The effect of range of motion (ROM) exercises on the occurrence of neuropathy and angiopathy in diabetes mellitus patients in the Medan Tuntungan Community Health Center area

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Abstract.
Ankle ROM training is a movement that includes 2 movements, namely dorsiflexion and plantarflexion which result in increased calf muscle strength and increased calf muscle pump thereby facilitating venous return which has a positive impact in facilitating the diffusion of oxygen and nutrients. By providing Active Lower ROM intervention to Diabetes Mellitus patients twice a day for 6 consecutive days at the same time. Statistically, it can be seen that there was an influence on the ABI and DNE values before the intervention was given and after the Active Lower ROM intervention was given. This type of research uses quasi-experimental research using two group pretest-posttest, namely an experimental design where there are control and intervention groups. The samples in this study were 35, of which 17 samples were for the intervention group and 18 samples were for the control group. Based on the results of the research, data obtained from the analysis of the effect of giving ankle ROM exercises on the DNE score and ABI value in the intervention group and the control group were, in the DNE score, the statistical test result was p = 0.000, and it can be believed that there is a significant difference between the DNE score of the intervention group. And the control group after doing ankle ROM exercises (p = 0.000 α = 0.05), then H0 was rejected or there was an effect of ROM exercises on reducing the risk of neuropathy. Meanwhile, the ABI value showed a statistical test result of p = 0.002 and it can be believed that there is significant difference between the ABI values of the intervention group and the control group after ankle ROM exercises (p = 0.002 α = 0.05), so H0 is rejected or there is an effect of ROM exercises on reducing the risk of Angiopathy.
Keywords : *Range of Motion Exercises and Diabetes Mellitus.*

I. INTRODUCTION

Diabetes Mellitus (DM) is a group of metabolic diseases characterized by hyperglycemia, resulting from abnormalities in insulin secretion, insulin action, or generally both. (DM isa group of metabolic disorders characterized by high blood glucose levels. a person with diabetes ownincreased risk of experiencing a number of serious, life-threatening health problems that require high medical care costs, decreased quality of life, and increased mortality rates (Diani et al, 2019). Diabetes mellitus is a major public health problem, diabetes mellitus is one of the four priority non-communicable diseases (cardiovascular, DM, cancer, chronic respiratory disorders). with a number ofOne of the problems experienced by diabetes mellitus patients is problems with the immune system, peripheral nervous system, or what is commonly called peripheral neuropathy (Djamaludin, 2019).

Based onAccording to the International Diabetes Federation (IDF 2019), the number of DM cases worldwide continues to increase annually. In 2017, there was an increase of 425 million people, and in 2019, it increased to 463 million people, with a diabetes rate of 9.0% in women and 9.6% in men. Meanwhile, it is estimated that by 2030, the number will increase to 578 million, and by 2045, the incidence is estimated to continue to increase to reach 700 million people diagnosed with DM. Indonesia ranked 7th in the number of DM sufferers in 2019 after China, India, America, Brazil, and Mexico, with 10.7 million people. The incidence of DM is projected and estimated to increase to 16.6 by 2045, according to the International Diabetes Federation (IDF, 2019).

According to the IDF, in 2019, China with a population of 116.4 million, India with around 77

million, and the United States with a population of 31 million, these three countries occupied the top positions with the most diabetes sufferers. The World Health Organization (WHO) in 2000 estimated that there would be an increase in DM sufferers in Indonesia, namely from 8.4 million cases to 21.3 million cases in 2030 (National Riskesdas, 2018). According to the Indonesian Ministry of Health (2018), the number of diabetes mellitus sufferers in Indonesia increased from 6.9% to 8.5% with a total of 12,191,564 sufferers. Based on data from the Basic Health Survey (Riskesdas) of the Ministry of Health in 2018, the graph shows that DKI Jakarta has the highest prevalence of diabetes mellitus in Indonesia, reaching 3.4%. The second highest prevalence of diabetes is in East Kalimantan, DI Yogyakarta, North Sulawesi, East Java, Bangka Belitung Islands, Gorontalo, Aceh, Banten and Central Sulawesi (Ahdiat, 2022).

One way to prevent decreased foot sensitivity can be done with physical exercise. The recommended physical exercise is foot exercise. Diabetic foot exercise is an activity carried out for diabetes sufferers to prevent injury and improve blood circulation in the feet. Foot exercise interventions in diabetes mellitus patients are carried out with the aim of increasing foot sensitivity and preventing complications related to peripheral nerve damage (Megawati et. al., 2020). In addition to foot exercise, there are various types of physical exercises for DM sufferers in relation to foot sensitivity, namely isometric and isotonic muscle contraction exercises, strength training, aerobic exercise, range of motion exercises. Lukita, et al (2018) stated that active ROM of the feet can improve blood circulation and reduce blood sugar levels to increase foot sensitivity.

II. RESEARCH METHODS

This study is a quantitative study with a quasi-experimental design with a Pre-Post Test Control Group design. The study design was divided into two groups, namely the control group and the intervention group. The control group was assessed using the ABI (Ankle Brachial Index) and DNE Scoring instruments without any intervention before and after the study. While in the intervention group, before being given the ROM (Range of Motion) application on the ankle, an ABI (Ankle Brachial Index) and DNE Scoring assessment were carried out, then ROM intervention was given and after that, they were assessed with the ABI (Ankle Brachial Index) and DNE Scoring.

III. RESEARCH RESULT

The purpose of this study was to determine how ROM exercises reduce neuropathy and angiopathy in patients with diabetes mellitus. This study was conducted in 2024 at the Medan Tuntungan Community Health Center in Medan Tuntungan District and Medan City. Age, gender, education, and occupation were the demographics of the study respondents. The following table shows the frequency distribution of respondents:

1. Distribution of Respondent Characteristics of Diabetes Mellitus Patients

Table 1 Distribution of Respondent Characteristics of Diabetes Mellitus Patients at Medan Tuntungan Health Center Intervention Group (n=17)

NO	Characteristics	F	Percentage of Tase
1	Age		
	35-50	4	23.53%
	>50	13	76.47%
	Amount	17	100.00%
2	Gender		
	Man	7	41.18%
	Woman	10	58.82%
	Amount	17	100.00%
3	Education		
	Sd	3	17.65%

	Junior high school	2	11.76%
	Senior high school	3	17.65%
	Bachelor	9	52.94%
	Amount	17	100.00%
4	Work		
	Housewife	5	29.41%
	civil servant	4	23.53%
	Farmer	3	17.65%
	Self-employed	5	29.41%
	Amount	17	100.00%

Based on table 1 above, the majority of respondents are aged 35-50 years as many as 4 respondents (23.5%), the majority of respondents aged >50 years as many as 13 respondents (76.5%). Respondents are male as many as 7 respondents (41.2%) while women as many as 10 respondents (58.8%). Respondents' education is elementary school, junior high school, high school as many as 8 respondents (47.1%), respondents are graduates as many as 9 respondents (52.9%). Respondents' occupations are housewives as many as 5 respondents (29.4%), respondents are self-employed as many as 5 respondents (29.4%), respondents are civil servants as many as 4 respondents (23.5%), respondents are farmers as many as 3 respondents (17.6%).

2. Distribution of Respondent Characteristics of Diabetes Mellitus Patients at Medan Tuntungan Community Health Center Control Group

Table 2 Distribution of Respondent Characteristics of Diabetes Mellitus Patients at Medan Tuntungan Health Center Control Group (n=18)

NO	Characteristics	F	Percentage of Tase
1	AGE		
	35-50	5	27.78%
	>50	13	72.22%
	Amount	18	100.00%
2	Gender		
	Man	14	77.78%
	Woman	4	22.22%
	Amount	18	100.00%
3	Education		
	Sd	3	16.67%
	Junior high school	2	11.11%
	Senior high school	8	44.44%
	Bachelor	5	27.78%
	Amount	18	100.00%
4	Work		
	Housewife	0	0.00%
	civil servant	4	22.22%
	Farmer	9	50.00%
	Self-employed	5	27.78%
	Amount	18	100.00%

Based on Table 2, it can be seen that in the control group, the majority of respondents were aged 35-50 years (5 respondents) (27.8%), while the majority were aged >50 years (13 respondents) (72.2%).

There were 14 male respondents (77.8%). whereas4 female respondents (22.2%). Respondents' education level was elementary school, junior high school, and senior high school (13 respondents (72.2%), while 5 respondents (27.8%) were graduates (S1, S2, S3). Respondents' occupations were housewives (0%), 5 respondents (27.8%), 4 respondents (22.2%) were self-employed, and 9 respondents (50.0%) were farmers.

3. Distribution of Average Neuropathy Values Before and After Range of Motion (ROM) Exercise in the Intervention Group

Table 3 Distribution of Average Neuropathy Values Before and After Range of Motion (ROM) Exercise in the Intervention Group

Variables	N	Mean	P Value
Neuropathy Score before Range of Motion Exercise	17	4.88	0.00
Neuropathy Score after Range of Motion Exercise	17	3.65	

Based on table 3, the average value before treatment is 4.88 and after treatment is 3.65. From these results, there is a difference in values that shows a significant meaning which means a decrease in the risk of neuropathy. The reduction in the risk of neuropathy is measured by the Diabetic Neuropathy Examination Score in the treatment group before and after foot exercise. To determine whether there is a difference in neuropathy values at the beginning (pre) and at the end of the study (post) in the group, an inferential analysis was carried out using a paired t test. The results of the test for differences in neuropathy values before & after using foot exercise in the 6-day treatment group using the Paired t test, obtained a P value = 0.00 ($p < 0.05$), this means that the use of the t test has a significant effect.

4. Distribution of Average Angiopathy Values Before and After Range of Motion (ROM) Exercise in the Intervention Group

Table 4 Distribution of Average Angiopathy Values Before and After Range of Motion (ROM) Exercise in the Intervention Group

Variables	N	Mean	P Value
Assess Angiopathy Before Range Of Motion Exercises	17	0.84	0.002
Angiopathy Score after Range of Motion Exercise	17	0.87	

Based on Table 4, the average value before treatment was 0.83 and after treatment was 0.86. These results show a significant difference in values, indicating a reduced risk of angiopathy.

The reduction in the risk of angiopathy was measured by comparing ankle systolic pressure and brachial systolic pressure. The easiest tool to measure blood pressure currently is to use a Spygnomanometer in the treatment group before and after leg exercises. To determine whether there was a difference in Angiopathy Values at the beginning (pre) and at the end of the study (post) in the group, an inferential analysis was carried out using a paired t test. The results of the difference in angiopathy Values before & after using leg exercises in the 6-Day treatment group using the Paired t test, obtained a P Value = 0.002 ($p < 0.05$), this means that the use of the t test has a significant effect.

5. Distribution of average Neuropathy Values in the control group without intervention before and after the study.

Table 5 Distribution of average Neuropathy Values in the control group without intervention before and after the study

Variables	N	Mean	P Value
Neuropathy Score before Range of Motion Exercise	18	4.89	0.579
Neuropathy Score after Range of Motion Exercise	18	4.94	

Based on table 4.6.3, the control group was assessed using DNE Scoring without any intervention. The average values were 4.89 and 4.94. From these results, there was a difference in values that showed a significant meaning, meaning there was no decrease in the risk of neuropathy. The results of the difference in neuropathy scores without intervention in the control group for 6 days using the Paired t test, obtained a P value = 0.579 (p> 0.05), this means that there was no significant effect on the DNE Score in the control group.

6. Distribution of average Angiopathy Values in the control group without intervention before and after the study

Table 6 Distribution of average Angiopathy Values in the control group without intervention before and after the study

Variables	**N**	**Mean**	**P Value**
Assess Angiopathy before Range of Motion Exercises	18	0.84	0.024
Angiopathy Score after Range of Motion Exercise	18	0.82	

Based on table 4.6.4 in the control group, an assessment was carried out using ABI Scoring without any intervention. The average value was 0.84 and 0.82. From these results, there was a difference in values that showed a significant meaning, meaning there was no decrease in the risk of angiopathy. The results of the difference in angiopathy values without intervention in the control group for 6 days using the Paired t test, obtained a P value = 0.024 (p>0.05), this means that there was no significant effect on angiopathy values in the control group.

7. Analysis of the Effect of ROM Exercise on Neuropathy Values and Angiopathy Values

Variables	N	Mean ± SD	P Value
Neuropathy Score of Intervention Group	17	1.235 ±0.831	0
Neuropathy Values of the Control Group	18	0.056 ±0.416	
Angiopathy Score of Intervention Group	17	0.023 ± 0.026	0.002
Angiopathy Value of Control Group	18	0.019 ± 0.014	

Based on the above data, the analysis data on the effect of providing ankle ROM exercises on neuropathy values and angiopathy values in the intervention group and the control group were obtained. In the Neuropathy Value, the statistical test results were p = 0.000, and this can be believed that there is a significant difference between the neuropathy values of the intervention group and the control group after ankle ROM exercises (p = 0.000 α = 0.05). While in the angiopathy value, the statistical test results were p = 0.002 and this can be believed that there is a significant difference between the angiopathy values of the intervention group and the control group after ankle ROM exercises (p = 0.002 α = 0.05)

DISCUSSION

1. Neuropathy and Angiopathy Incidence Before and After Range of Motion Exercises

Ankle ROM exercises are movements that include 2 movements, namely dorsiflexion and plantarflexion, which result in increased calf muscle strength and increase calf muscle pumps, thereby facilitating venous return, which has a positive impact on facilitating the diffusion of oxygen and nutrients (Djamaludin djunizaret, al 2019). Based on research by Rahmawati et, al (2022) by providing Active Lower ROM interventions to Diabetes Mellitus patients twice a day for 6 consecutive days at the same time. Statistically, there was an effect on ABI and DNE values before and after the Active Lower ROM intervention. This was because during the study, respondents were able to comply with the procedures set by the researcher, where respondents participated in the Active Lower ROM intervention twice a day for 6 consecutive days at the same time.

2. Distribution of neuropathy values before (Pre) and after (Post) in the intervention group

From table 3 above, the neuropathy values before (PRE) and after (POST) in the intervention group have different values where the number of intervention groups is 17 and the values obtained before (Pre) with a value range of 4-6 with a moderate category of 17 respondents. The value after (Post) obtained a value range of 1-3 with a mild category of 7 respondents and a value range of 4-6 with a moderate category of 10 respondents. This shows a significant change before and after being given treatment, seen in the value range, namely before being given treatment 17 respondents were found to have moderate neuropathy (4-6) and after being given treatment, there were 7 respondents with a mild neuropathy category (1-3) and the remaining 10 respondents with a moderate neuropathy category (4-6). This is because effective movement is given to make blood circulation smooth so that the flow of the nervous system is not disturbed.

3. Distribution of angiopathy values before (Pre) and after (Post) in the Intervention group

From table 4 above, the angiopathy values before (PRE) and after (POST) in the intervention group have the same value where the number of control groups is 17 and the values obtained before (Pre) and after (Post) the research was conducted were in the range of 0.70-0.90 with a mild category.

4. Distribution of neuropathy values before (Pre) and after (Post) in the control group

From table 5 above, the neuropathy values before (PRE) and after (POST) in the control group are the same, where the number of control groups is 18 and the values obtained before (Pre) and after (Post) the study were in the range of 4-6 with a moderate category. This is because the control group was not given any intervention so there was no significant change in the neuropathy values before and after the study. Lack of mobilization causes blood circulation, especially in the ankle area, to be disrupted and form blood clots, causing edema in the nerves, thus disrupting nerve signals (Djamaludin Djunizar et, al 2019).

5. Distribution of angiopathy values before (Pre) and after (Post) in the control group

From Table 6 above, the angiopathy values before (PRE) and after (POST) in the control group are the same, where the number of control groups is 18 and the values obtained before (Pre) and after (Post) the study were in the range of 0.70-0.90 with a mild category. This is because the control group was not given intervention so there was no significant change in the neuropathy values before and after the study. Also, the lack of mobilization makes blood circulation is not smooth and forms clots, thereby reducing contractions in the muscles in the legs (Setiawati et al, 2019).

6. The Effect of Range of Motion Exercises on the Incidence of Neuropathy and Angiopathy in Diabetes Mellitus Patients in the Medan Tuntungan Community Health Center Area

Based on the data above in table 7, the analysis data of the effect of giving ankle ROM exercises on the neuropathy and angiopathy values in the intervention group and the control group were obtained. In the angiopathy value, the statistical test results were $p = 0.000$, and this can be believed that there is a significant difference between the neuropathy values of the intervention group and the control group after doing ankle ROM exercises ($p = 0.000$ $\alpha = 0.05$), So H0 is rejected or there is an effect of ROM exercises on reducing the risk of neuropathy. While in the angiopathy value, the statistical test results were $p = 0.002$ and this can be believed that there is a significant difference between the angiopathy values of the intervention group and the control group after doing ankle ROM exercises ($p = 0.002$ $\alpha = 0.05$), So H0 is rejected or there is an effect of ROM exercises on reducing the risk of angiopathy. When viewed from the category, it seems that there is no significant change. However, the researcher intends For NoThe assessment is not based on categories but rather on the values obtained from each measurement. Looking at the values for each measurement, there are certainly differences in each variable; even within the same category, the values differ. This applies to both the intervention and control groups.

IV. CONCLUSION

In the intervention group, there was a significant difference in DNE scores between the initial and final measurements of the study in the intervention group ($p = 0.00 < \alpha = 0.05$). A significant

difference in ABI values between the initial and final measurements of the study in the intervention group ($p = 0.02 < \alpha = 0.05$). In the control group, there was no significant difference in DNE scores between the initial and final measurements of the study ($p = 0.579 > \alpha = 0.05$). And there was no significant difference in ABI values between the initial and final measurements of the study ($p = 0.024 > \alpha = 0.05$). There is an effect of ankle ROM exercises on the prevention of neuropathy and angiopathy, marked by a significant difference in DNE scores between the intervention group and the control group at the end of the study $p = 0.000 < \alpha = 0.05$, and there was a significant difference in ABI values between the intervention group and the control group at the end of the study $p = 0.002 < \alpha = 0.05$.

SUGGESTION

Applying ankle ROM exercises in the care of DM patients with a tendency towards neuropathy and angiopathy according to the criteria (without contraindications) in addition to the four pillars of DM management. Further research is needed with other types of movements involving not only the ankle but also other parts of the lower extremities, considering that vascularization is a crucial factor in diabetic foot problems. Research is needed on other factors that can prevent neuropathy and angiopathy, of course with a more representative sample size.

REFERENCE

[1]. Asep, M., Sri, MD, Baharudin, SL, & Iwan, MA (2024). The Effect of Leg Exercises on ScoreIpswich Touch Test in Type 2 Diabetes Patients. Bakti Tunas Husada Health Journal.

[2]. Aulia, AM (2023). Relationship between ABI Value and Foot Sensation Score of Patients with DM.

[3]. Buenita, S., & Alifyah, HQ (2020). Utilization of Health Services in Type 2 Diabetes Mellitus Patients. Research Article.

[4]. Cek, M., & Kaimudin. (2021). The Effectiveness of Siginjai Exercises in Reducing Blood Sugar Levels in Type 2 Diabetes Mellitus Patients in Jambi City. ***Health Journal***.

[5]. Dwi, A. (2020). The Effect of Physical Activity and Diet on Blood Sugar Levels in Diabetes Mellitus Patients.

[6]. Dwi, WB, & Azizah, KU (2021). Increasing foot sensitivity with range of motion diabetic exercise onType 2 DM sufferers. ***Edunursing Journal***.

[7]. Eka, S., Halbina, H., & Megawati. (2020). The incidence of angiopathy in the elderly withType 2 diabetes mellitus, Jongaya Makasar Community Health Center.

[8]. Felifur, FB (2023). The Relationship Between Blood Glucose Control and the Incidence of Diabetic Neuropathy.

[9]. Fitiria, A., Mira, A., Yaumil, R., Annisa, A., Hirsa, N., Puja, V., et al. (2022). The Effect of Active Lower Range of Motion on Ankle Branchial Index (ABI) Values in Type 2 DM Patients. Muhammadiyah .***Nursing Journal.***

[10]. Hamzah, H. (2023). Risk Factors IncidentDiabetic Neuropathy in Type 2 DM Patients Undergoing Outpatient Treatment at the Internal Medicine Polyclinic of Hikmah Hospital, Makassar.

[11]. Hanna, M., Fidha, R., & Muhamad, L. (2023). Diagnosis, Risk Factors, and Management of Diabetic Neuropathy.

[12]. Heni, N., Agung, W., & Insanul, F. (2024). Buerger's Influence AllenExercises for Sensitivity FootType 2 Diabetes Patients in the Masaran Region of SRAGEN. ***Jurnal Medika Usada***.

[13]. Hestri, PI, Ruris, H., Hafan, SJ, & Sri, W. (2023). Analysis of the Effectiveness of Handling Foot Gangrene with Hydrogel in DM Patients in the Catleya Room, Dr. Soebandi Jember *Regional Hospital.* ***Nursing Journal.***

[14]. Inyatul, M. (2022). The Effect of a Combination of Range of Motion (ROM) Leg Exercises and Foot Gymnastics on Foot Sensitivity in Patients

[15]. DM in the Demak II Health Center Area.

[16]. Legiran, & Ayu, T. (2023). The Relationship Between Physical Activity and Blood Sugar Levels in Type 2 Diabetes Mellitus Patients. ***Andalas Medical Journal***, 172-178.

[17]. Muhamad, B., Baharudin, K., & Sitti, R. (2021). The Effect of Foot Exercises on Neuropathy Response

Values in Type 2 Diabetes Patients at the Makasar Community Health Center (Puskesmastamalenr Ea). ***Scientific Journal of Diagnostic Health***.

[18]. Nila, P., Mulyaningsih, & Sri, H. (2020). Active Foot Range of Motion (ROM) Improves Foot Sensitivity in DM Patients.

[19]. Nina, O., Virginia, S., & Irfan, KM (2023). ImplementationDischarge Planning in Type 2 Diabetes Patients at Putri Hijau Hospital, Medan. Scientific Research Journal.

[20]. Sinta, M.(2023). Analysis of Diabetic Foot Exercise Intervention on Diabetes LevelsFoot Sensitivity in Type 2 Diabetes Mellitus Patients In the sub-districtEast Cengkareng.