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Active Lower Range of Motion (ROM)-Assisted Wooden Roller Reflexology Increasing Foot Sensitivity in Type II Diabetes Mellitus Patients

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ABSTRACT

Chronic hyperglycemia in diabetes mellitus non-enzymatic glycosylation and excessive glucose to intracellular diffusion leads to structural abnormalities and capillary function as well as peripheral nerve injury. Nerve cell injury and supported by capillary dysfunction lead to neuropathy. This study aims to determine the effect of active lower ROM-assisted by wooden reflexology roller on the sensitivity on type II Diabetes patient's. The design was quasi experimental with pre and posttest non-equivalent control group design on 36 respondents selected by purposive sampling at PHC I North Denpasar and control at PHC II Abiansemal. The result showed that the average sensitivity of the respondent's feet in the treatment group increased from 11.56 to 17.17 with the result of the paired t test is 0,00, it means there is influence of the exercise on the foot sensitivity, while the sensitivity of the control group's foot increases from 11.44 to 11.50 but the result of Wilcoxon Sign Rank Test is 0.91 and means no significant changes on patient's foot sensitivity. The difference average between these two groups was tested with Mann Whitney U Test obtaining result 0,00 which stating that there was a significant difference between the treatment and control group. Based on that, it's suggested to the health service unit to arrange procedure so this exercise can be applied to DM patient.

Keywords: *neuropathy diabetic, active lower ROM, wood reflection*

INTRODUCTION

Diabetes Mellitus (DM) is a chronic condition that occurs when glucose levels in the blood is increasing because the body cannot produce insulin or use insulin ineffectively, type II DM is the most common case of diabetes. Approximately 90% of patients have DM type II of all cases of DM [1].

In type II of DM, chronic hyperglycemia occurs due to insulin resistance so that tissue becomes ineffectively to take glucose. This condition maycause Diabetic Neuropathy (ND)[2];[3].

ND is characterized by decreased foot sensitivity like thickness, tingling, pain, and burning[4]. A research suggests that 84.37% of patients experience decreased foot sensitivity ranging from moderate sensitivity to not feel the touch at all[5]. Another study also revealed that the mean sensitivity of the patient's foot decreased to 3.07 (standard deviation = 1.71) in the treatment group and 3.73 (standard deviation = 1.79) in the control group before doing exercise[6].

The disorder is characterized by loss of pain sensation and inability to feel the temperature changes arising as a result of minor sensory nerve damage (C-*fiber*), whereas the disturbance manifested by loss of sensation when touched or given vibration, *proprioception,* motor neuronal disorders is the result of major neural damage (A-Delta). Peripheral neuropathy may occur with or without early symptoms. Initial symptoms perceived by diabetics include loss of sensation and ongoing pain [9].A study in the United States showed that about 15% of DM patients are estimated to have DF at sometimes in their lives, and the study also found that 60-70% of DF starts

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from neuropathy ([10]*in*[11]).

Efforts to treat symptoms of sensitivity decreasing are necessary to prevent neuropathy. The DM management strategy with complaints of sensitivity decreasing is divided into three parts. The first strategy is diagnosing as early as possible, then the second one is doing the best glycemic control and foot care, and the third strategy aimed at controlling the complaints of sensitivity decreasing after the second strategy is implemented. Foot care can be done by keeping the skin clean and avoid foot trauma[2].

One of physical exercise that can be applied to DM patients is ROM exercises to increase muscle strength, increase joint flexibility, and decrease plantar foot pressure [12]. When the contraction occurs, blood will flow into the vein and will be refilled from the arteries during relaxation vase. Blood in the veins will not return to the original blood vessels because there are venous valves[13]. Increased blood flow can encourage the production of NO which can keep the endothelial (the lining of the walls). NO can stimulate the formation of *endothelial derive relaxing factor* (EDRF) which plays an important role in vasodilatation or dilation of the arteries. NO also plays an important role in keeping blood pressure normal[13].

Reflexology can stimulate the decrease of HbA1c so that sorbitol doesn't accumulate and the production of NADPH co-factor increases. Reflexology technique in this study using wooden reflexology. As described in chapter two that this reflective wood has an elongated shape with a smooth bulge surface that can squeeze as well as massage the reflexology point on the sole of the foot but does not pose a harm to the patient's foot. Sliz *et al.*in 2012explained that reflexology therapy can be done with a tool made of wood. The wood is rolled on the floor using the soles of the feet. The cerebral system will suppress the amount of pain signals entering the nervous system by activating a pain system called analgesia when the pressure point is massaged or touched and given a flow of energy[16]. When the massage creates a pain signal, the body pulled out morphine which secreted by the cerebral system so that it relieves pain and creates a pleasant feeling *(euphoria)*. The reaction of the body's reflexology will excrete the neurotransmitters involved in the analgesia system, especially the encephalin and endorphins that play a role in inhibiting pain impulses by blocking the transmission of these impulses in the cerebral and spinal cord systems[16,17].

MATERIALS AND METHOD

This research was conducted using *quasi experimental*, *pre and posttestnon-equivalent control group design*. The number of samples used were 18 people in each group selected according to the inclusion and exclusion criteria: men and women who were willing to be respondents in this study, aged between 40-79 years, had a history of having type II DM ≥3 years, not with joint, heart, and shortness of breath, not experiencing complications of diabetic ulcers (already injured and under treatment), and not with a history of trauma or injury (currently in the treatment stage).

Active role of ROM assisted wooden roller Reflexology was done twice a day in two weeks starting from April 21th until May 5th 2018 at Public Health Center (PHC) I North Denpasar and PHC II Abiansemal. The foot sensitivity data of both groups on the pre- and post-exercise were measured using the *Semmes Weinstein 10gmonofilament*. The data analysis used is univariate analysis and bivariate analysis using *paired t-test, Wilcoxon Sign Rank test,* and *Mann U Whitney test*.

RESULTS

The result of bivariate analysis on this research is as follows: From 20 points that have been tested using monofilament at pretest, the respondent can still feel the stimulation with the average sensitivity of the of the respondent in the treatment group before the training is 11.56 (standard deviation 1,338) and control group is 11,44 (standard deviation 2,26).

Final measurements (posttest) showed that from 20 points tested again using monofilament, there was an increase in the level of sensitivity of the respondents in the treatment group after the active lower ROM-assisted wooden roller reflexology was 17.17 (standard deviation 1.75) and the control group was 11.50 (standard deviation 1.69).

Meanwhile, respondents who still cannot feel the stimulus (neuropathy) at certain points are presented in the table below as follows:

Table 1. Distribution of Neuropathy at Checkpoint of Respondents' Foot Before and After Given Exercise

Check Point	Number of Respondents							
	Treatment Group				Control Group			
	Right		Left		Right		Left	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
a	5	4	8	4	9	7	9	10
b	6	3	10	6	5	6	4	5
c	12	5	9	4	10	8	11	11
d	9	2	12	5	12	14	14	12
e	15	5	12	4	13	11	16	14
f	9	4	7	4	5	6	4	4
g	12	6	15	7	15	14	15	16
h	13	6	8	5	14	12	3	5
i	13	7	11	6	14	14	14	16
j	3	2	3	2	3	4	4	4

Description:

a : Under the thumb
b : Under the middle finger
c : Lower pinkie
d : Metatarsal head 1
e : Metatarsal head 3
f : Metatarsal head 5
g : Middle foot
h : Lateral
i : Heel
j : Dorsum

Based on these data, it can be seen that the MTH point has neuropathy nearly on both legs and both groups of respondents before given exercise. Meanwhile, the final test shows the number of respondents who experienced neuropathy in the treatment group less than the control group.

The result of *paired t-test* in the treatment group and the *Wilcoxon Sign Rank Test* in the control group obtained the data of sensitivity level of patient's feet DM type II presented in the form of picture below:

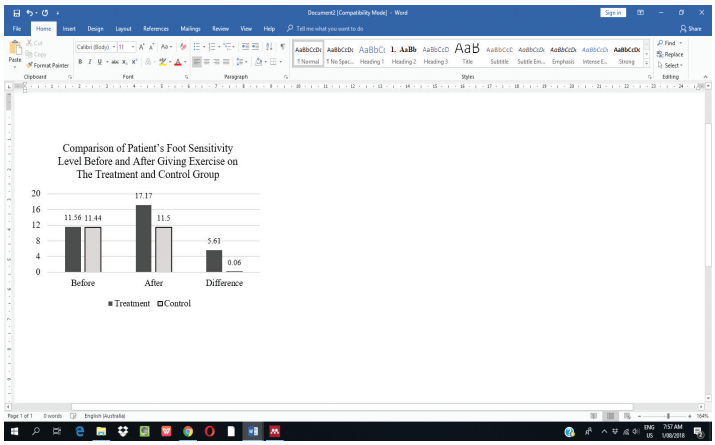

Figure 1. Comparison of Patient's Foot Sensitivity Level Before and After Giving Exercise on The Treatment and Control Group

DISCUSSION

The result of the research shows before doing active lower ROM-assisted wooden roller reflexology, the average in the treatment group is 11.56 with the standard deviation 1,338. Based on the results of this study, the number of respondents who can feel the point of MTH 3 on the right and left foot of the treatment group and left foot of the control group is less than at the other point. A study proves that the highest plantar pressure is found on the feet of the MTH section[18]. Biomechanically, of the three sites with the highest incidence of ulceration (heel, metatarsal, and thumb), there is a plausible explanation for why only metatarsals are associated with higher plantar pressure. The upper part of the MTH is the back of the foot which bearing the weight of body more than the weight at each step. The MTH region is a heterogeneous and complex part with many types of soft and thin plantar tissue. In contrast, the heel and thumb have a simpler anatomy (skin, plantar fat, and bone) with a thicker plantar soft tissue[19].

The patients' foot sensitivity before and after exercise is different. The level of sensitivity of the patient's foot after being given active lower ROM-assisted wooden roller reflexology exercises for 2 weeks increased from an average of 11.56 to 17.17 at the *post test level* by a margin of 5.61. The result of the statistical test using *paired t test* obtained the *p value* (*Sig. 2-tailed*) of 0.000 (p *value*<0.05), it shows that there is significant difference between the sensitivity level of the patient's foot before and after given exercise.

A study showed that the patient's foot sensitivity level was increased after reflective massage therapy from 11.38 to 13.63 with *p value* 0,000 (p <α), this result means that there was a significant difference between the mean sensitivity level of the feet before and after in the experimental group. The other ones also showed an increase in the mean sensation of intervention group protection after being given active-less ROM exercises from 2.38 to 4.58 and the results showed a significant difference between *pre* and *posttest* with *p value* = 0,00 and α = 0.05[20].

Those above studies and this study have similarities to prove that there is significant influence of the exercise given to the treatment group, but the margin is different. The average difference of treatment group in this study was 5.61, while Lisnawati's research was only 1.69 and Widyawati only 2.2. In this case the two previous studies and this study both used the physical exercise method as an independent variable, but the form of exercise given was different. Lisnawati applied the reflexology massage and Widyawati applied the active lower ROM exercises in the treatment group while in this study combined those two into the active lower ROM-assisted wooden roller reflexology (wood as a means of reflexology session). Thus it can be proven that their collaboration resulted in increased leg sensitivity more than previous studies.

The results showed that *pretest* the control group showed an average of 11.44 with a standard deviation of 2.255. The sensitivity level of type II diabetic patients in *pre* and *posttest* has a difference. The foot's sensitivity level at *posttest* increased from an average of 11.44 to 11.50 with a difference of 0.06. However, the result of statistical test using *Wilcoxon Sign Rank Test* showed *p value* of 0.908 (*p value*> 0,05) so it can be concluded that there is no significant change of sensitivity of DM type II patients in the control group in both *pre* and *posttest*.

A similar study conducted by Lisnawati and Hasanah proved that the average sensitivity level of the foot in the control group increased by 0.09 but *p value* 0.334 (*p*> α) which means no significant influence between *pre* and *posttest*. The control group's respondents only received standard treatment such as education, elderly gymnastics, and examination with standard drug i.e. Metformin 500 mg which was held regularly every week at PHC. The education provided at both PHC is not helpful in relation to the delivery of material that is often poorly understood by the patient. This is evidenced by the results of interviews, which most patients say do not know about complications that may occur when the DM is uncontrolled. The gymnastics have not met the standard of Control and Prevention of Type 2 Diabetes Mellitus by PERKENI and do not specifically resolves the symptoms of decreasing the sensitivity of the patient's foot such as tingling, thickness, and numbness in the sole of their foot[21-23].

The statistic result of *Mann Whitney U Test* in this research shows that *p value* = 0,00 (*p value*<0,05) so it can be concluded that there is a significant difference between treatment groups given active role ROM assisted wooden roller reflexology with control group which only given standard treatment. Based on the results of research can be proved that active role ROM assisted wooden roller reflexology more effectively improve the sensitivity of the foot better than doing standard treatment.

CONCLUSIONS

This study found that: 1) The mean *pretest* of sensitivity level of respondent of treatment group was 11,56 and control group was 11,44; 2) The average *posttest of* respondent group's sensitivity level is 17,17 and control group is 11,50; 3) There were significant differences in values of *pre* and *posttest* sensitivity of DM type II patients in treatment group by 5.61 and *p value* (*Sig. 2-tailed*) by 0.000 (*p value* < 0.05); 4) There was no significant difference in values of *pre* and *posttest* sensitivity of DM type II patients in control group with difference 0.06 and *p value* (*Sig. 2-tailed*) of 0.908 (*p value*> 0,05); and 5) There was an influence of active lower ROM-assisted wooden roller reflexology on the sensitivity of DM type II patients in treatment group with *p value* (*Sig. 2-tailed*) in test *Mann U Whitney* of 0.001 (*p value* < 0.05).

COMPETING INTERESTS

The authors declare that they have no competing interests.

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