



## **THE EFFECTIVENESS OF FOOT EXERCISE AND HYDROTHERAPY ON BLOOD SUGAR LEVELS IN THE ELDERLY**

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### **ABSTRACT**

**Background:** Elderly are susceptible to health problems due to decreased organ function such as increased blood sugar levels that are at risk for diabetes mellitus, so proper management is needed with physical activity. Foot exercise and hydrotherapy can be an alternative to physical activity for elderly to lower blood sugar levels. **Objective:** To determine the effectiveness of the combination of foot exercise with and without hydrotherapy on blood sugar levels in the elderly. **Methods:** Experimental study with parallels 3 groups pre and post-test design. Research subjects were 21 elderly, divided into control group (n=7), combination of foot exercises and hydrotherapy intervention group (n=7), and foot exercise intervention group (n=7). The intervention was done 3 times a week for 5 weeks. Blood sugar levels were measured using POCT. **Results:** There is no significant decrease in blood sugar levels from control group ( $p>0.05$ ). There is significant decrease in blood sugar levels from foot exercise and hydrotherapy intervention group ( $p<0.05$ ) and foot exercise intervention group ( $p<0.05$ ). The difference in blood sugar levels showed significant results between foot exercise and hydrotherapy intervention group and control group ( $p=0.000$ ) and between foot exercise intervention group and control group ( $p=0.004$ ). There are no significant differences in blood sugar levels between foot exercise and hydrotherapy intervention group and foot exercise intervention group ( $p=0.112$ ). **Conclusion:** Both feet exercise and hydrotherapy are effective in lowering blood sugar levels in the elderly.

**Keywords:** *Foot exercise, Hydrotherapy, Blood sugar, Elderly*

### **INTRODUCTION**

The aging process will certainly have an impact on a person's health. The older the age, the more vulnerable the body is to health problems caused by decreased organ function, so proper management is needed to maintain the health of the elderly.<sup>1</sup> The decreased organ function causes various complaints of disease, including diabetes mellitus.<sup>1</sup> Diabetes mellitus is one type of chronic disease that is often suffered by the elderly. The national diabetic prevalence rate is 10.9% based on data from the Riset Kesehatan Dasar (Riskesdas 2018). Diabetes mellitus management can be carried out with pharmacological therapy and non-pharmacological therapy. Non-pharmacological therapy that can be done is exercise with foot exercises and hydrotherapy (sook feet in warm water).<sup>1</sup>

Foot exercise is a physical activity that aims to improve blood circulation so that nutrients to the tissues run more smoothly, strengthen small muscles, calf muscles, and thigh muscles, and overcome joint motion limitations.<sup>2</sup> Foot exercise is recommended to be done with moderate intensity

(with a maximum heart rate of 60-70 times per minute), for 10 minutes, 3-5 times per week for no more than 2 consecutive days without exercising.<sup>3</sup> In foot exercise, active muscles contracting can result in the permeability of cell membranes to increased glucose intake, reduced insulin resistance, and increased insulin sensitivity.<sup>4</sup> Meanwhile, sook feet in warm water with a temperature of 38-40° C above the ankles cause vasodilation of peripheral blood vessels so that they can reduce blood pressure, relieve joint pain, reduce muscle tension, kill germs, and lower blood sugar levels.<sup>5,6,7</sup>

Therefore, this study was conducted effectiveness of the combination of foot exercise with and without hydrotherapy on blood sugar levels in the elderly.

### **METHOD**

This study is an experimental study with parallels 3 pre and post-test design methods with a control group during September-October 2021. The research subjects used in this study were the elderly in RW 04, Karang Wetan, West Ungaran selected by



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purposive sampling based on inclusion criteria and exclusion criteria.

The inclusion criteria are (1) Elderly and domiciled in RW 04, Karang Wetan, West Ungaran, Semarang Regency, (2) aged 60-80 years, and (3) willing to participate in the study by filling out and signing an informed consent form. The exclusion criteria for the research subjects were (1) unable to speak, unable to hear, unable to see, (2) unable to use and understand Indonesian, (3) had a psychiatric disorder, and (4) had a disability. The sample size was determined using the unpaired analytical study formula. The research subjects were 21 elderly who were grouped into three groups, namely the control group, intervention group 1, and intervention group 2. The determination of the subject group was carried out by a random allocation procedure. In the control group, no intervention was given. As for intervention group 1, an intervention was given in the form of foot exercises and soak feet in warm water 3 times a week for 5 weeks.

Then intervention group 2 an intervention was given in the form of foot exercises 3 times a week for 5 weeks. Foot exercise is done using a video guide for foot exercises published by the Rumah Sakit dr. Kariadi Semarang and used newspapers as materials with duration of  $\pm 10$  minutes. Then to soak feet in warm water, is done for 15 minutes with a water temperature of  $40 \pm 1^\circ$  Celsius which is measured using a water thermometer, and between them is given a pause for 1 minute to stabilize the water temperature to keep it warm. Measurement of blood sugar levels when carried out using Point of Care Testing (POCT) Easy Touch 3 in 1 Multi check which has been calibrated on all research subjects 2 times, before and after the intervention.

The research data were analyzed using the IBM SPSS Statistics 25 computer program. Since the number of research subjects  $< 50$ , the normality of the data using the Shapiro–Wilk test. Data that were normally distributed were subjected to paired t-test to compare the results of the pre-test and post-test, then One Way ANOVA test with Post Hoc LSD was performed to compare the results between the control group, intervention group 1, and intervention group 2

## RESULTS

### Basic characteristics of Research Subjects

The study involved 21 elderly people from RW 04, Karang Wetan, West Ungaran, Semarang. Total of 7 elderly in intervention group 1 intervened in foot exercises and soaked their feet in warm water for 5 weeks. Seven elderly in intervention group 2 did only foot exercise intervention for 5 weeks. Basic characteristics of subjects shown in table 1.

**Table 1.** Characteristics of research subjects

Character <sup>s</sup>	Group			p
	Control (n=7)	Intervention 1 (n=7)	Intervention 2 (n=7)	
Age	65,57 $\pm$ 3,55;	65,43 $\pm$ 8,94;	61,71 $\pm$ 2,75;	0,129**
Gender				
- Man	4 (57,14%)	2 (28,57%)	0 (0%)	
- Woman	3 (42,86%)	5 (71,43%)	7 (100%)	
Height	1,64 $\pm$ 0,06	1,59 $\pm$ 0,04	1,61 $\pm$ 0,04	0,211*
Weight	64 $\pm$ 6,81	64,43 $\pm$ 4,93	62,71 $\pm$ 4,35	0,831*
BMI	23,76 $\pm$ 2,18	25,35 $\pm$ 1,78	24,24 $\pm$ 1,52	0,400**

<sup>s</sup>Table Values are Mean  $\pm$  Standard Deviation \*One Way ANOVA Test \*\*Kruskal Willis Test

### Comparison of Blood Sugar Levels

Based on table 2, the comparison of blood sugar levels during pre-test and post-test for all groups was tested by paired t-test. In the control group, the results of the different tests between pre-test and post-test showed a value of  $p > 0.05$  ( $p = 0.857$ ), which means that there were no significant differences in blood sugar levels during pre-test and post-test. In intervention group 1, namely the foot exercise and soak feet in warm water group, it was found that the results of the different test between pre-test and post-test showed  $p < 0.05$  ( $p = 0.002$ ), which means that there were significant differences in blood sugar levels during the pre-test. Then in intervention group 2, namely the foot exercise intervention group, the results of the different tests between pre-test and post-test showed a  $p$ -value  $< 0.05$  ( $p = 0.000$ ), which means that there were significant differences in blood sugar levels during pre-test and post-test.



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**Table 2.** Blood sugar levels of pre-test, post-test, and delta based on intervention

Group	Blood sugar levels		p
	Pre- test	Post-test	
Control	137,86 ± 17,01	138,14 ± 15,51	0,857 <sup>†</sup>
Intervention 1	125,14 ± 24,94	113,14 ± 24,85	0,002 <sup>†*</sup>
Intervention 2	133,71 ± 15,72	125,86 ± 16,00	0,000 <sup>†*</sup>
p	0,481 <sup>§</sup>	0,078 <sup>§</sup>	

\*Significant (p < 0,05); <sup>§</sup> One Way ANOVA; <sup>†</sup> Paired t

### Comparison of Blood Sugar Levels Between Groups

After testing the normality of the data, the difference between the pre-test and post-test scores of blood sugar levels between groups was analyzed using the One Way ANOVA test with Post Hoc LSD because the data were normally distributed. The difference between the pre-test and post-test scores in the control group was 0.43±4.12. The difference between the pre-test and post-test scores in the intervention group for foot exercises and warm water foot baths was -12.00±6.30. The difference between the pre-test and post-test scores in the foot exercise intervention group was -7.86±2.80.

**Table 3.** Post Hoc LSD difference test between groups

Group	Pre-test	Post-test	p	Sig.
		Control	0,000	Significant
Intervention 2	Control	0,004	Significant	

Based on table 3, it can be seen that there is a significant difference between the pre-test and post-test scores of blood sugar levels between the control group and the foot exercise and soak feet in warm water intervention group (p=0.000). Then there was also a significant difference between the pre-test and post-test scores of blood sugar levels between the control group and the foot exercise intervention group (p=0.004). In addition, the difference in pre-test and post-test scores of blood sugar levels was not significant between the foot exercise and soak feet in warm water intervention group and the foot exercise intervention group (p=0.112).

### DISCUSSION

The significant results in the two intervention

groups, both the combination of foot exercise with hydrotherapy and without hydrotherapy, were supported by previous research by Rohani, R. in 2017 which stated that there was an effect of foot exercise and soak feet in warm water on peripheral blood circulation, causing a decrease in blood sugar levels. (p=0.002).<sup>8</sup> The intervention group that was given the intervention of a combination of foot exercise and hydrotherapy showed a significant decrease in blood sugar levels (pre-test to post-test) where the results were in line with previous research by Maryani, Dwi., et al in 2013 which showed that there was a significant decrease in blood sugar levels after a combination therapy intervention was performed with foot exercises and soak feet in warm water.<sup>9</sup>

Foot exercise is one of the physical activities that can be used as an alternative for the elderly to lower blood sugar levels. Physical activity is associated with increasing the speed of muscle glucose recovery or glucose intake used by muscles as an energy source. Muscles utilize stored glucose and when glucose is reduced, muscles will take glucose from the blood when exercising or doing physical activity. This causes a decrease in blood glucose levels and improves blood glucose control. The same thing was also stated by Stein (2001) who stated that moderate physical activity such as foot exercise can provide good benefits, such as increasing insulin sensitivity and controlling glycemia.<sup>10</sup>

The warm temperature of soak feet in warm water causes vasodilation of peripheral blood vessels, thereby making blood circulation smooth. Research conducted by Hoekstra SP (2008) states that soaking the feet in hot or warm water is more effective at lowering blood sugar levels than cardio exercise that requires adrenaline. Controlling blood sugar levels can help reduce risk factors for diabetes. Soak feet in warm water can burn calories up to 126 calories or the equivalent of walking for 30 minutes.<sup>6</sup>

The limitation of this study is that the researcher could not control for confounding variables such as drug consumption, diet, stress level, and daily physical activity that could affect the results of the study. In addition, researchers also experienced difficulties in getting research subjects, due to activity restrictions by the PPKM which caused



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agencies to limit the activities of the elderly so that researchers looked for alternative research subjects.

## CONCLUSION

Physical activity in the form of foot exercises and hydrotherapy performed 3 times a week for 5 weeks is effective in reducing blood sugar levels in the elderly. However, there was no significant difference between the two which was more effective for lowering blood sugar levels in the elderly. This is evidenced by a significant decrease in blood sugar levels in the elderly group who were given foot exercise intervention and soak feet in warm water for 5 weeks and the elderly group who was given foot exercise intervention for 5 weeks.

Further study is needed by controlling confounding variables such as drug consumption, diet, stress level, and daily physical activity. Then the further study is needed by paying attention to the sex distribution of research subjects, it is hoped that a more balanced distribution of subjects will complete the research.

## ETHICAL APPROVAL

This research ethical clearance was issued by Medical Health and Research Ethics Commission (KEPK), Faculty of Medicine, Universitas Diponegoro no. 192/EC/KEPK/FKUNDIP/VI/2021.

## CONFLICT OF INTEREST

There is no conflict of interest in this research.

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## AUTHOR CONTRIBUTIONS

Conceptualization, Edy Nuswantara Putra, Yuswo Supatmo, Erna Setiawati, and Marijo; methodology, Edy Nuswantara Putra, Yuswo Supatmo, Erna Setiawati; software Edy Nuswantara Putra; validation, Edy Nuswantara Putra; formal analysis, Edy Nuswantara Putra, Yuswo Supatmo, Erna Setiawati; investigation, Edy Nuswantara Putra, Yuswo Supatmo, Erna Setiawati; resources, Edy Nuswantara Putra; data curation, Edy Nuswantara Putra; writing—original draft preparation, Edy Nuswantara Putra, Yuswo Supatmo, Erna Setiawati; writing—review and

editing, Edy Nuswantara Putra, Yuswo Supatmo, Erna Setiawati; visualization, Edy Nuswantara Putra, Yuswo Supatmo, Erna Setiawati; supervision, Edy Nuswantara Putra, Yuswo Supatmo, Erna Setiawati, and Marijo; project administration, Edy Nuswantara Putra; funding acquisition, Edy Nuswantara Putra.

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