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Combination of DM Gymnastics and Foot Gymnastics Toward Peripheral Vascular Neuro on Type II Diabetes Mellitus Clients

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Abstract: ***Peripheral arterial disease (PAD) is one of the complications of type 2 diabetes often encountered by DM sufferers. PAD can be detected through peripheral neurovascular examination that includes inspection of Ankle-Brachial Index (ABI), akral, and paresthesia on foot. This study is used Quasi Experiment design. The purpose of this study was to analyze the effect of physical activity on foot, foot gymnastics, DM gymnastics and foot gymnastics toward peripheral neurovascular of clients with type 2diabetes mellitus. The number of samples was 36 people in total, divided into 4 groups, each consisted of 9 respondents, who belonged to (1)the walking group, (2) foot gym group, (3) DM gym and foot gym group, and (4) control group.Consecutive sampling technique was used in this study. The independent variable is the physical activity of walking, foot gymnastics, DM gymnastics and foot gymnastics, while the dependent variable is peripheral neurovascular. The data was collected using interviews and observations using questionnaire and observation sheets. Data analysis using frequency distribution and "Anova" with α = 0:05. The results show that there is an increase in most of the value of ABI feet with walking method for 30 minutes. akral and paresthesia score with DM &foot gymnastics method for 15 minutes. It can be concluded that DM gym and foot gymnastics have good impact onfoot peripheral neurovascular of type 2 diabetes patients (p = 0.000). it is recommended that further research must be conducted about the impact of DM &foot gym with multi variables.***

Keywords: walking activity, foot gymnastics, DM and foot gymnastics, peripheral neurovascular, diabetes mellitus type 2

1. Introduction

Diabetes Mellitus is a group of metabolic diseases with hyperglycemia characteristic that occurs due to abnormalities in insulin secretion, insulin action, or both (ADA 2010 in Perkeni, 2011). Diabetes mellitus (DM) has a probability of peripheral tissue perfusion disorder resulting in diabetic neuropathy and micro as well as macro ischemia due to some metabolic and neurovascular factors (Suyono, 2009).

Peripheral arterial disease (PAD) is one of type 2 diabetes complications. PAD can be detected by using Ankle-Brachial Index (ABI) examination. Ankle brachial is an easy way to figure out circulation disorders on foot. The test is used to measure the ratio of systolic blood pressure on legs by systolic blood pressure on the arm (brachial).

In addition to medication and diet control on the client with diabetes, one of the prevention of disorders of peripheral tissue perfusion is to carry out physical activity, such as walking, DM and foot gymnastics regularly.

Walking can strengthen muscles and promote blood circulation. Walking willcreate strong muscles of leg, thighs, and also the buttocks. It can also able to increase muscle endurance because the body is moving, so the stamina can be maintained. The heart rate can be accelerated to pump the blood around the body, so that the blood circulation in the body will remain intact.

DM and foot gymnastics is an activity or exercise performed by patients with diabetes mellitus to prevent injury and help blood circulation of the foot. Foot gymnastics also can strengthen the small muscles of the foot and prevent foot deformities. The strength of the calf muscles, thigh muscles, and also overcomes the limitations of motion can also be overcame (Sumosardjuno, S, 1986 in Tyo, A, 2009).

The purpose of DM exercise is to train the muscles and joints, and enhance blood circulation on foot, while the leg exercises can help improve blood circulation and strengthen the small muscles of the foot so as to prevent the occurrence of foot deformities. Not only that it can increase calf muscles strength, muscular thighs, and also overcomes the limitations of joint movement that is often experienced by diabetes mellitus clients.

General Objective

To find out the effect of physical activity such as walking, foot gymnastics, DM and foot gymnastics toward peripheral neurovascular on type 2 diabetes mellitus client.

Specific Objectives

In particular, this study aims to:

a) Analyzing the peripheral circulation in DM client's foot before and after walking activity.
b) Analyzing the peripheral circulation in DM client's foot before and after foot exercise.
c) Analyzing the peripheral circulation in DM client's foot before and after physical activity and exercise feet gymnastics DM.
d) Analyze the effects of physical activity on foot, foot gymnastics, DM gymnastics, footgymnastics toward peripheral neurovascular ondiabetes mellitus type II clients.

Hyphotesis

1. There is an effect of walking activity towardperipheral neurovascular onType II Diabetes Mellitus client
2. There is an effect of foot gym toward peripheral neurovascular on Type II Diabetes Mellitus client 3. There is

an effect of DM and foot gym toward peripheral neurovascular on Type II Diabetes Mellitus client.

Framework

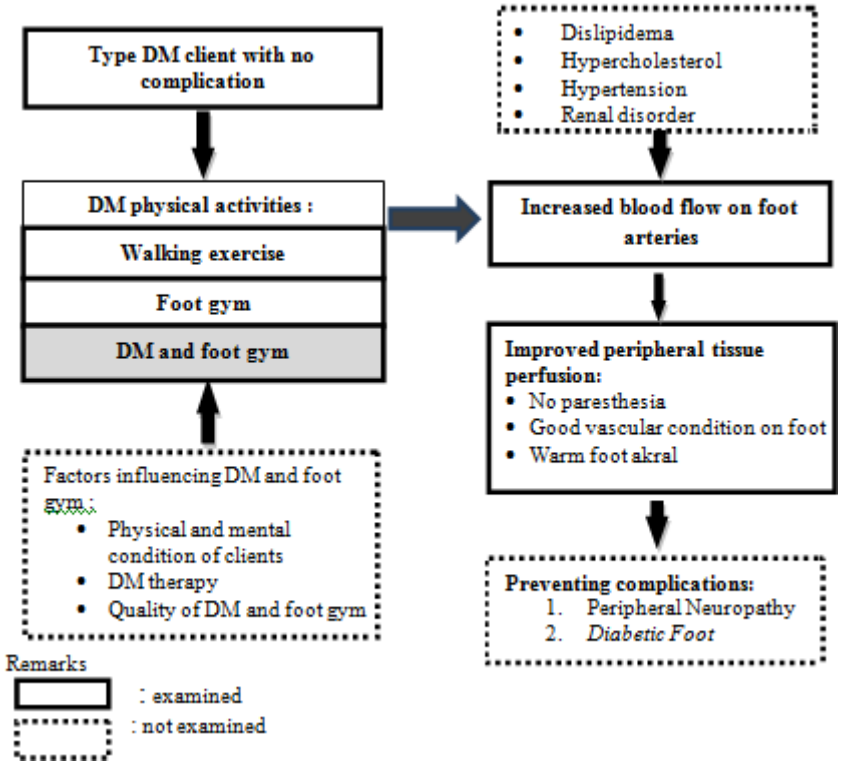

Figure 1: Framework

2. Method and Design

a. Design: Quasi Experiment
b. The number of samplesare 36 respondents, with details as follows:
1. 9 respondents on control group
2. 9 respondents onwalking physical activity group:
   a) 3 respondents walk for 30 minutes once/week
   b) 3 respondents walkfor 30 minutes 3 times/week
   c) 3 respondents walk for 30 minutes every day
3. 9 respondents on foot gym physical activity group:
   a) 3 respondents do foot gym 15 minutes once/week
   b) 3 respondents do foot gym 15 minutes 3 times/week
   c) 3 respondents do foot gym 15 minutes every day
4. 9 respondents on DM and foot gym physical activity group:
   a) 3 respondents do DM and foot gymnastics 15 minutes once/week
   b) 3 respondents do DM and foot gymnastics 15 minutes 3 times/week
   c) 3 respondents do DM and foot gymnastics 15 minutes every day

Criteria for inclusion:
1) Clients are cooperative and aged between 45-60 years.
2) Client with risk of complications and circulatory disorders and foot neuropathy

3. Result and Discussion

3.1 Result

1) Peripheral neurovascular responds in the control group (without physical activity)

Based on data obtained from the results of research through the examination of perfusion/vascularization ofrespondents' foot, the results of the exam are as follow:

Table 3.1: Frequency Distribution of akral,paresthesia, ABI (Ankle Brachial Index) in the control group

Foot	Foot akral				Foot paresthesia				ABI (*Ankle Brachial Index*)			
	Cold		Present		Mild obstruction		Normal		Mild obstruction		Normal	
	f	%	f	%	f	%	f	%	f	%	f	%
1. Right 1	1	11	8	89	3	33	6	67	2	22	7	78
2. Right 2	2	22	7	78	4	44	5	56	4	44	5	56
3. Left 1	4	44	5	56	3	33	6	67	1	11	8	89
4. Left 2	4	44	5	56	4	44	5	56	2	22	7	78

Based on Table 3.1 it can be seen that the respondents withwarm right leg akral is 89%, there is no paresthesia on right foot 1and left foot 1 with the value of 70%. ABI value of the left leg 1 is normal (89%).

2) Respondents' peripheral neurovascular in walking activity group.

The results are as follow:

Table 3.2: Frequency distribution of respondentsakral foot before and after walking activity

Foot	Foot akral				Foot paresthesia				ABI (*Ankle Brachial Index)*			
	Cold		Present		Mild obstruction		Normal		Mild obstruction		Normal	
	f	%	f	%	f	%	f	%	f	%	f	%
1. Right before the gym	5	56	4	44	6	67	3	33	4	44	5	56
2. Right after the gym	0	0	9	100	2	22	7	78	0	0	9	100
3. Left before the gym	6	67	3	33	5	56	4	44	1	11	8	89
4. Left after the gym	2	22	7	78	2	22	7	78	0	0	9	100

Based on table3.2it can be discovered that foot akral on both feet after walking activity is warm, right foot (100%) and left foot (78%),78% no paresthesia on right and left foot after walking activity, ABI values on both respondents' feet after walking is normal (100%).

3) Peripheral neurovascular of respondents on foot gym group.

Table 3.3: Frequency distribution of respondents akral foot before and after foot gym (on foot gym group)

Foot	Foot akral				Foot paresthesia				ABI (*Ankle Brachial Index)*			
	Cold		Present		Mild obstruction		Normal		Mild obstruction		Normal	
	f	%	f	%	f	%	f	%	f	%	f	%
1. Right before the gym	7	78	2	22	6	67	3	33	4	44	5	56
2. Right after the gym	3	33	6	67	2	22	7	78	0	0	9	100
3. Left before the gym	6	67	3	33	6	67	3	33	3	33	6	67
4. Left after the gym	0	22	9	100	1	11	8	89	0	0	9	100

Based on Table 3.3 it can be seen that foot akral on both feet after walking activity is warm, the right foot (67%) and left foot (100%), no paresthesia on right foot (78%) and left foot (89%) after walking activity. ABI values on both legs after walking is 100%.

4) Respondents Peripheral Neurovascular in DM & foot gym activity.

Table 3.4: Frequency Distribution of respondents foot akralbeforeand after DM &foot gym

Foot	Foot akral				Foot paresthesia				ABI (*Ankle Brachial Index)*			
	Cold		Present		Mild obstruction		Normal		Mild obstruction		Normal	
	f	%	f	%	f	%	f	%	f	%	f	%
1. Right before the gym	9	100	0	0	7	78	2	22	8	89	1	11
2. Right after the gym	2	22	7	78	0	0	9	100	0	0	9	100
3. Left before the gym	8	89	1	11	6	67	3	33	0	0	9	100
4. Left after the gym	0	0	9	100	1	11	8	89	0	0	9	100

Based on Table 3.4 it can be seen that foot akralof respondents both feet after theDM &foot is warm, left foot (100%) and right foot (78%). No paresthesia on after DM and foot gym, the right foot (100%) and the left one (89.5%), ABI value on both feet after DM &foot gym is 100%.

5) Peripheral neurovascular of DM patients before and after physical activity

The following is the analysis of foot peripheral neurovascular of diabetic patients before and after physical activity of walking, foot gymnastics, DM and foot gymnastics. The data were analyzed using paired t-test and Wilcoxon test with 5% margin of error.

Table 3.5: Results of Paired t-test Analysis

Group		Mean ± SD		t count	Sig.	Remarks
		Pre	Post			
I	Right	0.916 ± 0.050	1.068 ± 0.083	5.700	0.000	Significant
	Left	0.922 ± 0.038	1.052 ± 0.047	8.889	0.000	Significant
II	Right	0.943 ± 0.086	1.000 ± 0.073	4.907	0.001	Significant
	Left	0.940 ± 0.082	1.020 ± 0.047	3.660	0.006	Significant
III	Right	0.862 ± 0.021	0.984 ± 0.038	10.000	0.000	Significant
	Left	0.918 ± 0.015	1.001 ± 0.034	6.804	0.000	Significant
IV	Right	0.969 ± 0.103	0.932 ± 0.065	1.779	0.113	Not significant
	Left	1.004 ± 0.111	0.944 ± 0.062	2.769	0.024	

Results of paired t-test on Ankle Brachial Index (ABI) before and after walking physical activity (Group I) shows the influence of physical activity on peripheral neurovascular of foot of diabetic patients, the right foot

(significance 0.000 <alpha 0.050) and left foot (significance 0.000 <alpha 0.050).

Results of paired t-test on Ankle Brachial Index (ABI) before and after foot gym (Group II) shows the influence of foot gym on peripheral neurovascular of diabetic patients foot, on the right foot (significance 0.001 <alpha 0.050) and left foot (significance 0.006 <alpha 0.050).

Results of paired t-test on Ankle Brachial Index (ABI) before and DM &foot gym (Group III) shows the influence of DM & foot gymnastics on neurovascular peripheral of diabetic patients foot, on the right foot (significance 0.000 < alpha 0.050) and left foot(significance 0.000 <alpha 0.050).

Results of paired t-test on Ankle Brachial Index (ABI) before and after physical activity of control group (group IV) shows no increase in physical activity of control group of toward peripheral neurovascular of diabetic patients left foot, while there is no effect shown on the right leg (significance 0.113 > alpha 0.050).

Table 3.6: Results Analysis of Wilcoxon test

Group		Score			Z count	Sig.	Remarks
		Post < Pre	Post > Pre	Post = Pre			
I	Right akral	0	5	4	-2.236	0.025	Significant
	Left akral	1	5	3	-1.633	0.102	No
	Right paresthesia	1	5	3	-1.633	0.102	No
	Left paresthesia	0	3	6	-1.732	0.083	No
II	Right akral	1	5	3	-1.633	0.102	No
	Left akral	0	6	3	-2.449	0.014	Significant
	Right paresthesia	2	6	1	-1.414	0.157	No
	Left paresthesia	1	6	2	-1.890	0.059	No
III	Right akral	0	7	2	-2.646	0.008	Significant
	Left akral	0	8	1	-2.828	0.005	Significant
	Right paresthesia	0	7	2	-2.646	0.008	Significant
	Left paresthesia	1	6	2	-1.890	0.059	No
IV	Right akral	1	0	8	-1.000	0.317	No
	Left akral	2	1	6	-0.577	0.564	No
	Right paresthesia	3	2	4	-0.447	0.655	No
	Left paresthesia	2	2	5	0.000	1.000	No

Test results of foot akrall and paresthesia before and after walking physical activity (Group I) shows the influence of physical activity on right foot akral (significance 0.025 <alpha 0.050), the left foot akral(significance 0.102> alpha 0,050) ,right foot paresthesia (significance 0.102> 0.050 alpha), and left foot paresthesia (significance 0.083> 0.050 alpha) found no influence of physical activity.

Test results of foot akraland paresthesia before and after foot gym (Group II) shows the influence of foot gymonleft foot akral(significance 0.014 <alpha 0.050), the right foot akral(significance 0.102> alpha 0,050) ,right foot paresthesia (0,157 significance> alpha 0.050), and the left foot paresthesia(significance 0.059> 0.050 alpha) there is no influence of physical activity.

Test results of foot akral and paresthesia before and after before and after DM and foot gymnastics (Group III) shows the influence of DM &foot gymnastics on right foot (akralsignificance 0.008 <alpha 0.050), left foot akral (significance 0.005 <alpha 0.050), and right foot paresthesia (significance 0.008 <alpha 0.050), while the left leg paresthesia (significance 0.059> 0.050 alpha) and there is no influence of physical activity.

Test results of foot akral and paresthesia before and afterfoot gym (Group II) shows the influence of foot gym onleft foot akral (significance 0.014 <alpha 0.050), right foot akral (significance 0.102> alpha 0,050), right foot paresthesia (0,157 significance> alpha 0.050), and the left foot paresthesia (significance 0.059> 0.050 alpha). There is no influence of physical activity.

Test results of foot akral and paresthesia before and after DM & foot gymnastics (Group III) shows the influence of DM &foot gymnastics on right footakral(significance 0.008 <alpha 0.050), left foot akral(significance 0.005 <alpha 0.050), and right foot paresthesia(significance 0.008 <alpha 0.050), left leg paresthesia (significance 0.059> 0.050 alpha). There is no influence of physical activity.

Test results of foot akral and paresthesia before and after physical activity of control group (group IV) showed no effect of group activities on control group on their right foot akral (significance 0.317> alpha 0.050), left foot akral(significance 0.564> alpha 0.050), right foot paresthesia (significance 0.655> 0.050 alpha), and left foot paresthesia (significance 1.000> 0.050 alpha).

6) The comparison between physical activity and peripheral neurovascular DM patient foot

The following is the analysis of peripheral neurovasculaarof diabetic patientsfoot after physical activity such as walking, foot gymnastics, DM and foot gymnastics. Data analysis was conducted using test Analysis of Variance (ANOVA) and Kruskal Wallis test with error margin of 5%

Table 4: 21 ANOVA Analysis

		Group	Mean ± SD	Notation	F count	Sig	Remarks
Right	Pre	I	0.916 ± 0.050	ab	3.567	0.025	Significant
		II	0.943 ± 0.086	ab			
		III	0.862 ± 0.021	a			
		IV	0.969 ± 0.103	b			
	Post	I	1.068 ± 0.083	b	6.223	0.002	Significant
		II	1.000 ± 0.073	ab			
		III	0.984 ± 0.038	ab			
		IV	0.932 ± 0.065	a			
Left	Pre	I	0.922 ± 0.038	a	2.792	0.056	No
		II	0.940 ± 0.082	a			
		III	0.918 ± 0.015	a			
		IV	1.004 ± 0.111	a			
	Post	I	1.052 ± 0.047	b	7.868	0.000	Significant
		II	1.020 ± 0.047	b			
		III	1.001 ± 0.034	ab			
		IV	0.944 ± 0.062	a			

The test results of the peripheral neurovascular of diabetic patients foot on the right foot before physical activity showed significant differences between some of the physical activity performed (significance 0.025 <alpha 0.050), namely DM and foot gym which differ significantly from the control group.

The test results of the peripheral neurovascular of diabetic patients foot on the right foot after physical activity showed significant differences between some of the physical activity performed (significance 0.002 <alpha 0.050), namely walking physical activity which differ significantly from the control group.

The test results of the peripheral neurovascular of diabetic patients foot on the left foot before physical activity showed no significant differences between some of the physical activity performed (significance 0.056> 0.050 alpha).

The test results of the peripheral neurovascular of diabetic patients foot on the left foot after physical activity showed significant differences between some of the physical activity performed (significance 0.000 <alpha 0.050), such aswalking activity and foot gym differ significantly from the control group.

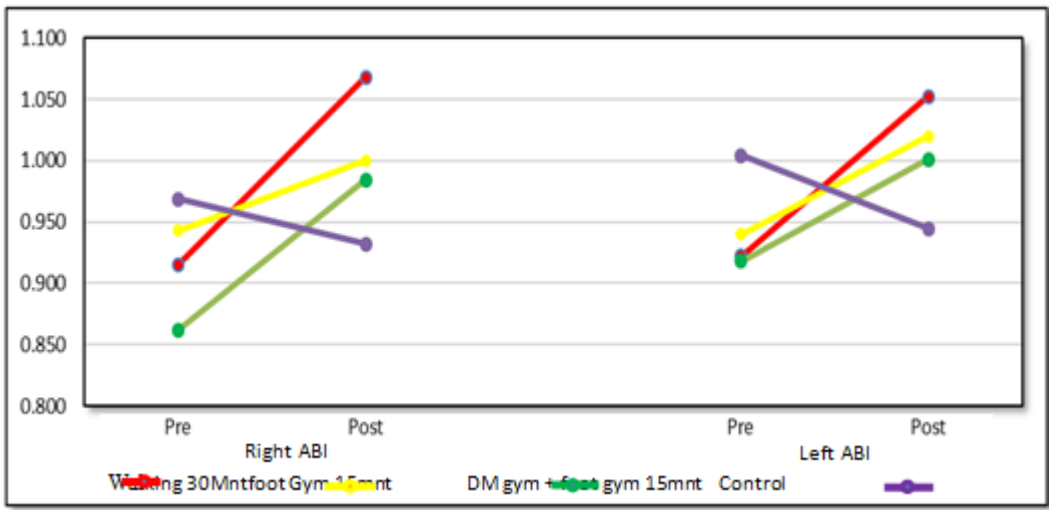

Figure 4.1: Graph of comparison between walking activity toward peripheral neurovascular (ABI) in DM patient foot

As shown in figure 4.1 there is an increase in most of the values of ABI on the right and left foot with walking method of 30 minutes.

Table 4:22. Analysis Results of Kruskal Wallis

			Chi-square	Sig	Remarks
Akral	Right	Pre	15.909	0.001	Significant
		Post	3.276	0.351	No
	Left	Pre	3.889	0.274	No
		Post	11.552	0.009	Significant
Paresthesia	Right	Pre	4.091	0.252	No
		Post	5.000	0.172	No
	Left	Pre	1.222	0.748	No
		Post	3.750	0.290	No

The test results on right foot akral showed a significant difference before physical activity among some physical activity performed (significance 0.001 <alpha 0.050), while there is no significant difference after physical activity (significance 0.351> 0.050 alpha).

The test results on left footakral showed a significant difference after physical activity among some physical activity performed (significance 0.009 <alpha 0.050), whereas there is no significant difference before physical activity (significance 0.274> 0.050 alpha).

The test results right leg paresthesia right leg showed no significant difference between some physical activity undertaken before physical activity (significance 0.252> 0.050 alpha) and after physical activity (significance 0.172> 0.050 alpha).

The test results on left foot paresthesia showed no significant difference between some physical activity undertaken before physical activity (significance 0.748> 0.050 alpha) and after physical activity (significance 0.290> 0.050 alpha).

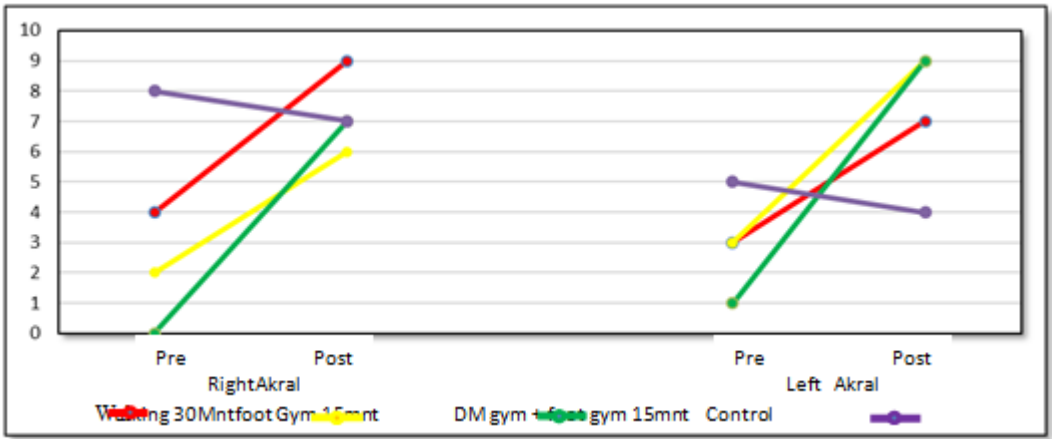

Figure 4.2: Graph of comparison between physical activity and peripheral neurovascular (ABI) of DM patient foot

As shown in figure 4.2 there is an increase in most of the scores of the right and left foot akralwith DM and foot gym for 15 minutes.

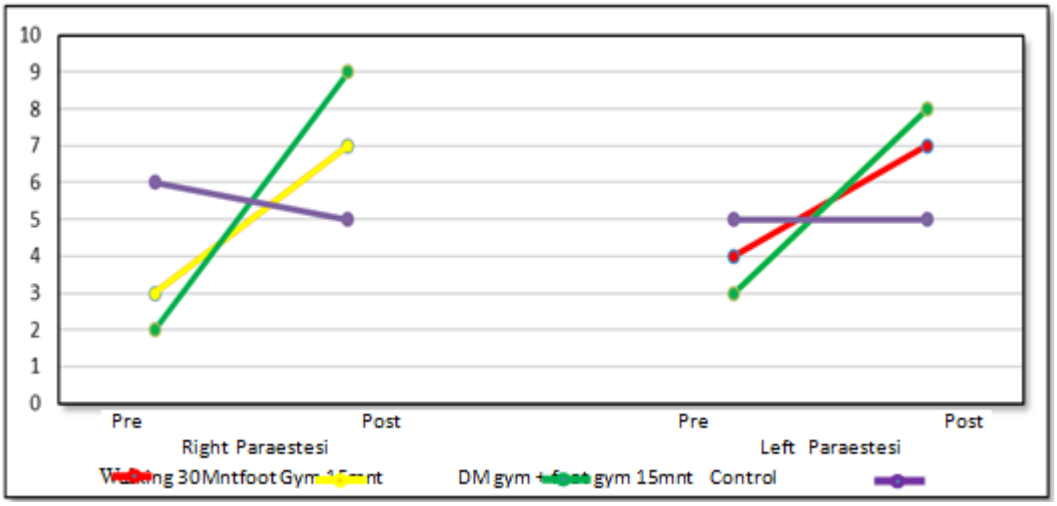

Figure 4.3: Graph of comparison between physical activity and peripheral neurovascular (paresthesia) of DM patient foot

As shown in Figure 4.3 there is an increase on the scores of most right and left paresthesia with DM and foot gym for 15 minutes.

4. Discussion

Activities on foot, foot gym, and DM & foot gym in this research were carried out every day for 6 weeks by each respondent in those 3 treatment groups. Peripheral neurovascular measurement was conducted twice before and after physical activity, by performing foot examination to check foot (cold or warm) paresthesia and ABI (Ankle Brachial Index). The researchers used SOP for foot examination, ABI measurement of and foot gym.

Peripheral neurovascular in control group.
Peripheral neurovascular measurements on respondents before (1) and after (2) in control group can be seen from the results of the foot which is showing that feet akral is cold or warm, the paresthesia and ABI score by way of comparingfoot systolic pressure with brachial systolic pressure of using digital tensimeterand its valid result.

Based on the results of the assessment on peripheral neurovascular feet akral and foot paresthesia before and after

physical activity, the control group showed no change during 6 weeks regarding right and left footakral, right and left foot paresthesia. The respondentsmost likely do modest physical activity or never do any physical activity, such as walking, DM gymnastics, and foot gymnastics. Prior to the activity,ABI respondents showed normal scores, but after six weeks there is a decrease in ABI score, due to the possibility that respondents only do modest physical activity or never do physical activity, such as walking, DM gymnastics and foot gymnastics which finally causes perfusion disorders on their feet.

This is due to the control group which did not do physical activity every day.Onfoot akralexamination the respondent has carried out activities that cannotbe avoided. Besides, most of the respondents were aged between 53 up to 58 years and most respondents stated that the have been suffered from diabetes between 6 to 10 years, so it is possible that it can influence the occurrence of decreased perfusion including temperature changes on foot akralof DM patients.

The warmth of foot akralof DM patients is influenced by superficial blood flow in the legs and feet in general circulation. akral of left and right foot are not always at the same warmth, it is influenced by the thickening of blood vessels on both legs and leg muscle strength is not always the same, thus affecting the level of activity of both legs when doing leg exercises. If foot gymactivity on both legs are not the same intensity, the results will affect akral foot perfusion.

55% of the respondents in this study mostly ranged between 53-58 years old. This is supported by Subroto (2006) who states that type 2 diabetes usually appears on people over the age of 30 years. The process of aging can lead to the progressive preparation of β cells which decreases insulin secretion and sensitivity of receptors (Subroto, 2006).

Age is closely associated with the increase in blood glucose levels. With the increasing age, the prevalence of diabetes and impaired glucose tolerance become higher. The aging process that takes place after the age of 30 years resulted in a change of anatomical, physiological and biochemical condition. Change begins from the cellular level, continue at the tissue level and finally at the organ level that may affect the function of homeostasis. One of the components of the body that are changing is the pancreatic beta cells that produce insulin, the cells of the target tissue to produce glucose, the nervous system, and other hormones that affect glucose levels. WHO explains that after the age of 30 years old, the blood glucose levels will rise to 1-2 mg/dL/yr in fasting state and going up from 5.6 to 13 mg/dL at 2 hours after eating (Sudoyo, 2006).

Paresthesia assessment on both feet showed no change to paresthesia, meaning that there is no effect of foot gymnastics on declining paresthesia. Paresthesia or tingling sensation is usually obtained from subjective recognition of respondents, so that it cannot be fully used as a guidance for the respondents withDM. Respondents sometimes feel difficult to state when and how many times they experience paresthesia every day.Respondents are not used to sporting activities or exercise, especially those who already have the disease for over than 5 years due to the thickening of the veins of the legs so that blood flow to the legs isnot smooth. It would also be affected if the respondents have hypertension and obesity as well as elevated levels of blood sugar and cholesterol.

In ABI (Ankle Brachial Index) assessment on both legs, it can be seen that ABI was normal, which means that there is gymnastics influence on ABI. This condition is supported by the fact that most DM respondents do gymnastics and walking exercise every week, and all respondents have DM routine treatment including doing some blood sugar checks. As many as 60% of respondents do DM gymnastics that contributes to the increase in blood flow to feet.DM gym can improve blood flow throughout the body, including the feet, thus affecting feet perfusion, including the ABI of both feet.

Peripheral neurovascular on physical activity group

The measurement of peripheral neurovascular of the respondents before foot gym on treatment group is similar to control group which can be seen at the time of data collection as results of the akral foot examination, paresthesia and ABI score.

Based on the results of the akralassessment on both feet after exercise, it showed that the measurement of the foot was significant, which means that there is no influence on foot akral. It happens because this group does leg exercises every day for 6 weeks, so that blood flow to the legs is more fluent and feet akralbecomes warmer.Besides, this group was not only undergoing foot gym every day but also DM gymnastics every week, so the blood flow to the leg ismore smooth and the foot akralis warm.

Assessment on foot paresthesia found out that both legs are normal with no paresthesia, it means that there is an influence of activity on paresthesia. Its paresthesia level is obtained from the subjective statement of the respondent, so it is less objective because the respondents with DM disease often feel that their feet is tingling if they sit too long. Respondents sometimes feel difficult to state when and how many times they experience paresthesia every day. Respondents are not used to sporting activities or exercise, especially those who already have the disease for over than 5 years due to the thickening of the veins of the legs so that blood flow to the legs is not smooth. It is also influenced by the majority of respondents who are aged between 53 up to 58 years and mostly suffer from diabetes between 6 to 10 years, especially if respondents have hypertension and obesity as well as elevated levels of blood sugar and cholesterol, so it is possible to influence the occurrence of decreased perfusion including paresthesia.

Paresthesia on both feet are not always the same, it is influenced by the thickening of blood vessels on both legs which are different too and both leg muscles strength is also not always the same, thus affecting the level of activity of both legs when doing foot gym. If foot gym activities on both legs are not the same intensity, the results affect perfusion decrease.

In ABI (Ankle Brachial Index) assessment on both legs, it can be seen that ABI was normal, which means that there is gymnastics influence on ABI. This condition is supported by the fact that most DM respondents do gymnastics and walking exercise every week, and all respondents have DM routine treatment including doing some blood sugar checks.

Conditions of hyperglycemia causes increased oxidation products. Glucose combines with proteins to produce glycosylated proteins can be damaged by free radicals, and the combination with the fat will form Advanced Glicosylated End Products (AGEs) that damage tissue sensitivity (Head, 2006). Damage to the sensitivity of this tissue will eventually lead to decreased sensation of protection.

It is also influenced by several factors, namely the majority of respondents in this study is female.Research by Booya et al (2005) shows that potential risk for diabetic neuropathy is more on female respondents than male respondents.

Other than that because most of the member in the treatment group arehousewives, then their frequency of doing sport activity is minimal. It can be suggested from the data that a number of respondents did not do some sports. Dongoes (2001) states that exercise has many benefits, among others areimproving and controlling blood sugar, lowering the risk of cardiovascular disease (if done at least 30 minutes, 3-4 times/week until HR reached to 220-age/min), weight loss, and causing excitement.

After doing leg exercises on a regular basis, then an increase in the value of ABI in both legs and both feet akral become warmer. Paresthesia also decrease, this is in accordance with the theory that exercise activity can improve feet perfusion so that the client have more sensitivity.

Tappan and Benjamin (1998) and Turner (2005) in Turner & Merriman (2005) state that the effect of leg exercises may increase blood flow to the legs or improve perfusion of peripheral tissues including the legs of DM client.

In this study, according to the researchers, in addition to the effect of foot gymnastics, there are several other factors that also affect it, among others aremedication history that the majority of respondents (60%) had undergone treatment for 5 years byroutinely perform a physical examination and blood sugar levels every month consists of taking medication glibenclamide, a combination of glibenclamide and metformin. The benefits of these drugs in general is to prevent hyperglycemia. Since neuropathy is triggered by changes in the blood vessels, causing nerves hypoxia.Both axon and myelin suffered damage due to decreased blood flow, resulting in barriers to the transmission of nerve impulses. Excess glucose is converted into sorbitol and will be accumulated in the nerves. Increased sorbitol also causes failure of the motor nerve conduction (Ignativicius& Workman, 2006). With this treatment, the patient's blood sugar levels can be controlled so that thesorbitol increase which causes nerves conduction failure can be minimized.

In addition, as many as 70% of respondents do DM gymnastics every week, this contributes to an increase in blood flow to legs.DM gym can improve blood flow throughout the body, including the feet, thus affecting perfusion in feetakral and ABI legs.

5. Conclusion and Recommendation

5.1 Conclusion

Based on the research results it can be concluded that:

1. Walking activity toward peripheral neurovascular on patients with diabetes mellitus foot:
   1) ABI on both legs increases.
   2) Right foot akral is warmer than the left foot
   3) Paresthesia on both feet still present.
2. Foot gymnastics toward peripheral neurovascular on patients with diabetes mellitus foot:
   1) ABI on the right foot is better than the left foot.
   2) Left footakral is warmer than on the right foot
   3) Paresthesia on both feet still present
3. DM and foot gymnastics toward peripheral neurovascular on patients with diabetes mellitus foot:
   1) ABI on both legs increased
   2) Left footakralis warmer than the right foot
   3) Paresthesia on right foot is lower than the left foot.

5.2 Recommendation

Further research is expected to study about:

1) The effect of DM &foot gymnastics with multi variables.
2) Factors that affect the success of DM &foot gymnastics (age, duration of diabetes mellitus, experience and knowledge of the foot gymnastics, medical history, smoking history, sports activities, etc.).

References

[1] Adam. 13 September 2008. *Perawatan Kaki Diabetes*, (Online), (http://www.Perawatan Kaki Diabetes smallCrab online.mht, diakses tanggal 11/6/2009 pukul 20:38 WIB)
[2] Arikunto, S. 2006. *Prosedur Penelitian Suatu Pendekatan Praktek.* Edisi Revisi 6. Jakarta: Rineksa Cipta
[3] Askandar. 2001. (Online), (http://abhique.blogspot.com/2008/06/ulkus-diabetikum.html, diakses tanggal 6/6/2008)
[4] Brunner and Suddart. 2001. *Buku Ajar Keperawatan Medikal Bedah.* Edisi 8. Jakarta: EGC
[5] Canadian Family Physycian. 2001. *Diabetic Foot Ulcer, Pathophysiology, Assessment, and Therapy.* Can Family Physycian
[6] Depkes RI. 9 Juni 2005. *Diabetes Mellitus Masalah Kesehatan Masyarakat yang Luas*, (Online), http://med.depkes.ac.id/DataJurnal/tahun2005vol26/vol 26No.3Supple-men/9-John%20, diakses tanggal 31/9/2012 pukul 21:38 WIB)
[7] Handaya, Yuda. 2009. *Ulkus Diabetikum*. (Online), (http://dokteryudabedah.com/ulkus-kaki-diabetes.html, diakses tanggal 3/12/2009)
[8] Hasan, Fuad. 2010. *Gambaran Pengetahuan Dan Sikap Diabetesi Tentang Perawatan Kaki Dalam Mencegah Terjadinya Ulkus Diabetikum Di Wilayah Kerja Janti*

Malang. Malang: Politeknik Kesehatan Kemenkes Malang
[9] International Diabetes Federation. 2009. *International Consensus on the Management and the Prevention of the Diabetic Foot*, (Online), (http://www.diabetic-foot-consensus.com, diakses tanggal 25/8/2009 pukul15:09 WIB)
[10] Ira, 17 Oktober 2008. *Diabetes Serang Malang*. (Online), (http://malangraya.web.id/2008/10/17dibetes-serang-malang, diakses tanggal 31/7/2009 pukul 14.33 WIB)
[11] Mansjoer. 2000. *Kapita Selekta Kedokteran*. Jakarta: Media Aesculapius.
[12] Martinus. 2005. 1001. *Tentang Diabetes.* Bandung: Media Inc
[13] Nico, A. 2008.*Perawatan Kaki Diabetes*.(Online), (http://www.Perawatan-kaki-DM-tanyajawab_smallCrab_online_mht, diaksestanggal23/8/2009 pukul 16.37 WIB)
[14] Notoatmodjo. 2002. *Metodologi Penelitian Kesehatan*. Jakarta: EGC
[15] Nursalam. 2003. *Konsep & Proses Metodologi Penelitian Ilmu Keperawatan: Pedoman Skripsi, Tesis dan Instrumen Penelitian Keperawatan*. Jakarta: Salemba Medika
[16] Price, A.2005. *Patofisiologi: Konsep Klinis Proses-proses Penyakit Edisi 6.* Jakarta: EGC
[17] Putu, I. 2005. *Patofisiologi dan Biomekanisme Diabetic Foot Ulcer*. (Online), (http://ackogtg.wordpress.com, diakses tanggal 27/7/2009 pukul 18.27 WIB)
[18] Smeltzer and Bare. 2002. *Buku Ajar Keperawatan Medikal Bedah Edisi8 Volume 2.* Jakarta: EGC
[19] Sugiyono. 1999. *Metode Penelitian Administrasi*. Bandung: Alfabeta
[20] Tandra, Hans. 2008. *Segala Sesuatu Yang Harus Anda Ketahui Tentang Diabetes Tanya Jawab Lengkap Dengan Ahlinya.* Jakarta: PT. Gramedia Pustaka Utama
[21] Tjokronegoro. 1997. *Ilmu Penyakit Dalam Jilid 1*. Jakarta: Balai Penerbit FKUI
[22] Tyo,A.2009. *Senam Kaki Diabetes*.(Online), (http://akh-tyo.blogspot.com/2008/04/senam-kaki-diabetes.html, diakses tanggal 23/8/2009 pukul 16.12 WIB)
[23] WHO. 2000. *Pencegahan Diabetes Melitus, laporan kelompok studi WHO*. Jakarta: Hipokrateas