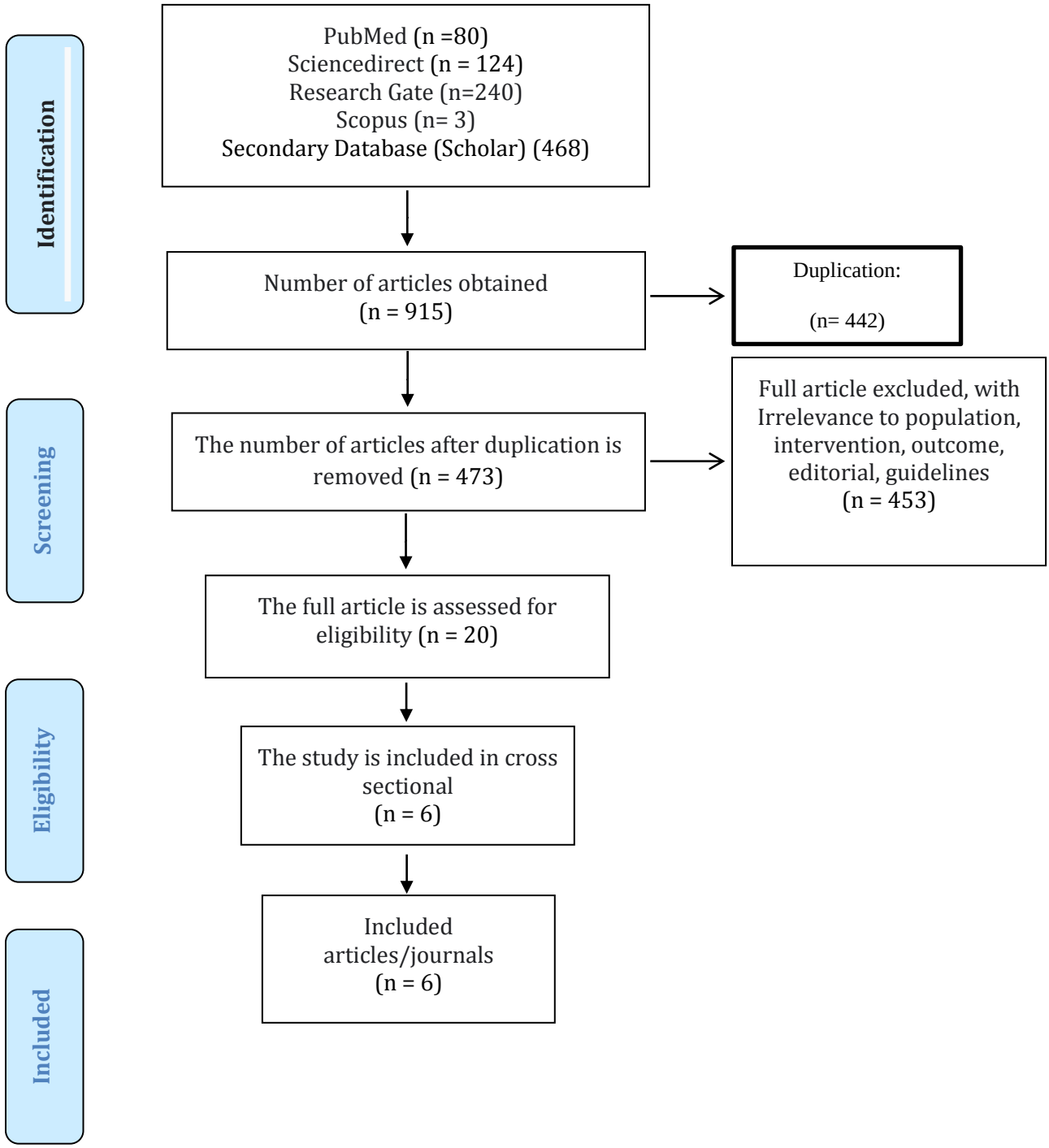

Diagram.1: PRISMA Flow Diagram

RESULTS

Five articles were included in this review using a cross-sectional method, and 1 article used a cohort study based on the study design. Based on a year of publication, one article was published in 2017, one was published in 2018, two were published in 2019, and two were published in 2020.

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The first article written by (7) aims to determine the relationship between the duration of diabetes mellitus and the value of the ankle-brachial index in patients with type 2 diabetes mellitus at Dr. Moewardi Surakarta hospital. The sample used in this study was 30 patients with type 2 diabetes who were hospitalized at Dr. Moewardi Surakarta hospital. The sampling technique used is consecutive sampling. The instruments used to record characteristic data were a checklist, sphygmomanometer, and stethoscope. This type of research is descriptive correlative using a cross-sectional approach.

The results showed that respondents had a normal ABI value with a duration of DM > 0.05, which meant that Ho was accepted. So it can be concluded that there is no relationship between the duration of suffering from diabetes mellitus with the ABI value in type 2 diabetes mellitus patients, which means that the duration of suffering from diabetes mellitus does not affect the abnormal ABI value.

The second article was written by (8) to estimate the ankle-brachial index in patients with type 2 diabetes mellitus in a tertiary care hospital. The study population was diabetic patients aged three years between 40 - 80 years, both male and female, without a diagnosis of peripheral arterial disease or previous clinically suggestive intermittent claudication. During the six-month study period, a total of fifty patients with type 2 diabetes mellitus were evaluated for ABI values. The results showed a higher prevalence of low ABI in men, at a later age, in subjects who continued treatment with oral anti-diabetics or insulin, leading to more advanced disease, and in those with cardiovascular disease. The mean ± for age (years) & duration of diabetes mellitus (years) for the entire population were 60.52±8.92 & 9.95±3.85, respectively. ABI was detected in 34 (68%) patients with a male sex predominance of 22 (64.7%), while the mean ± SD for ABI in the male and female populations were 0.51 ± 2.31 and 0.63 ± 1.94. Thus, a low prevalence of ABI exists in the diabetic population, related to age, sex, time of evolution of diabetes, and the presence of arteriosclerosis in other vascular regions. A low ABI is detected in the diabetic population and is a strong risk factor for cardiovascular and cerebrovascular disease. The third article was written by (9) to determine the relationship between LDL and ABI with the severity of diabetic foot in Banjarmasin, especially Ulin Hospital. This study used a cross-sectional with an analytical observational method. The population in this study was diabetic foot patients at the Diabetic Foot Polyclinic, Ulin Hospital, Banjarmasin. The study was conducted by interviewing and measuring ABI in diabetic foot patients.

The results showed a significant correlation between ABI and the severity of diabetic foot (p = 0.06; r = -0.244), there was no relationship between LDL and the severity of diabetic foot (p = 0.09; r = -0.395). The results of logistic regression analysis did not find a relationship between ABI (p = 0.163; OR = 0.008) and LDL (p = 0.69; OR = 0.984) with the severity of diabetic foot.

The fourth article, Cabratosa et al. (2020) which aims to compare the ankle-brachial index (ABI) with diabetes mortality and complications in people with no symptoms of peripheral arterial disease (PAD) in people with type 2 diabetes aged 35-85 years, has ABI measurements classified into six categories. The research design and method used was a retrospective cohort study.

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The results showed that the highest incidence was nephropathy, with 24.4 cases per 1000 person-years in the reference category 1.1≤ABI≤1.3. A low ABI was associated with an increased and significant risk of an ABI lower than 0.9; below this level, the risk continues to rise sharply. Different ABI categories were associated with a risk of death, macro-vascular, and micro-vascular complications in people with diabetes, asymptomatic for PAD, and in primary prevention, a high ABI (above 1.3) was associated with a significantly increased risk. Thus it was concluded that ABI was associated with various risks of type 2 diabetes, such as complications in asymptomatic persons for PAD in primary cardiovascular prevention.

The fifth article by Wicaturatmashudi (2019) aims to identify the determinant factors that affect the value of the ankle-brachial index in Type II Diabetes mellitus patients at Siti Khadijah Hospital Palembang. The population in this study was all patients with type II diabetes mellitus who underwent outpatient treatment at Siti Khadijah Hospital in Palembang with a sample of 50 respondents. The design of this study was cross-sectional.

The results showed no relationship between age, gender, blood sugar levels, and smoking with ABI values. There is a relationship between the mean arterial pressure value with the ABI value (p-value 0.0005) with a strong relationship category and a positive pattern (r = 0.710). So it can be concluded that there is a significant relationship between the average arterial pressure and the ABI value and has a positive relationship pattern where the higher the arterial pressure value, the higher the ABI value.

The sixth article was written by (12) to investigate whether PAD, as indicated by low ABI scores, was associated with the development of diabetic retinopathy in patients with type 2. The sample consisted of 414 (221 men and 193 women) patients with type 2. The exclusion criteria set were typed 1 DM patients receiving dialysis and had undergone a kidney transplant.

The results showed 69 (16.7%) had ABI < 0.9 or 1.3. The median follow-up period was 23 (15-40) months, of which 74 (17.9%) patients developed diabetic retinopathy. In multivariate analysis, ABI < 0.9 or 1.3 was independently associated with the development of DR (vs. ABI 0.9 to < 1.3; hazard ratio, 2.186; 95% confidence interval, 1.261 to 3.789; p = 0.005). An abnormal ABI was associated with diabetic retinopathy in our patient with type 2 DM without diabetic retinopathy.

DISCUSSION

Individuals with type 2 diabetes mellitus have a lower prevalence of ABI (68%) than individuals in general. This prevalence was higher in men, at a later age, in subjects who continued treatment with oral anti-diabetics or insulin, leading to more advanced disease than in individuals with cardiovascular disease. Thus, a low prevalence of ABI exists in the diabetic population, related to age, sex, time of evolution of diabetes, and the presence of arteriosclerosis in other vascular regions. Determination in this population would allow high-risk individuals who are candidates for more energetic control of glycemic status, risk factors, and disease screening (8).

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A low ABI is associated with a significantly increased risk and an ABI lower than 0.9, and below this level, the risk continues to rise sharply. A high ABI over 1.3 was also associated with a significantly increased risk. ABI is associated with a distinct risk of type 2 diabetes complications in persons without symptoms for PAD and those in primary cardiovascular prevention (13). Based on several studies, the ABI value is associated with symptoms of diabetes mellitus. Research conducted by (10) that macrovascular complications, the incidence of ischemic stroke is twice that of acute myocardial infarction, namely 7.7 (95% CI 7.0 to 8.6) and 4.1 (95% CI 3,6 to 4.7) per 1000 person-years, in the normal ABI group (1.1≤ABI<1.3). As for microvascular complications, neuropathy presented the lowest incidence of 3.4 (95% CI 2.9 to 4.0) per 1000 person-years in the category with the usual ABI, a slightly higher incidence of retinopathy, and nephropathy had a much higher incidence. Ie, 24.4 (95% CI 22.9 to 25.9) per 1000 person-years. These results suggest that ABI assessment can be considered in the initial risk assessment of acute and chronic disease complications of diabetes mellitus to assist in treatment decision-making.

CONCLUSIONS

ABI values in people with diabetes are influenced by age, with a lower prevalence of ABI being higher in men, treatment with oral anti-diabetic or insulin, mean arterial pressure, the severity of diabetic foot, and the presence of symptoms of complications of diabetes mellitus such as diabetic retinopathy. However, the duration of suffering from diabetes mellitus did not affect the abnormal ABI values. Based on the factors that influence it, the ABI value can indicate the presence of complications of diabetes mellitus. Thus, health professionals can use ABI measurement as a simple, inexpensive, non-invasive, and time-consuming method to detect complications in diabetic patients.

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