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# Combination diabetic foot spa, rubber band resistance exercise and music therapy in patients with diabetes mellitus

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## Combination diabetic foot spa, rubber band resistance exercise and music therapy in patients with diabetes mellitus



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### ABSTRACT

**Introduction:** People lack physical activity, while food substances that enter the body and are not used for activities cannot be burned but will be stored by the body as fat and sugar, which can cause DM. Non-pharmacological therapies can be done through physical therapy. The study aimed to determine the effectiveness of the combination diabetic foot spa, rubber band resistance exercise and music therapy in patients with diabetes mellitus.

**Methods:** This research was a pre-experimental design. They included 230 DM patients, and the sample was finalized at 150 respondents. The independent variable was diabetic foot spa, rubber band resistance exercise and music therapy, while the dependent variables were blood glucose levels, the ankle-brachial index, and foot sensitivity. The data was analyzed using a t-test and Wilcoxon rank test.

**Results:** Diabetic foot spa, rubber band resistance exercise and music therapy in early neuropathy detection testing have a blood glucose level of  $t=15.808$  and  $p\text{-value}=0.000$ . This therapy also significantly affects an ankle-brachial index (ABI) with  $p<0.001$  and foot sensitivity with a  $p\text{-value}<0.001$ .

**Conclusion:** Diabetic foot spa, rubber band resistance exercise and music therapy done regularly and independently can reduce complication rate in DM patients such as tingling and pain in the feet can be reduced or even disappear and prevent complications of foot infections that can often lead to amputation. Health workers can use this innovation to improve the health status of DM patients.

**Keywords:** diabetic foot spa, rubber band resistance exercise, music therapy, DM.

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### INTRODUCTION

People tend to do less physical activity, while food substances that enter the body and are not used for activity cannot be burned but will be stored by the body as fat and sugar. This will cause Diabetes Mellitus (DM).<sup>1</sup> DM is a metabolic disorder characterized by hyperglycemia (increased serum glucose levels) due to a lack of insulin hormone, decreased insulin effect or both.<sup>2</sup> Type 1 DM is generally acquired since childhood with pancreatic beta cell damage due to autoimmune, genetic or idiopathic factors. In contrast, Type 2 DM is generally acquired after adulthood due to insulin resistance associated with lifestyle changes.<sup>3</sup>

The 2019 eighth edition of the Diabetes Atlas from the IDF (International Diabetes Federation) states that 425 million worldwide, or about (8.8%) of

people aged 20 to 79 years have diabetes. The IDF stated that the number of DM sufferers in Indonesia in 2017 reached 10.3 million and is estimated to increase to 16.7 million in 2045.<sup>4</sup> WHO 2018 explains that 1.6 million or (4%) people worldwide die from DM. East Java ranks 10th with the highest number of people with diabetes mellitus in Indonesia.<sup>5</sup> One of the regions in Indonesia with the highest number of people with diabetes is East Java Province, with a prevalence of DM sufferers of 2.1% in the top 10, namely in the fifth place in the prevalence of people with diabetes mellitus in Indonesia. Bondowoso's public health results in 69,335 visits to diabetes in 2018.<sup>6</sup>

Lifestyle changes such as diet and exercise habits are a predisposition to insulin resistance. So that blood sugar levels can always be controlled, people with diabetes need to strive for a healthy

lifestyle, namely by regulating how to eat so that they don't overeat and increasing physical activity so that the body stays healthy and avoids complications that may occur. Diabetes control in Indonesia is mostly managed using drugs, even though drugs are not the only way that can be used for the management of DM. DM management by regulating food, exercise, and drugs. Rehmaina's research (2017) results on physical activity activities, diabetes gymnastics and walking, are very well done by people with type 2 diabetes mellitus to reduce blood sugar levels.<sup>7</sup> Diabetes exercise activities in patients with type 2 DM indicate that sports activities carried out properly, correctly, regularly and measurably will help stabilize blood sugar levels, and help reduce the need for insulin or drugs and maintain body weight.<sup>8,9</sup>

Non-pharmacological therapy that

can be done is physical therapy, one of which is diabetic foot spa.<sup>10,11</sup> Foot spa is a foot treatment in cleansing and massage with warm water, which usually uses a special salt mixture for foot spa.<sup>12,13</sup> Other techniques and facilities for physical exercise in patients with type 2 DM use rubber band resistance in combination with music therapy. Music therapy can increase the production of endorphins and serotonin hormones, making individuals feel happier and reducing anxiety.<sup>14</sup> Based on the description of the data and background above, the researchers are interested in conducting a study entitled "Combination diabetic foot spa, rubber band resistance exercise and music therapy on patients with diabetes mellitus."

## MATERIALS AND METHODS

### Materials

This study uses a pre-experimental design with one group pre-test and post-test design. The population in this study was 230 patients with Type 2 DM who visited the Kotakulon Bondowoso Public Health Center. The sampling technique in this study used non-probability sampling purposive sampling with a total of 150 respondents divided into an intervention group of 75 respondents and a control group of 75 respondents.

### Data collection procedures

The data collection method used in this research is by means of observation. The materials and equipment to check blood sugar levels include a blood glucose test meter, glucose strips, alcohol swabs, and lancing devices. The instrument for measuring the Ankle Brachial Index (ABI) uses a non-mercury-type sphygmomanometer. The instrument used to measure foot sensitivity was the hammer reflex and cotton swab. The tools needed for intervention other than foot spa tools are rubber bands, tape recorders and watches.

Before the intervention, the respondent conducted a pre-test measuring blood sugar levels and blood pressure. After the intervention, the respondent conducted a pulse check to determine the target heart rate. The physical exercise treatment of the diabetic foot spa is carried out with foot care activities which include foot exercises,

skin cleansing, pedicure and foot massage, combined with rubber band resistance exercise, which is a series of rubber bands with a length of 1 m consisting of 5 rubbers in 1 cover for training muscle endurance and music therapy given for 1 month with a frequency of exercise 2 times a week independent activity, 1 time a week joint exercise and post-test blood sugar levels, blood pressure and pulse. Exercise time is 30 minutes, where each movement consists of 5 minutes, 15 minutes of core training, 5 minutes of cooling down, and 5 minutes of stretching.

### Data analysis

Data analysis used univariate and bivariate analysis. Univariate analysis was to see the distribution and frequency of the dependent and independent variables. Bivariate analysis determined the effect between the dependent variable and independent variables were analyzed by t test for blood glucose levels and Wilcoxon test for ABI and foot sensitivity with  $\alpha = 0.05$ . This research has passed the ethics test by the Ethics Commission of Universitas Nahdlatul Ulama Surabaya with No. 183/EC/KEPK/UNUSA/2022

## RESULTS

Based on Table 1 it is explained that the majority of respondents are in the 45-60 age range as many as 58 respondents (77.3%) for the intervention group and 54 respondents (72.0%) for the control group.

Based on the gender of the

respondents, almost half of them were women, both in the intervention group, 46 respondents (61.3%) and the control group, 47 respondents (62.7%). Based on marital status, both the intervention and control groups were all married (100%). Based on the BMI (body mass index), the majority of respondents had a normal category, as many as 57 (76%) people for the intervention group. In comparison, the fat category was 54 (72%) people for the control group.

## DISCUSSION

### Blood glucose level

Based on the study's results listed in Table 2 it is known that blood sugar levels before treatment, out of 75 respondents (100%), had abnormal blood sugar levels, with an average blood sugar level of 276.93 mg/dl. The results showed that all respondents with abnormal blood sugar levels before several influencing factors could cause the intervention. This follows the theory put forward by Tandra (2018), which says that the risk factors associated with developing type II diabetes are heredity, overweight, lack of exercise, age, gender, stress and excessive food intake.<sup>15</sup> Low levels of physical activity affect the occurrence of insulin resistance in type II diabetes. At the same time, active in exercise have better insulin and glucose profiles than inactive individuals. Risk factors for diabetes mellitus include heredity (genetic), namely genetic factors that can directly affect beta cells and change their ability

**Table 1. Characteristics of patients with diabetes mellitus type 2 (n = 150)**

No	Variable	Group	
		Intervention (%)	Control (%)
1.	Age (Years)		
	< 45	8 (10.7 %)	10 (13.3 %)
	45-60	58 (77.3 %)	54 (72.0 %)
2.	Gender		
	Male	29 (38.7 %)	28 (37.3 %)
	Female	46 (61.3 %)	47 (62.7 %)
3.	Marital status		
	Singel	0	0
4.	Married	100 (100%)	100 (100%)
	Body Mass Index (kg/m2)		
	Thin	18 (24.0 %)	47 (62.7%)
	Normal	57 (76.0%)	28 (37.3%)
	Obesity	27 (36.0%)	54 (72.0%)
	Overweight	48 (64.0%)	21 (28.0%)



**Table 2.** The dispute of the blood glucose levels, the ankle-brachial index, foot sensitivity, and before and after the intervention of a combination diabetic foot spa, rubber band resistance exercise and music therapy

Variable	Mean	Std. Deviation	Std. Error Mean	p-Value
Blood glucose level				
Pre-test	276.93	15.808	58.342	0.000
Post-test	227.93	18.695	69.534	
ABI (ankle-brachial index)				
Pre-test	3.77	0.814	0.169	0.001
Post-test	3.86	0.417	0.039	
Foot sensitivity				
Pre-test	2.75	0.523	0.117	0.001
Post-test	3.25	0.000	0.000	

to recognize beta cells and change their ability to identify and disseminate insulin secretory stimuli. Obesity or overweight is over 20% of ideal body weight or BMI (Body Mass Index) more than 27 kg/m<sup>2</sup>.<sup>16</sup> The age factor at risk of suffering from type 2 DM is age over 30 years due to anatomical, physiological, physiological and biochemical changes. Lack of physical activity causes insulin resistance in type 2 DM.<sup>17</sup> According to Ruben et al. (2016) said that physical exercise will cause an increase in blood flow, it will open more capillary nets so that the receptors become more active, which will affect the decrease in blood glucose in patients with diabetes mellitus.<sup>18</sup>

Table 2 shows the study results of blood sugar levels after being given the intervention, with an average decrease in blood sugar levels from 276.93 to 227.93. This is a decrease in blood sugar levels between before and after being given treatment by 49.00 mg/dl. According to PERKENI (2015), a person is said to have diabetes mellitus (DM) if his blood sugar level is 200 mg/dl.<sup>19</sup> Diabetic foot spa begins with physical activity in the form of gymnastics, then continues with skin cleansing, pedicure and foot massage.<sup>20,21</sup> This is in line with the opinion of Rumahorbo (2014) that the benefits of physical exercise are that it can reduce blood sugar levels and cardiovascular risk factors.<sup>22</sup>

Based on the results of the t-test listed in Table 2 obtained p-value <0.001, then Ho is rejected. Thus it can be concluded that there is an effect of a combination of diabetic foot spa, rubber band resistance exercise and music therapy on reducing blood sugar levels. In patients with type 2 diabetes mellitus. High blood glucose

levels have a broad negative impact on carbohydrate metabolism and protein and fat metabolism.<sup>23</sup> As a result, atherosclerosis can occur in tissues, especially peripheral areas in the legs. High blood glucose accelerates the process of atherosclerosis in large blood vessels such as the aorta, coronary arteries, or arteries that supply blood to the legs and brain. To keep blood circulation smooth, that is with a healthy lifestyle, such as regular exercise, reducing fatty foods, quitting smoking, dealing with stress and getting enough rest.<sup>24</sup> One way to increase blood circulation is with a diabetic foot spa which consists of various activities, namely diabetic foot exercises before the foot spa, skin cleansing, which is cleansing using a soft and mild baby bath soap, pedicure, namely cutting and scraping nails if the respondent has long nails and the last is foot massage, which is a superficial massage of the feet to increase blood circulation.<sup>12</sup> Diabetic foot SPA serves to smoothen blood circulation with an effect that is felt directly on the nerves in the feet so that there is no deposition of sugar and blood that carries oxygen and nutrients that will be delivered to all parts until the tips of the toes can flow so that it can flow easily. good circulation.<sup>24</sup>

In addition to foot exercises and soaking in warm water, foot massage activities in a diabetic foot spa also affect peripheral blood circulation. Foot reflexology therapy can affect the body's hormones, increasing the secretion of endorphins. Endorphins have a natural narcotic effect, reducing pain and increasing excitement. Nerve impulses generated when listening to music are transmitted to the hypothalamus to produce corticotropin-releasing factor (CRF). The CRF will stimulate the pituitary gland to increase the production

of pro-opioid melanocortin (POMC) so that the production of endorphins by the adrenal medulla increases. Endorphins that are secreted into the bloodstream affect the mood to relax. Endorphins cause vasodilation of blood vessels resulting in a decrease in average blood pressure.<sup>25</sup> The good intensity also influenced the decrease in the respondent's blood sugar level during the physical exercise intervention. The intensity of physical exercise can be assessed from the target pulse. This condition follows the THR (target heart rate) examination results. It was found that all respondents had reached the THR with a calculation of 60-70% of the maximum heart rate (220-age = MHR). This aligns with Agustini & Dewi's research (2017) in their journal, which states that 15 respondents achieved THR within 30 minutes of doing rubber band resistance exercise.<sup>26</sup> This study is also supported by the research of Jin, Park & So (2015), researchers used rubber bands as an exercise medium, and the results showed changes in blood glucose levels of hyperglycemic older women before and after muscle strength training showed that blood glucose results (p<0.021) were proven to decrease. Diabetic foot spa, rubber band resistance exercise and music therapy combined can reduce blood sugar levels in patients with type 2 diabetes.<sup>27</sup>

#### ABI (ankle-brachial index)

Based on the results of the study listed in Table 2 it is known that the ABI before treatment had an ABI value with an average of 3.77. The ABI test is one of the tests that can be used directly to assess the arterial circulation of the lower extremities.<sup>28</sup> Many factors that affect ABI include long suffering from diabetes mellitus, blood

sugar control, activity/exercise, treatment of diabetes mellitus and hypertension and a history of rheumatoid arthritis. Patients with type 2 diabetes tend to experience changes in the elasticity of the capillaries of blood vessels, thickening of the walls of blood vessels, and the formation of plaques or thrombus caused by hyperglycemia, causing vascularization to the periphery to be hampered. This causes DM patients to tend to have an Ankle Brachial Index (ABI) value that is lower than the normal range of 0.91-1.31.<sup>6</sup>

Table 2 shows the results of the ABI study after being given an intervention with an average increase in the ABI value from 3.77 to 3.86. This research aligns with Affiani's (2017) study, which treated diabetic foot spa for 5 days in the intervention group with 23 respondents. The control group was not given treatment as many as 23 people. These research results show that diabetic foot spa effectively affects peripheral blood circulation. The more routine the diabetic foot spa is done, the better the peripheral blood circulation to prevent complications from diabetes mellitus.<sup>12</sup> Diabetic foot spa is a foot care activity that diabetic patients need to prevent gangrene and treatment of peripheral blood vessels. The principle of preventing diabetic foot is to avoid the occurrence of injuries and continue to try to control the state of blood sugar. At a diabetic foot spa, in addition to foot exercises, skin cleansing and pedicure or nail cutting activities are intended to prevent nails that are too long and go in so that they can injure the feet. Foot massage is a series of diabetic foot spa activities that are no less important than foot gymnastics, skin cleansing, pedicure, and foot masks.<sup>13,20,21</sup> Music therapy is a medium used to accompany physical exercise with a duration of music for 30 minutes. Music therapy can increase the production of endorphins and serotonin hormones, making individuals feel happier and reducing anxiety.<sup>14</sup>

Based on the Wilcoxon test results listed in Table 2 the p value < 0.001 then, Ho is rejected. Thus it can be concluded that there is an effect of a combination of diabetic foot spa, rubber band resistance exercise and music therapy on reducing ankle brachial index in patients with type

2 diabetes mellitus. Efforts to treat and prevent complications in DM patients, one of which is to do regular physical exercise.<sup>30</sup> This is in line with the research of Wardani et al. (2019) with the results that diabetic foot spas are effective in improving the ABI value. This is because physical exercise is one of the principles in managing diabetes mellitus.<sup>13,21</sup> Foot exercise is a management of diabetes mellitus with a non-pharmacological approach in overcoming the symptoms of tingling caused by impaired leg blood circulation and can facilitate leg blood circulation.<sup>10,11</sup> This is due to the effect of the foot spa, rubber band resistance accompanied by music which can increase the blood circulation of the feet. The ABI value can be normal with these effects and other influencing factors. The combination of diabetic foot spa therapy, rubber band resistance exercise and music therapy can increase the ankle-brachial index (ABI) value. This happens because combination therapy helps improve blood circulation, strengthen the small muscles of the feet, prevent foot deformities, and overcome the limitations of joint motion.

#### Foot sensitivity

Based on the research results listed in Table 2 it is known that the sensitivity of the feet before treatment with an average of 2.75. Diabetic foot spa helps improve peripheral circulation in the feet, thereby increasing the sensitivity of the feet of people with diabetes. Researchers assume that the physical activity of foot spa and rubber band resistance exercise can help improve blood circulation in the leg area so that it will help stimulate peripheral nerves in receiving stimulation. This will increase the sensitivity of the feet, especially in people with diabetes mellitus who experience an average decrease in peripheral circulation. According to Colberg et al. (2016), regular physical exercise increases capillary muscle density and muscle insulin sensitivity in individuals with prediabetes and type 2 diabetes. Smooth blood circulation allows blood to deliver more oxygen and nutrients to body cells.<sup>31</sup> This is supported by the research of Wardani et al. (2019), which found the effect of diabetic foot spa on foot sensitivity. The results of this study showed an increase in the average

foot sensitivity in the intervention group who had a diabetic foot spa compared to the group that did not do a diabetic foot spa.<sup>13,20,21</sup>

Table 2 shows the results of the foot sensitivity study after being given the intervention, with an average increase in the ABI value from 2.75 to 3.25. Foot movements, both gymnastics and walking, are effective in increasing foot sensitivity. The stimulation regarding foot movement reflexology relaxes and improves blood circulation.<sup>23</sup> Smooth blood circulation allows the blood to deliver more oxygen and nutrients to the body's cells while bringing more toxins to be excreted so that smooth blood flow will increase the sensation of protection on the skin. During skin cleansing or cleaning activities, the feet are soaked in warm water mixed with salt. Warm water and salt are useful for improving blood circulation because warm water causes vasodilation of blood vessels.<sup>13</sup> Foot spa, which includes soaks, massages and foot exercises, directly affects peripheral circulation. Foot massage can affect the body's hormones, namely endorphins. Endorphins have a natural narcotic effect, reducing pain and increasing excitement. Endorphins cause vasodilation of blood vessels so that it can increase blood circulation.<sup>21</sup>

Based on the Wilcoxon statistical test results in Table 2, the p-value=0.001, then Ho is rejected. Thus it can be concluded that there is an effect of a combination of diabetic foot spa, rubber band resistance exercise and music therapy on increasing foot sensitivity in patients with type 2 diabetes mellitus. This is in line with the research of Wardani et al. (2019), where the study results were based on the level of foot sensitivity. All 60 respondents experienced a decrease in foot sensitivity. Of the 60 respondents, the results were obtained from a decrease to an increase.<sup>13,20,21</sup> With the average level of sensitivity of the foot before and after the left foot, a result of 2.50. The lowest result of sensitivity of the pre foot with a value of 2, and the highest post with a value of 10. While on the right foot, with an average value of 3.00, the highest results were low pre-foot sensitivity with a value of 4 and the highest post with a value of 9. This shows that the combination of diabetic foot spa therapy,



rubber band resistance exercise and music therapy can increase foot sensitivity. This happens because the combination therapy aims to improve lower extremity perfusion in type 2 DM patients.<sup>32-34</sup>

## CONCLUSION

A combination of diabetic foot spa, rubber band and resistance exercise and music therapy is a non-pharmacological therapy that can be used as a preventive and promotive effort in programs to control blood sugar levels in type II DM patients that can be done easily and effectively.

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## ETHICAL APPROVAL

This research has passed the ethics test by the Ethics Commission of Universitas Nahdlatul Ulama Surabaya with No. 183/EC/KEPK/UNUSA/2022

## CONFLICT OF INTEREST

The authors affirm that they have no known financial or interpersonal conflicts that would have seemed to impact the research presented in this study.

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## AUTHOR CONTRIBUTION

All authors contributed to this study's conception and design, data analysis and interpretation, article drafting, critical revision of the article, final approval, and data collection.

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