



Effectiveness of Foot Exercises Together with the Hydrotherapy Program on Blood Sugar Levels in Elderly People without Diabetes

Edy Nuswantara Putra¹, Yuswo Supatmo², Erna Setiawati³, Marijo⁴

¹Department of Medicine, Faculty of Medicine, Diponegoro University, Semarang, Indonesia

²Department of Physiology, Faculty of Medicine, Diponegoro University, Semarang, Indonesia

³Department of Physical Medicine and Rehabilitation, Faculty of Medicine, Diponegoro University, Semarang, Indonesia

⁴Department of Anatomy, Faculty of Medicine, Diponegoro University

Abstract

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Author Affiliation:

Department of Medicine,
Faculty of Medicine, Diponegoro University,
Semarang, Indonesia

Author Correspondence:

Edy Nuswantara Putra
Prof. Sudarto Street, Tembalang, Semarang,
Central Java, 50275, Indonesia

E-mail:

edynuswantaraputra@gmail.com

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Background : The elderly human population is susceptible to health problems due to decreased organ function. The risk of diabetes in old age also reduces quality of life. Preventing the risk of developing diabetes mellitus requires simple and simple exercise programs such as foot exercises and hydrotherapy. The effect of light leg exercise and hydrotherapy on carbohydrate metabolism is unknown. The objectives of this study was to find out the impact of hydrotherapy alone or in combination with foot exercise on elderly's blood sugar levels.

Methods : Parallel three-group pre and post-test designs for an experimental investigation. 21 elderly in RW 04 Karangwetan, Ungaran served as research participants, 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 took place three times per week for five weeks. We used POCT to assess blood sugar levels.

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 is no significant differences in blood sugar levels between foot exercise and hydrotherapy intervention group and foot exercise intervention group ($p=0.112$).

Conclusion : Simple exercise activities such as foot exercises together with hydrotherapy have been proven to reduce blood sugar levels in healthy elderly populations without diabetes.

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.¹ The decreased organ function causes various complaints of disease, including diabetes mellitus.¹ Diabetes mellitus is a common chronic condition among 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 both pharmaceutical and non-pharmacological treatment. A non-pharmacological therapy can involve physical activity combined with foot exercises and hydrotherapy (soaking feet in warm water).

Foot exercises aim to enhance blood circulation, improve joint motion, and strengthen tiny muscles.² 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.³ 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.⁴ Meanwhile, soaking feet in warm water with a temperature of 38–40°C above the ankles cause peripheral blood vessels to dilate in order to lower blood pressure, ease joint discomfort, and ease muscle tension, kill germs, and lower blood sugar levels.^{5–7}

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

METHODS

Three parallel pre- and post-test design methodologies were used in the experimental study 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 purposive sampling depending on inclusion and exclusion criteria.

(1) Ages 60 to 80 years old, (2) residence in RW 04, Karang Wetan, West Ungaran, Semarang, and (3) willingness to engage in the study by completing and signing an informed consent form are the inclusion criteria. 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 formula for an unpaired analytical research was used to calculate the sample size. The study included 21 elderly divided into three groups; control, intervention 1, and intervention 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 for 5 weeks, 3 times per week.

Then, for five weeks, foot exercises were given to intervention group 2 three times each week. A video tutorial is used to perform foot exercises for foot exercises published by the Rumah Sakit Dr. Kariadi Semarang and used newspapers as materials with a duration of ± 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, prior to and following intervention.

Using the computer program IBM SPSS Statistics 25, the research data were examined. The Shapiro-Wilk test is used to determine the data's normality because there were less than 50 research participants. To evaluate the outcomes of the pre- and post-tests using normally distributed data, a paired t-test was used. One Way ANOVA with Post Hoc LSD was then used to compare the outcomes of the control group, group 1 with intervention, and group 2 with intervention.

The Health Research Ethics Commission (KEPK) of the Faculty of Medicine, Diponegoro University, granted approval for the study with approval number 192/EC/KEPK/FK-UNDIP/VI/2021.

RESULTS

Characteristics of research subjects

The sample consisted of 21 elderly from West Ungaran, RW 04, Semarang. In intervention group 1, a total of seven elderly people underwent foot exercises and 5 weeks of warm water soaks. Then as many as 7 elderly in intervention group 2 did only foot exercise intervention for 5 weeks. Table 1 presents the characteristics of the research subjects.

Comparison of blood sugar levels

A paired t-test was used to compare the blood sugar levels for each group's pre- and post-test periods based on Table 2. There were no significant differences in blood sugar levels between the pre-test and post-test in the control group, according to the findings of the various tests between pre-test and post-test, which revealed a value of $p > 0.05$ ($p = 0.857$). The findings of the several tests between the pre-test and post-test in intervention group 1, or the foot exercise and warm water soak group, showed $p < 0.05$ ($p = 0.002$), indicating that there were significant differences in blood sugar levels during the pre-test. The results of the various tests between the pre-

TABLE 1
Subjects Characteristics

Characteristics		Group			p
		Control (n=7)	Intervention 1 (n=7)	Intervention 2 (n=7)	
Age		65.57 ± 3.55;	65.43 ± 8.94;	61.71 ± 2.75;	61.71 ± 2.75;
Gender	Man	4 (57.14%)	2 (28.57%)	0 (0%)	
	Woman	3 (42.86%)	5 (71.43%)	7 (100%)	
Height		1.64 ± 0.06	1.59 ± 0.04	1.61 ± 0.04	0.211*
Weight		64 ± 6.81	64.43 ± 4.93	62.71 ± 4.35	0.831*
BMI		23.76 ± 2.18	25.35 ± 1.78	24.24 ± 1.2	0.400**

[§]Table Values are Mean ± Standard Deviation, *One Way ANOVA Test, **Kruskal Wallis Test

TABLE 2
Blood sugar levels of pre-test, post-test, and delta based on intervention

Group	Blood sugar levels		p	p
	Pre-test	Post-test		
Control	137.86 ± 17.01	138.14 ± 15.51	0.857 [¶]	0.43 ± 4.12
Intervention 1	125.14 ± 24.94	113.14 ± 24.85	0.002 ^{¶*}	-12.00 ± 6.30
Intervention 2	133.71 ± 15.72	125.86 ± 16.00	0.000 ^{¶*}	-7.86 ± 2.80
p	0.481 [§]	0.078 [§]		0.000 ^{§*}

*Significant (p<0.5); [§]One Way ANOVA; [¶]Paired t

TABLE 3
Post Hoc LSD difference test between groups

Group		p	Sig.
Pre-test	Post-test		
Intervention 1	Intervention 2	0.12	Not significant
	Control	0.000	Significant
Intervention 2	Control	0.004	Significant

test and post-test in intervention group 2, or the foot exercise intervention group, then showed a p-value<0.05 (p=0.000), indicating that there were significant differences in blood sugar levels between the pre-test and post-test.

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.

According to Table 3, there is a significant difference (p=0.000) between the pre-test and post-test blood sugar levels for the control group and the foot exercise and soak feet in warm water intervention group.

Additionally, there was a significant change in blood sugar levels between the control group and the foot exercise intervention group between the pre-test and post-test scores ($p=0.004$). Additionally, there was no statistically significant difference between the foot exercise intervention group and the foot exercise group in terms of blood sugar levels between pre-test and post-test ($p=0.112$).

DISCUSSION

The significant outcomes in the two intervention groups foot exercise plus hydrotherapy combined with exercise alone were supported by Rohani, R. earlier research from 2017, which found that foot exercise and foot soaks in warm water had a positive impact on peripheral blood circulation and reduced blood sugar levels. ($p=0.002$).⁸ The intervention group that was given the intervention of a combination of foot exercise and hydrotherapy indicated that the results (pre-test to post-test) significantly reduced blood sugar levels 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.⁹

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.¹⁰

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.⁶

The limitation of this study is that we could not control confounding variables such as the respondents' current consumption of medication, dietary habits and the composition of carbohydrates, fats and proteins, anxiety, stress levels, and previous daily physical activity. We were not optimal in collecting respondents because of the PPKM period due to Covid-19.

CONCLUSION

Elderly blood sugar levels can be reduced by physical activity, foot exercises, and hydrotherapy when done three times per week for five weeks. Which was more efficient at lowering blood sugar levels in elderly people had no discernible advantage over the other. This is demonstrated by a notable drop in blood sugar levels in both the elderly group who received a foot exercise intervention and 5 weeks of foot soaking in warm water, as well as the elderly group who just received a foot exercise intervention.

The effect of simple sports activities such as foot exercises and hydrotherapy 3 times a week for 5 weeks in elderly people without diabetes can reduce blood sugar levels. Further research on a large scale is needed to control other confounding factors.

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