

Original Article

Effect of brisk walking in reducing the risk of diabetic foot with ankle-brachial index and monofilament indicators

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Abstract

Brisk walking is one of the moderate-intensity physical exercises that has a positive impact on health. The purpose of this study was to determine the effectiveness of brisk walking in controlling blood glucose levels and preventing the risk of diabetic foot. The research design in this study was quasi-experimental. A total of 54 diabetic patients who met the inclusion and exclusion criteria were randomly divided into treatment and control groups. The brisk walking intervention was given 4 times a week for 4 weeks. The post-test results in the treatment group were HbA1c (6.68 ± 0.08), blood glucose (149.41 ± 3.58), ankle-brachial index (0.95 ± 0.02), monofilament (6.29 ± 0.23). The post-test results in the control group were HbA1c (7.14 ± 0.08), blood glucose (172.04 ± 3.88), ankle-brachial index (0.83 ± 0.02), monofilament (3.59 ± 0.20). The post-test results of the four parameters in the treatment group showed positive results and were significantly different compared to the control group. Brisk walking exercises done regularly and continuously are effective in managing diabetes mellitus and improving blood circulation to prevent the risk of diabetic foot.

Keywords: diabetic foot, brisk walking, ankle-brachial index, monofilament

Introduction

Diabetes mellitus is a chronic disease that commonly affects people in the world. Chronic hyperglycemia conditions in diabetes mellitus cause macrovascular and microvascular disorders, which can cause various complications in the body organs of diabetes. Diabetes can cause nerve damage, reduced circulation, and even loss of limbs [1].

The increase in the prevalence of diabetes mellitus sufferers is also accompanied by an increase in the incidence of peripheral arterial disease and peripheral neuropathy, which causes the legs of diabetic sufferers to experience disability and amputation. The preva-

lence of peripheral arterial disease and peripheral neuropathy in diabetes patients is 10–70% of the diabetes population [2, 3].

Hyperglycaemia plays an important role in the development of neuropathy and peripheral arterial disease in people with diabetes mellitus [4, 5]. Hyperglycemia in diabetes mellitus impacts peripheral arterial and neuro-peripheral disorders in the legs. One of the signs and symptoms of peripheral arterial disorders and diabetic peripheral neuropathy is a tingling, burning, and stabbing pain in the legs, especially at the distal end [6, 7]. Failure to prevent peripheral arterial disease and peripheral neuropathy can lead to ulceration, disability, and lower extremity amputation [8].



Diabetes mellitus patients often ignore their body condition, which has been diagnosed with chronic diabetes. The patient only became aware when a diabetic foot wound occurred, and it did not heal. This causes high rates of disability and amputation in diabetes mellitus patients. Implementing the pillars of diabetes management to control diabetes mellitus so that complications do not occur is a major challenge for medical personnel and diabetes mellitus patients. Physical exercise is one of the light treatments diabetes mellitus patients can do. Physical exercise helps reduce HbA1c and blood glucose levels in prediabetes sufferers [9].

Choosing physical exercises that are easy and can prevent diabetic foot complications is the main goal in reducing disability and amputation in diabetes mellitus patients. Walking is a form of physical exercise that is easy for diabetes patients to do anywhere and anytime. Physical exercise, such as walking, can detect neuropathy in diabetes mellitus [10]. Walking with moderate intensity or greater, done at least 30 minutes/day, effectively maintains body weight and improves glycemic control [11].

Brisk walking can be an indicator of assessing a person's physical condition [12]. Brisk walking has better benefits compared to slow walking. A research study comparing physical activity between fast walking, slow walking, and sitting positions on the risk of developing type 2 diabetes mellitus reported that brisk walking significantly prevented the risk of developing type 2 diabetes mellitus compared to slow walking and sitting activities [13]. Brisk walking has been reported to be genetically associated with lower cardiometabolic risk and may be a beneficial intervention for various health outcomes [14].

Material and methods

Study design and participants

The design used in this study is a pre-post test with control group design. This study design measures the results of pre and post-variables after the intervention was given to the treatment group compared to the control group. In both groups before and after the intervention, HbA1c and blood glucose levels were measured, as well as ABI and monofilament scoring examinations. The population in this study were diabetes mellitus sufferers in the Health Center area, Indonesia. The sampling technique in this research used a purposive sampling technique with inclusion and exclusion

criteria determined by the researcher. Diabetes mellitus patients meet the following requirements. Inclusion criteria: suffering from diabetes >1 year, age 25–60 years, tingling in the feet, no injuries. Exclusion criteria: the presence of foot ulcers and decreased ability. A total of 54 patients with diabetes mellitus were divided into two groups, namely the treatment group of 27 patients and the control group of 27 patients. The treatment group was given an intervention in the form of brisk walking exercises 4 times a week for 4 weeks. Meanwhile, as a comparison group, the control group only underwent observations.

Data collection and measurement

Data collection and measurement were conducted in two stages: before the intervention (pre-test) and after the intervention (post-test). Four parameters of data measurement were used: HbA1c level examination, blood glucose level examination, ABI score examination (Ankle-brachial index), and monofilament examination. Diabetes mellitus patients in the treatment group and control group were measured using these four parameters and compared.

Statistical analysis

Measurement data are expressed as the mean \pm SEM. The statistical significance of the pre-test and post-test between groups was analyzed using a one-way analysis of variance (ANOVA) or Kruskal-Wallis test based on data normality and homogeneity and followed by LSD Post Hoc test or Mann-Whitney and Independent Samples test. Data were considered statistically significant if the p -value \leq 0.05. All calculations were performed using SPSS.

Results

Effect of brisk walking on HbA1c levels

HbA1c levels were measured before and after brisk walking for 4 weeks in the treatment and control groups. HbA1c levels in the treatment group significantly differed before and after brisk walking. Post-brisk walking HbA1c levels in the treatment group were also significantly different compared to post-test HbA1c levels in the control group. The mean post-test result of HbA1c levels in the treatment group was 6.68 ± 0.08 , while in the control group, it was 7.14 ± 0.08 .

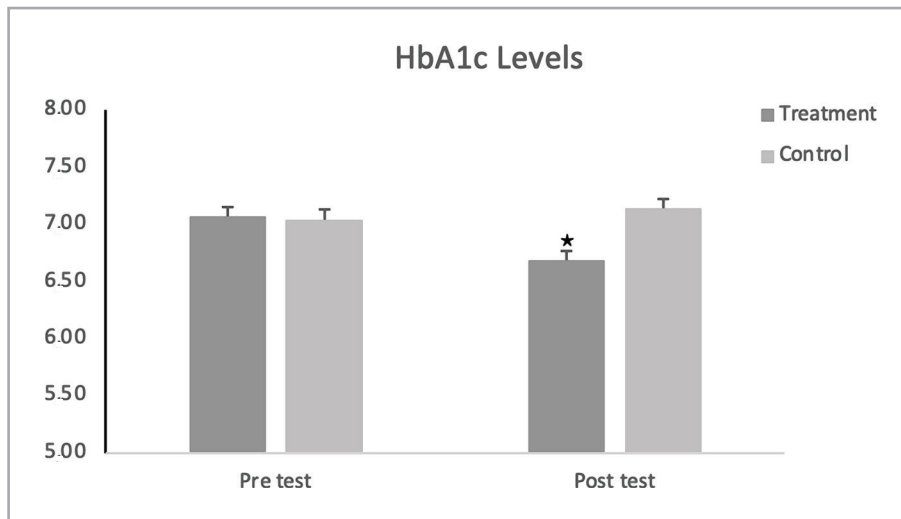


Figure 1: HbA1c levels in the treatment and control groups.

Figure 1 illustrates the changes in HbA1c levels in the treatment and control groups measured before and after the brisk walking intervention. Data are expressed as mean \pm SEM (n=27). The final results showed a significant difference in HbA1c levels between the treatment group and the control group ($p<0.001$).

Effects of brisk walking on blood sugar levels

Fasting blood sugar levels in the treatment and control groups were measured before and after brisk walking. In the treatment group, fasting blood sugar levels after being given brisk walking decreased compared to fasting blood sugar levels before brisk walking. They were significantly different compared to fasting blood sugar levels in the control group. The mean post-test value in the treatment group was 149.41 ± 3.58 , while in the control group, it was 172.04 ± 3.88 .

Figure 2 illustrates the changes in fasting blood sugar levels in the treatment and control groups pre- and post-brisk walking intervention. Data are expressed as mean \pm SEM (n=27). The final results showed a significant difference in glucose levels between the treatment group and the control group ($p<0.001$).

Effect of brisk walking on ABI scores

Ankle Brachial Index (ABI) scores were calculated on both feet of each respondent in the treatment group and control group of the study. The mean ABI value in the treatment group before brisk walking was 0.86 ± 0.01 , and after brisk walking was 0.95 ± 0.02 . Meanwhile, the mean ABI value in the control group before was 0.87 ± 0.01 , and after was 0.83 ± 0.02 . In the comparison of the ABI scores pre-test and post-test, it was found that in the treatment group, there was

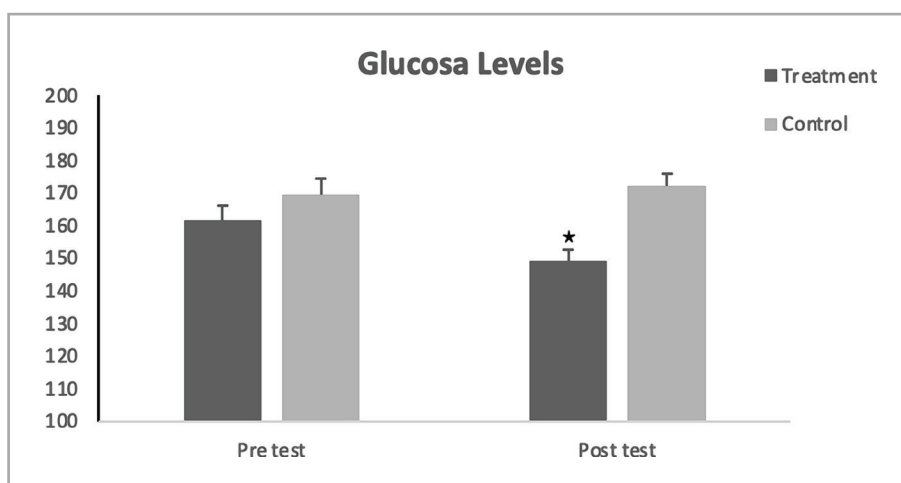


Figure 2: Glucose levels in the treatment and control groups.

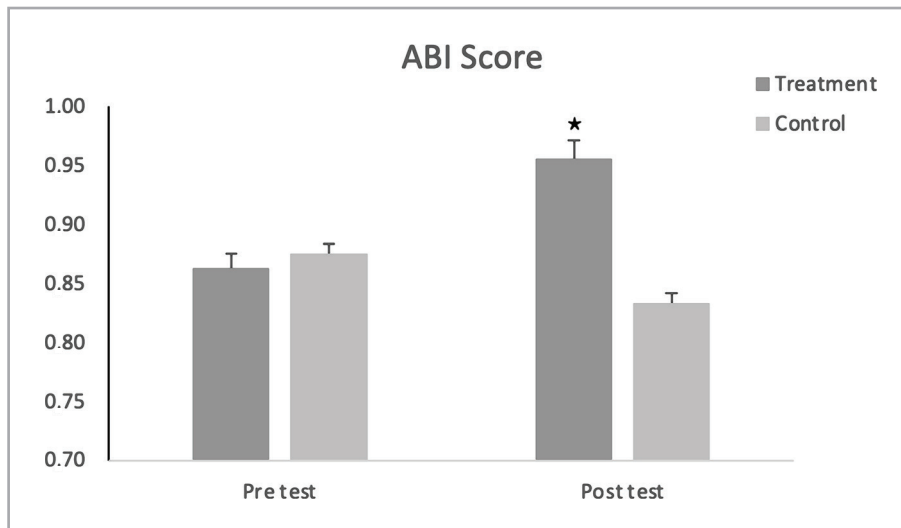


Figure 3: ABI scores in the treatment and control groups.

an improvement in the ABI score, and the ABI score post-test had a significant difference compared to the control group.

Figure 3 illustrates the average ABI scores in the treatment and control groups prior to and following the brisk walking intervention. Data are expressed as mean±SEM (n=27). Statistical results show a significant difference in ABI score between the treatment group and the control group in the final results (p<0.000).

Effect of brisk walking on monofilament scores

The monofilament test was evaluated before and after the brisk walking intervention in both groups. The monofilament score is calculated from the total

score of both respondents' feet. In the treatment group, the monofilament score obtained before the intervention was a mean value of 4.11±0.22, indicating peripheral neuropathy, and after the intervention, there was an improvement, namely a mean value of 6.29±0.23 (normal). Monofilament scores in the control group did not show improvement before and after the intervention, with mean values of 4.55±0.18 and 3.59±0.20, indicating peripheral neuropathy. The post-test monofilament score results in the treatment group were significantly different compared to the control group.

Figure 4 illustrates the average monofilament scores in the treatment and control groups before and after the brisk walking intervention. Data are expressed as mean±SEM (n=27). Statistical results show a significant



Figure 4: Monofilament scores in the treatment and control groups.

difference in monofilament scores between the treatment and control groups in the final results ($p < 0.000$).

Discussion

Diabetes mellitus, a hyperglycemic state characterized by high HbA1c levels and high fasting blood sugar levels, can cause various complications, both macrovascular and microvascular. One of the complications that often occurs in diabetes mellitus sufferers is impaired vascularization in the lower extremities, which can cause peripheral arterial disease, discomfort in the feet, and oxidative stress, which can cause the risk of foot ulcers [15, 16].

In this study, in the control group and treatment group before implementation, the average score for HbA1c levels and fasting blood glucose levels was in the high category. Meanwhile, the ABI and monofilament examination scores are in the poor or low category. The results showed that uncontrolled diabetes mellitus with high HbA1c levels and high blood glucose levels affected the ABI and lower extremity monofilament values. ABI and monofilament are indicators of symptoms of peripheral arterial disease, which occurs due to impaired vascularization in diabetes mellitus sufferers. Previous research studies stated that chronic diabetes mellitus sufferers with hyperglycemia had poor ABI and monofilament values [17, 18].

The results of this study show that brisk walking helps people living with diabetes control blood glucose levels. The results of this study stated that the treatment group given brisk walking exercise showed a decrease in HbA1c and fasting blood glucose levels before and after implementation. HbA1c and fasting blood glucose levels were lower in the treatment group compared to the control group. Brisk walking is a useful physical exercise for diabetes mellitus sufferers. Brisk walking is a simple physical exercise that has a major impact on human biology and is important for maintaining health [19]. Previous research explains that participants who walk ≥ 4500 steps/day have an approximately 60% lower risk of diabetes compared to those who walk less and that brisk walking increases insulin resistance [20].

The results of this study show that brisk walking prevents the risk of peripheral arterial disease in diabetes mellitus sufferers. The results of this study stated that the treatment group given brisk walking training showed improvements in ABI and monofilament scores before and after implementation. ABI and monofila-

ment scores were better in the treatment group compared to the control group. Brisk walking is a form of aerobic exercise that can increase oxygen consumption and improve physical fitness. Regular brisk walking not only strengthens muscles but also increases blood and oxygen circulation in the body, thereby optimizing metabolism [21]. Brisk walking can also modulate immune responses, metabolism, angiogenesis, and tissue maintenance so that it can facilitate extremity vascularization [22].

Management of diabetes mellitus sufferers is not only to control blood glucose levels, but management is needed to prevent vascularization disorders in the extremities to minimize complications from peripheral arterial disease, which causes diabetic foot ulcers. Physical exercise is a form of diabetes mellitus management that can help diabetes mellitus sufferers control their blood glucose levels. Apart from that, physical exercise that maximizes movement in the lower extremities can improve circulation [23]. Physical exercise with light to moderate intensity and on an ongoing basis can be an additional therapy for diabetes mellitus sufferers in controlling the disease.

Conclusion

Brisk walking is a form of physical exercise that can control diabetes and prevent the risk of peripheral artery disease in diabetes mellitus sufferers. Brisk walking done regularly and continuously can optimize carbohydrate metabolism so that HbA1c and blood glucose levels in diabetes mellitus can be controlled. In addition, brisk walking can improve blood and oxygen circulation in the body, thereby preventing symptoms of peripheral artery disease by improving ABI and monofilament scores. HbA1c levels, blood glucose levels, ABI scores, and monofilament scores were found to be better in the treatment group given brisk walking training compared to the control group.

Conflict of Interest

The authors declare no conflict of interest.

Ethics approval

The approval for this study was obtained from the Research Ethics Committee of the Faculty of Medicine,

Sebelas Maret University, Indonesia (approval ID: No.52/UN27.06.11/KEP/EC/2024).

Consent to participate

Written informed consent was obtained from all the participants.

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