THE EFFECT OF DIABETES FOOT EXERCISES ON ANKLE BRACHIAL INDEX VALUES IN TYPE 2 DM PATIENTS

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ABSTRACT

Diabetes Mellitus (DM) is a metabolic condition characterized by various symptoms resulting from increased blood sugar levels (hyperglycemia), caused by abnormalities in insulin secretion, insulin action, or both. In Indonesia, type 2 diabetes is caused by a decrease in the amount of insulin produced. Similarly, throughout the world, we face the threat of diabetes. In 2020, the International Diabetes Federation (IDF) announced that the diabetes epidemic in Indonesia continues to increase. Indonesia ranks seventh in the world in terms of the number of diabetes attacks. The design used was a Pre-Experimental with a "pre-test and post-test" approach. Foot exercises were carried out four times for two weeks at the Bogor City Hospital, with a total sample of 30 respondents. The results of this study before and after foot exercises obtained a p value of 0.002 (≤ 0.05) so that the conclusion was that Ho was rejected and Ha was accepted. It can be interpreted that there is an effect of diabetic foot exercises on the ankle brachial index value in type 2 DM patients. According to the researcher's analysis, the results of the study on the Pretest and Posttest showed that there was an increase in the ankle brachial index value before and after the diabetic foot exercise action in type 2 DM patients. And it can be concluded that there is an effect of diabetic foot exercises on the ankle brachial index value in type 2 DM patients.

Keywords: *Diabetes Mellitus, Diabetic Foot Exercises, Ankle Brachial Index*

INTRODUCTION

Diabetes Mellitus (DM) is a metabolic disease characterized by a collection of symptoms resulting from elevated blood sugar levels (hyperglycemia) caused by abnormalities in insulin secretion, insulin action, or both. Hyperglycemia causes blood sugar to accumulate in the blood, preventing it from entering cells. This failure results from a decrease in insulin levels or even a malfunction of the insulin hormone. Type 2 DM is caused by a decrease in insulin production.

Indonesia also faces a diabetes threat similar to the rest of the world. The International Diabetes Federation (IDF) reported in 2020 that the diabetes epidemic in Indonesia continues to show an increasing trend. Indonesia ranks seventh in the world for the number of diabetes attacks. Based on gender, the IDF estimates the prevalence of diabetes in 2019 was 9% in women and 9.65% in men. The prevalence of diabetes is expected to increase with age, reaching 19.9%, or 111.2 million people aged 65-75. This figure is predicted to continue to rise, reaching 578 million in 2030 and 700 million in 2045. 2

People with diabetes mellitus (DM) are at high risk of developing serious complications. One of the most common complications is diabetic foot complications. If not adequately treated, diabetic foot conditions can progress to amputation. Foot exercises are exercises performed by people with diabetes mellitus to prevent foot complications (diabetic ulcers) and improve blood circulation in the feet.

Diabetic foot ulcers are one of the very serious complications of diabetes mellitus to prevent and treat the occurrence of diabetic foot ulcers caused by peripheral neuropathy and peripheral arterial disease by measuring the Ankle Brachial Index value using Doppler. 5 Blood circulation in the foot area can be measured through non-invasive examinations, one of which is the Ankle Brachial Index examination with non-invasive examination of the blood vessels that serves to detect clinical signs and symptoms of ischemia, decreased peripheral perfusion that can lead to angiopathy and diabetic neuropathy. The results of ABI measurements show the state of blood circulation in the lower legs with a range of values 0.90-1.2 indicating that circulation to the leg area is normal. This value is obtained from the results of the comparison of isstolic pressure in the feet and hands. 6

Diabetic foot exercises affect the Ankle-Brachial Index, improving blood circulation in the feet. This physical exercise is one of the principles in the management of diabetes, where it is included in the secondary prevention of risk factors for diabetes complications, especially diabetic foot and amputation. 7 Diabetic foot exercises are also used as foot exercises. Exercises or movements performed by both feet alternately or simultaneously are useful for strengthening and flexing the muscles in the lower leg area, especially the ankles and toes. In principle, foot exercises are performed by moving all the joints of the foot and are adjusted to the patient's ability. One of the expected goals of performing these foot exercises is to improve blood circulation in the foot area. 8

Based on a preliminary study conducted through observation and interviews, four patients had never received any education or foot exercises. They stated they wanted to do foot exercises to prevent foot ulcers. Ankle-brachial index (ABI) measurements were then performed to assess blood circulation. After sampling 10 patients, the minimum ABI value was 0.66 and the average value was 0.86, indicating a decrease in the ABI value in patients with type 2 diabetes mellitus, and patients also frequently complained of tingling in the feet.

Based on the results of interviews conducted with health workers, it was found that diabetic foot exercises had never been carried out on type 2 DM patients and it was not known for certain how much influence diabetic foot exercises had on the Ankle Brachial Index in type

2 DM patients, so researchers were interested in examining the influence of diabetic foot exercises on the Ankle Brachial Index in type 2 DM patients.

METHOD

The experimental design used in this study was a pre-experimental design, using a one-group pre-test and post-test design. The population in this study were 30 patients with Type 2 DM at Bogor City Hospital. The sample collection used a purposive sampling technique.

Inclusion Criteria

1) Type II DM patients without cellulitis, deep vein thrombosis, chronic ulceration in the wrist areafoot..

2) Aged 30-60 years.

3) Signing*informed consent*.

Exclusion Criteria

1) Type II DM patients with unstable emotional states.

2) Not doing leg exercises regularly*(drop out).*

3) Having hearing loss.

4) Experiencing mental disorders.

5) Having a physical disability in the legs.

In this study, the instruments used were a sphygmomanometer and a Doppler to determine the ankle-brachial index value by comparing the results of systolic pressure in the lower leg and arm. The procedure was carried out in accordance with the Ankle Brachial Index measurement procedure sheet. The results were recorded in an ankle-brachial index recapitulation sheet, another implementation procedure sheet was a diabetic foot exercise procedure leaflet. Data analysis used univariate and bivariate analysis.

RESULTS

Table 1
Frequency Distribution of Ankle Brachial Index Observation Results (Pretest)

Ankle Brachial Index	F	%
Normal	3	10.0
Mild Obstruction	27	90.0
Moderate Obstruction	0	0
Severe Obstruction	0	0
Total	30	100

Based on the results of the table above, the results showed that the majority (90.0%) had mild blockages, namely 27 respondents.

Table 2

Frequency Distribution of Ankle Brachial Index Observation Results (Posttest)

Ankle Brachial Index	F	%
Normal	14	46.7
Mild Obstruction	16	53.3
Moderate Obstruction	0	0
Severe Obstruction	0	0
Total	30	100

Based on the results of the table above, the results showed that the majority (53.3%) had mild blockages, namely 16 respondents.

Table 3

Homogeneity Test Results

Levene Statistics	df1	df2	Sig.
45,298	1	58	0.000

Based on the results of the table above, it is known that the results of the homogeneity test using the Levene Statistic test through the SPSS version 25 program obtained a Sig. (Significant) value or probability value of 0.000, which means the Sig. value <0.05 means that the data comes from a population that has unequal or non-homogeneous variance.

Table 4

Shapiro Wilk Normality Test Results

	Shapiro-Wilk		
	Statistics	df	Sig.
Pretest	0.528	30	0.000
Posttest	0.372	30	0.000

Based on the results of the table above, it is known that the results of the normality test using Shapiro-Wilk through the SPSS version 25 program obtained a Sig. (Significant) value in the pretest and posttest, namely 0.000, which means Sig. <0.05, meaning that the data is not normally distributed.

Table 5

Hypothesis Test Results

Test Statistics	
	Posttest - Pretest
Z	*-3,051a*
Asymp. Sig. (2-tailed)	*,002*

Based on the results of the table above, it is known that the results of the hypothesis test using the non-parametric Wilcoxon signed rank test through the SPSS version 25 program obtained a Sig. (Significant) value in the Test Statistics table, namely 0.002, which means P Value <0.05 (H0 is rejected, Ha is accepted), meaning that there is an effect of diabetic foot exercise on the ankle brachial index value in type 2 diabetes patients.

DISCUSSION

1. Analyzing before diabetic foot exercise action on the Ankle Brachial Index value of Type 2 DM sufferers (Pretest)

   The results of the study showed that the average Ankle Brachial Index value of respondents before doing leg exercises was at a normal value of 10.0% of 3 respondents and a value with mild blockage of 90.0% of 27 respondents.

   This explains why, once people reach the age of 45, their organ function begins to deteriorate. This is due to a decline in the activity of pancreatic beta cells, which produce insulin. Because diabetes in older adults is complex and influenced by both extrinsic and intrinsic variables, it tends to progress. One independent factor influencing variations in the body's glucose tolerance is age. Diabetic foot exercises are a type of exercise used by people with diabetes to prevent injury and improve blood circulation in their feet. Foot exercises can improve blood circulation, strengthen the small muscles in the feet, and prevent foot deformities. Foot exercises can also help strengthen the muscles of the calves and ankles.[13]

   This study is comparable to Agus Triyanto's (2017) study. Based on the findings, there were 6 male respondents (31.6 percent) and 13 female respondents (68.4 percent). The number of female respondents was greater than that of male respondents. Women are more likely than men to have Diabetes Mellitus. The ankle brachial index in type 2 diabetes patients is lower than in non-diabetic people. Ankle brachial index values of 0.9-1.3 indicate that the patient does not experience circulatory disorders in the legs; however, if the ankle brachial index value is less than 0.9, the patient is considered to have circulatory problems in the legs.[29]

Based on the findings of this study, it can be said that most diabetic foot obstructions were mild before diabetic foot exercises were performed. Patients without circulatory problems in their legs would have an ankle brachial index value of 0.9 to 1.3, while those with circulatory problems would have an ankle brachial index value of less than 0.9.

2. Analyzing the post-diabetic foot exercise action on the Ankle Brachial Index value of Type 2 DM sufferers (Posttest)

   The results of the study showed that the average Ankle Brachial Index value of respondents after doing foot exercises was at a normal value of 46.7% of 14 respondents and the number of values with mild blockage was 55.3% of 16 respondents.

   Factors affecting the ankle brachial index include aging, which explains why, as people age, their organ function declines. This is due to a decline in the activity of pancreatic beta cells, which produce insulin. Because diabetes in older adults is complex and influenced by both extrinsic and intrinsic variables, it tends to increase. One independent factor influencing variations in glucose tolerance is age.[17]

   The findings of this study are consistent with those of Kaimudin (2019). The findings revealed that before the study, the average Ankle-Brachial Index of respondents after performing leg exercises was 1.1, or normal. Blood flow pumped by the heart throughout the body, including the legs, is regulated by three parameters: viscosity (blood thickness), blood vessel length, and blood vessel diameter.[7]

   Based on the results of this study, it can be concluded that there was a significant increase between the pre-test and post-test after diabetic foot exercises were carried out on the ankle brachial index value.

3. Analyzing the effect of diabetic foot exercise on the Ankle Brachial Index value of Type 2 DM sufferers.

   The results of this study before and after carrying out foot exercises, the results of the statistical test obtained a p value of $0.002 \leq 0.05$ so that it was concluded that Ho was rejected and Ha was accepted, which can be interpreted as having an effect of diabetic foot exercises on the ankle brachial index value in type 2 DM patients.

   Age, gender, and physical activity are factors that influence foot exercises and brachial index values. Diabetic foot exercises are an effective approach to improving circulation, especially in the legs. If diabetic patients perform leg exercises that involve primary muscle groups (leg muscles), the metabolic rate of active muscles will increase, resulting in regular contractions. Then there is the Ankle Brachial Index Assessment, a non-invasive blood

vessel examination used to detect clinical signs and symptoms of ischemia, decreased peripheral perfusion, and diabetic neuropathy. The Ankle Brachial Index is a simple method for measuring blood pressure in the ankle (foot) and brachial (hand) areas that does not require the use of a Doppler probe. Ankle Brachial Index measurement findings reflect the state of blood circulation in the lower limbs, with a value of 0.90 or more indicating normal circulation to the leg area, and less than 0.90 indicating limited circulation to the leg.[17]

The findings of this study are equivalent to the study of Concerned Women for America (2019) The results of the Wilcoxon Sign Rank test on the results of observations of the Ankle Brachial Index value before being given diabetic foot exercise intervention and the results of observations of the Ankle Brachial Index value after being given an intervention in the form of diabetic foot exercise to 30 respondents revealed that there was an effect of diabetic foot exercise on the Ankle Brachial Index value. In this study, the intervention group had a p value of 0.000 (p-value 0.05) which showed that diabetic foot exercise had a large effect on the Ankle Brachial Index value in type II DM patients at Pancaran Kasih GMIM Manado Hospital. By doing diabetic foot exercise regularly for the period recommended by the researcher, which is four times a week for two weeks.[30]

According to the researcher's analysis, the results of the research on the pretest and posttest showed that there was an increase in the ankle brachial index value before and after the diabetic foot exercise action in type 2 DM patients. And it can be concluded that there is an effect of diabetic foot exercise on the ankle brachial index value in type 2 DM patients.

CONCLUSION

1. Frequency distribution of the known Ankle Brachial Index value of Diabetes Mellitus patients before doing type 2 diabetes foot exercises, the results showed mild blockage of (90.0%) from 27 respondents.

2. Frequency distribution of the known Ankle Brachial Index value of Diabetes Mellitus patients after doing diabetes foot exercises for Type 2 DM, the results showed mild blockage of (53.3%) from 16 respondents.

3. It is known that the effect of diabetic foot exercises on the Ankle Brachial Index value of Type 2 DM sufferers, the p value is $0.002 \leq 0.005$ so that the conclusion is that Ho is rejected and Ha is accepted, which can be interpreted as having an effect of diabetic foot exercises on the ankle brachial index value in type 2 DM patients.

BIBLIOGRAPHY

1. Khairani. World Diabetes Day 2018. Data and Information Center, Ministry of Health, Republic of Indonesia. Published online 2019:1-8.
2. Ministry of Health of the Republic of Indonesia. Stay Productive, Prevent, and Treat Diabetes Mellitus. Data and Information Center, Ministry of Health of the Republic of Indonesia. Published online 2020.
3. Kale ED, Akoit EE. Risk analysis of diabetic foot ulcers in patients with diabetes mellitus (DM) in the DM and internal medicine outpatient clinic. J Health Info. 2018;14(Dm):1006-1018.
4. Priyanto, Sahar W. Blood Sugar Levels in the Aggregate of Elderly People with Diabetes. Proceedings of the 2013 National Conference of Indonesian National Education Associations (PPNI) in Central Java. Published online 2020:76-82. http://103.97.100.145/index.php/psn12012010/article/download/853/907
5. Fitria E, Nur A, Marissa N, Ramadhan N. Characteristics of Diabetic Ulcers in Diabetes Mellitus Patients at Dr. Zainal Abidin Regional Hospital and Meuraxa Regional Hospital, Banda Aceh. Health Research Center. 2017;45(3):153-160. Doi:10.22435/bpk.v45i3.6818.153-160
6. Said A, Novianti AD, Fety Y. Early Detection of Peripheral Artery Disease through Ankle Brachial Index Examination in the Prolanis Group at Poasia Community Health Center. HealInf J Penelit. 2021;13(1):11-19. Doi:10.36990/hijp.v13i1.249
7. Kaimuddin K, Selamat S. The Effect of Diabetes Exercise on the Ankle Brachial Index (ABI) Values of Diabetes Mellitus Patients. J Bahana Kesehat Masy (Bahana J Public Heal. 2019;3(2):102-107. Doi:10.35910/jbkm.v3i2.224
8. Prihatin TW, Dwi M R. The Effect of Diabetic Foot Exercises on Ankle Brachial Index Values in Type II Diabetes Mellitus Patients at Bergas Community Health Center, Semarang Regency. Indonesian Journal of Nursing Sciences. 2019;9(02):571-576. Doi:10.33221/jiiki.v9i02.227
9. Dr. Dr. Eva Decroli S-KF. No titlediabetes MELLITUS TYPE 2.; 2019.
10. Rahmasari. The effectiveness of momordica carantia (bitter melon) in reducing blood glucose levels. J Ilm Medical Record and Health Inform. 2019;9(1):57-64.
11. Lestari AAW. ResistanceInsulin: Definition, Mechanism, and Laboratory Testing. Clinical Pathology Update SURAMADE. 2020;1:1-8. https://repositori.unud.ac.id/protected/storage/upload/repositori/ad31ce278a7564c52f74b34e9c5fa38e.pdf
12. Tjandrawinata RR. Pathogenesis of Type 2 Diabetes2: Insulin Resistance and Insulin Deficiency. Dlbs. 2017;(February):1-4.
13. Kabosu RAS, Adu AA, Up to IAT. Risk Factors for Type Two Diabetes Mellitus in Bhayangkara Hospital, Kupang City. Timorese J Public Heal. 2019;1(1):11-20. doi:10.35508/tjph.v1i1.2122
14. Ministry of Health of the Republic of Indonesia. Signs and symptoms of type 2 diabetes. Published online 2019:1. http://p2ptm.kemkes.go.id/artikel-sehat/tanda-dan-gejala-diabetes
15. Ambarwati WN. Counseling for prevention and management of diabetes mellitus patients. 2019;60(1):69. Doi:10.7600/jspfsm.60.69
16. Puspita R, sholikah agusti T, pakha nasirochim D, putra erdana S. Pocket Book of Diabetes Mellitus. UNS Press. 2020;(November):70.
17. Prihatiningsih D. Ankle-Brachial Measurement. Seminar Work Update on DVT and PAD Management_17 March 2016. Published online 2016:1-8.
18. Tandra H. From Diabetes to Beautiful Feet. (Isran Febrianto Siregar, ed.).; 2020.

19. Wicaturatmashudi S. Determinant Factors of Ankle Brachial Pressure Index (ABPI) in Diabetes Mellitus Patients at the Polyclinic of Siti Khadijah Islamic Hospital, Palembang. J Nursing Sriwij. 2019;6(2355):16-26.
20. Society. Sop abi.
21. Wikihow. How to measure the ankle brachial index at the ankle. Published online 2019:1. https://id.wikihow.com/Mengukur-Indek-Brakialis-Pergelangan-Kaki
22. Sujianto U. Leg exercise module for educator training. Published online 2018:1-11.
23. Flora R, Purwanto S. Foot Exercise Training for Diabetes Patients Diabetes Complications in the Feet(Diabetic Foot). Unsriacid. Published online 2019:7-15.
24. Zenab D. Dai. Appendix 1. S. 2019;(2):59-63.
25. Widiawati S, Maulani M, Kalpataria W. Implementation of Diabetic Foot Exercises for Diabetes Mellitus Patients at Raden Mattaher Regional Hospital, Jambi. J Pengabdi Harapan Ibu. 2020;2(1):6. Doi:10.30644/jphi.v2i1.199
26. DT gymnastics, Sitting P. Sop leg gymnastics. Published online 2019.
27. Notoatmodjo S. Health research methods.; 2018.
28. Sugiyono. Research methodsquantitative, qualitative and R&D. (SUTOPO, ed.).; 2019.
29. Trianto A, Hastuti RT. The Effect of Foot Exercises on Ankle Brachial Index (ABI) Values in Type II Diabetes Patients at Persadia Unit Dr. Moewardi in 2015. J Nursing Glob. 2017;2(2):79-85. Doi:10.37341/jkg.v2i2.36
30. Concerned RD m. Diabetic Foot Exercises Affect Ankle Brachial Index Values in Type 2 Diabetes Mellitus Patients. 2019;001(46):571-576.