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Original Research

Effect Walking Exercise In Patient With Diabetic Peripheral Neuropathy: A Follow Study

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ABSTRACT

Background: *Diabetic peripheral neuropathy (DPN) is a common diabetes complication causing nerve damage and pain. Exercise benefits DPN, but its full impact is unclear.*
Objective: *This study examined the effects of walking exercise on DPN patients.*
Method: *A 62-year-old woman with type 2 diabetes and DPN participated in a 6-week walking program, exercising three times per week for 30 minutes each session. Measurements were taken before, during, and after the program to assess blood sugar control (HbA1c), neuropathic symptoms (MNSI), pain levels, balance, muscle strength, cognitive function, sleep quality, quality of life (WHOQoL), and social participation (PSSS).*
Results: *The patient's HbA1c decreased from 6.6 to 6.4, indicating improved blood sugar control. MNSI scores and pain levels during rest, standing, walking, and strenuous activity all decreased significantly throughout the program. Balance, muscle strength, cognitive function, sleep quality, and quality of life all improved as measured by Romberg test, TUG test, 5xSTS, 6MWT, FE score, GDS score, WHOQoL questionnaire, and PSSS score, respectively.*
Conclusions: *Regular walking exercise can effectively improve various aspects of DPN. Patients with DPN are encouraged to exercise regularly with family support and proper footwear.*

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INTRODUCTION

Blood sugar elevation is the most common symptom of a range of metabolic illnesses collectively known as diabetes mellitus. In 2019, 463 million people worldwide, or 9.3% of the total population, were classified as diabetics between the ages of 20 and 79. Relative insulin shortage brought on by insulin resistance and malfunctioning pancreatic cells is the hallmark of type 2 diabetes mellitus. Polyuria, polydipsia, polyphagia, and unexplained weight loss are typical signs of diabetes (Widiasari et al., 2021).

Diabetic Peripheral Neuropathy (DPN) 60–70% of cases of microvascular DMT2, is the general case in Indonesia (Yang et al., 2022). WHO statistics indicates that by 2025, there will be a considerable increase in the number of people with diabetes mellitus.. (Hossain et al., 2024) Uncontrolled diabetes mellitus can lead to complications, including DPN. DPN causes peripheral nerve damage due to high blood sugar by sending signals to the brain and other organs. DPN affects almost 50% of people with diabetes mellitus. DPN is associated with significant morbidity, including neuropathic pain, foot ulcers and amputation (Sartika, n.d.). Common symptoms in patient with DPN are numbness and decreased sensitivity to pain, paresthesia as well as cramps that occur at night. Patients with DPN usually experience weakness in the muscles in the lower extremities as well as decreased balance, this can limit activity in patients with DPN (Fadli and Rahman, 2021). DPN is usually characterized as general dysfunction of peripheral nerve fibers that is asymptomatic (Rosella Komalasari and Pristianto, n.d.). DM sufferers need physical fitness training to avoid complications from DM (Rosella Komalasari and Pristianto, n.d.)

Research conducted by the Centers for Disease Control and Prevention in 2009 found that the effect of *walking exercise* done regularly could reduce the risk of disability in type 2 diabetes sufferers by 60% and also had an impact on improving the patient's quality of life (Saeedi et al., 2019a). This is also in line with the research of Erti, et al in 2020 which explained that there was an increase in the Ankle Brachial Index (ABI) value of 0.095 in DPN patients after being given walking exercises (Saeedi et al., 2019b). Measurement of the Ankle Brachial Index (ABI) by comparing the ankle systolic pressure with the systolic blood pressure in the brachial artery (upper arm). However, these two studies contradict a 2020 study by Wu et al which found that although exercise walking improved blood sugar regulation and the cardiovascular system, the effect on DPN in the legs caused additional problems. This suggests that walking is not the only effective way for DPN to improve their physical fitness (Wu et al., 2022). Therefore, this research was conducted to improve previous research regarding the effects of walking exercise on many aspects such as balance, lower extremity muscle strength, pain levels, cognitive function, psychological aspects, quality of life, and social participation. It is hoped that the exercises carried out will have a positive effect on patients with DMT2 and DPN.

MATERIALS AND METHOD

This research has received research ethical feasibility from the Health Research Ethics Commission (KEPK) FK UMS with number 4798/B.1/KEPK-FKUMS/III/2023 on March 4 2023. The following are the inclusion critera of the study caonducted. The 62-year-old female patient has had a DMT2 diagnosis for ten years from a physician. Hemoglobin A1C for the patient was 6.9. The patient may walk without the need for support equipment and does not exhibit any neurological or cardiovascular problems or cerebral ataxia. It was noted that the patient had fallen once in the previous twelve months. The patient has good verbal comprehension skills. The patient reported having excruciating pain in both legs as well as numbness. When standing for an extended period of time, pain radiates like an electric shock. Due to the discomfort was insistent and discomfort, the patient is unable to walk for longer than fifteen minutes. The patient's legs were so sore and weak that took long time her to do household duties properly. The patient has cramps two or three times during the night. In addition to being quite depressed about the current state of affairs, the patient finds it impossible to cook because it requires her to stand for extended periods of time, which hurts both of his legs. Patients' ability to engage in various social activities within her neighborhood is restricted. For instance, because of their pain and numbness, patients are unable to sit on the floor during community meetings. This, it is requested of the patient to take a seat as the condition made her uncomfortable. Patients complain of discomfort during activities. The patient cannot contribute to her responsibilities at home as a mother and wife, such as cooking and doing laundry.

The patient's instability to stand for extended periods of time is the cause. She is unable to participate in community events that call for regular time commitments, such as trips to other cities. This information was obtained from an interview with the patient. The patient's inability to stand for long periods of time was the cause. She was unable to participate in community events that required a regular time commitment, such as trips to other cities. This information was obtained from an interview with the patient.

The patient's Participation Scale Short Simplified Questionnaire (PSSS-Ina) score was 32 out of 65. Participation Scale Short Simplified Questionnaire (PSSS-Ina) score is 32 out of 65 indicating restriction of patient participation. The validity and reliability of the PSSS were reported to be high. As for sensitivity (0,82) and specitifity (0,75). The patient attended a physical therapy program for 6 weeks. Walking was carried out for 6 weeks, 3 times a week, 30 minutes for each walking training. During walking training, oxygen saturation is controlled with oximetry and always fatigue, nausea, feeling like vomiting, blurred vision, cold sweat as signs of unconsciousness. Follow- up measurements were carried out every 2 weeks for 1 month.

DPN patients were examined using the Michigan Neuropathy Screening Instrument DPN patients were examined using MNSI and received a score of 3.5. This tool is reported to have good to moderate sensitivity and specificity, respectively 96,8% and 85,7% for clinical neuropathy examination with a cut-off score of 2.5 (Agarwal et al., 2023). Meanwhile, neuropathic pain such as burning, electric shock, cramps, numbness is measured using the Numeric Rating Scale (NRS). This measuring instrument is recommended because it is easy to understand by patients, especially the elderly. The validity value shows r = 0.90 and the reliability shows more than 0.95 (Ayu Handayany et al., n.d.).The scale goes from zero to ten, representing no pain at all to

imaginable pain or pain beyond an explanation (Fathi et al., 2024). Visual acuity is assessed using an eye chart test, where the patient is asked to sit in front of the chart about 3 meters and is asked to read the chart. The patient can use his glasses correctly. The patient begins to read the chart from smallest to largest.

Lower leg muscle functional strength was determined using the Five Time Sit to Stand (5xSTS) test. The 13 second score indicates the patient is at high risk for falls and accounts for 66% and 67% of sensitivity and specificity (Taniguchi et al., 2022). The patient was identified as having low lower extremity muscle strength 16.12 seconds.

The endurance is proven by the 6 minuteswalk test (6MWT). The patient was able to walk 270 meters. Cognitive function was determined by the Indonesian version of the Montreal Cognitive Assessment (MOCA-Ina) which showed a score of 21. MOCA was acceptable (ICC 0.820) for test-retest reliability (Surbakti et al., 2023).

RESULTS

Table 1. Patient Characteristics

Variable	Results
Age (years)	62
Marital status	Married
Work	Housewife
Educational Level	Senior High School
Duration of T2DM (years)	10
Hemoglobin A1C (%)	6,9
BMI Kg/m^2	28
Neuropathic pain (NRS)	
Pain At Rest	2
Standing (±15 minutes)	6
Walking (± 15 minutes)	9
Hard activities (cooking, cleaning the house) (± 15 minutes)	9
Visual acuity (score)	60
Vestibular Test	
Impulse Head Test	Negative
Dix Hallpike Test	Negative
Supine Roll Test	Negative

Table 2. Physical Exercise and Case Presentation

Variable	Score								
	Before Exercise	**Treatment 1**	**Treatment 2**	**Treatment 3**	**Treatment 4**	**Treatment 5**	**Treatment 6**	**F1**	**F2**
HbA1C (mg/dl)	6.9	-	-	-	-	-	6.4	-	6.6
MNSI Neuropathic pain (± 15 min)	3.5	3.5	3.5	3	2.5	2	1.5	2	2.5
Resting pain	2	2	2	2	1	0	0	2	2
Standing pain	6	6	5	5	4	3	2	2	5
Walking pain	9	9	8	5	5	4	3	5	7
Hard activities pain	9	9	9	7	6	4	3	5	7
MoCA Test	21	-	-	-	-	-	26	22	22
Romberg									
Eyes Open (seconds)	20.08	19.82	22.41	26.53	25.37	28.93	30.00	27.12	21.03
Eyes closed (seconds)	6.59	7.05	11.32	18.54	15.36	17.25	23.16	20.05	11.04
TUG (sec)	16.72	15.72	14.06	13.11	11.64	11.17	10.04	13.82	14.88
5xSTS (seconds)	16.12	16.53	14.47	15.02	13.22	12.82	11.04	12.82	15.32
6MWT (meter)	270								
FE (score)	55	60	70	70	70	75	75	60	60
Cramp pain	2	2	1	1	0	0	0	1	2
Quality of sleep	4	4	6	6	8	8	8	6	5
GDS	7	7	7	6	6	6	5	6	7
WHOQOL	59	60	67	71	81	81	89	81	67
Physical	38	38	50	56	63	75	75	63	50
Psychological	44	44	50	63	69	69	75	63	50
Social	44	44	50	50	56	75	75	69	50
Environmental	25	25	38	38	50	56	56	50	44
PSSS	32	32	30	25	24	21	16	18	25

The results obtained from measuring HbA1C in the sixth exercise were 6.4, whereas when individuals were given no exercise their HbA1C increased again to 6.6 in F2. The MNSI score increases when the patient is not given exercise, especially when the F2 becomes 2.5 but is still in the normal stage. The measurement of neuropathic pain is divided into four, the first measurement of resting pain found the best decrease in pain at T5, the second measurement of pain when standing showed the highest pain results before exercise and during T1 or the first exercise, as well as walking pain and pain during strenuous activity. However, at T6 there was a significant decrease in pain.

In the examination using the moca test, the best results were obtained at T6. Measurements using the Romberg test to assess static balance in diabetic peripheral neuropathy patients were also carried out, the Romberg test was carried out when the eyes were open and closed, the best results were shown at T6. When the TUG test was carried out, the best results were shown at T6 and there was a change in duration when the patient was no longer given exercise. When doing the five minutes walking test the best results are at T6 as well as when doing

the six minutes walking test. FE scores showed improvement at T6. The duration of cramps decreased when the score was 0 at T4-T6. The sleep quality of diabetic peripheral neuropathy patients also increased and showed a maximum score at T4-T6. When blood sugar levels are at T6, this is when they drop the most. Walking therapy improved the patient's quality of life, as evidenced by the highest rise in WHOQoL observed at T6. The PSSS scores and the physical, psychological, social, and environmental outcomes peak at T6. The outcomes of every test were derived from the case presentation that was previously mentioned. After the sixth exercise, the HbA1C significantly decreased. Similarly, MNSI testing showed improved results at the sixth therapy, with a notable decline. Conversely, improved outcomes were obtained at the sixth therapy when utilizing MNSI to check; there was a notable decrease. The sixth exercise produced no pain at rest, which is a positive outcome for people with diabetic peripheral neuropathy and type 2 diabetes mellitus. Furthermore, the sixth exercise yielded the best results in terms of evaluating pain during standing, walking, and heavy activity, since there was a notable decrease in pain compared to the prior exercise. The sixth exercise yielded excellent results, with a moca score of 26, indicating good outcomes from the exam.

When the Romberg test was carried out with eyes open in the sixth exercise, it showed good results with a time unit of 30 seconds, which shows normal balance, whereas when the Romberg test was carried out in the sixth exercise with eyes closed, the time unit results showed 23.16 seconds, this shows that The patient experienced balance problems, but this result was much better than the results of previous training. The TUG results also resulted in better implementation in the sixth exercise. The 5xSTS results show the optimal time with an achievement of 11.4 seconds. This shows good results for the 5xSTS examination. Prior to training, the patient's 6MWT results indicated that they could travel 270 meters. FE performed well in the sixth exercise as well. In the second exercise, cramps might last a lot less time, and in the fourth exercise, there won't be any cramps at all, and so on. The fourth exercise marked an improvement in the patient's quality of sleep. Additionally, a higher score of five on the sixth exercise of the GDS exam was recorded. The WHOQoL-measured quality of life also improved more during the sixth meeting. Physical, psychological, social and environmental training resulted in better scores in the sixth exercise, where we can see that in the sixth exercise the scores obtained are much higher than in the previous exercise. Finally, the PSSS measurement produced a score of 16, this shows the optimal number in the measurements carried out.

DISCUSSION

The reduction in HbA1C levels from 6.6 to 6.4 with consistent walking exercise indicates significant improvements in blood glucose control among diabetic patients. Regular physical activity enhances insulin sensitivity, facilitating better glucose uptake

by cells and thereby lowering HbA1C levels. This aligns with the established understanding of walking exercise critical role in diabetes management, as highlighted in literature such as "Physical Training and Activity in People With Diabetic Peripheral Neuropathy: Paradigm Shift" (Kluding et al., 2016). Furthermore, studies have consistently shown that structured exercise programs contribute to improved glycemic control, reinforcing the notion that walking exercise is a cornerstone in the management of diabetes and its complications.

In addition to improved blood glucose control, exercise has been shown to significantly reduce neuropathic symptoms, as evidenced by the decrease in Michigan Neuropathy Screening Instrument (MNSI) scores, particularly notable at the sixth exercise session (T6). This reduction can be attributed to the neuroprotective effects of exercise, which enhance blood flow to nerves and promote nerve regeneration. Research, such as the study "Effect of Aerobic Exercise with and without Strengthening Exercises on Neuropathic Symptoms in People with Diabetic Peripheral Neuropathy" (Naseer et al., 2023), supports these findings, demonstrating that a combination of aerobic and strength training exercises leads to substantial reductions in neuropathic symptoms. This dual benefit of improved glycemic control and reduced neuropathy underscores the multifaceted advantages of regular exercise for individuals with diabetes.

CONCLUSION

This study showed that the implementation of walking exercises in diabetic peripheral neuropathy (DPN) patients was effective in reducing pain. During the exercise period, there was a significant decrease in the degree of pain, cramping, improved sleep quality, as well as improved balance, lower limb muscle strength, cognitive function, psychological, quality of life, and social participation based on MoCA, Romberg test, TUG, 5xSST, 6MWT, FE, GDS, WHOQOL, physical, psychological, social environment, and PSSS scores. However, without exercise, pain levels tend to increase again. Therefore, it is recommended that patients continue to exercise independently with family support and stretch the calf muscles first to reduce the risk of injury. The use of comfortable footwear is also recommended to prevent excessive friction on the soles of the feet during exercise, to ensure the long-term positive impact of this exercise.

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