



Official Research Journal of  
the American Society of  
Exercise Physiologists

ISSN 1097-9751

April 2023  
Volume 26 Number 2

JEPonline

## Effect of Walking Meditation on Peripheral Neuropathy in Type 2 Diabetes Mellitus

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### ABSTRACT

**Jintaruethai P, Anek A, Mitranun W.** Effect of Walking Meditation on Peripheral Neuropathy in Type 2 Diabetes Mellitus. *JEPonline* 2023;26(2):69-78. The purpose of this study was to determine the effects of Buddhist walking meditation on diabetic neuropathy and blood sugar and cortisol levels in middle-aged patients with type 2 diabetes. The subjects were patients with type 2 diabetes aged 35 to 55 years. They were randomly allocated into the Walking Meditation (WM), Traditional Walking (TW), and Control Groups, with 15 subjects in each Group. During the study, six subjects completed less than 80% of the exercise program due to coronavirus infections and quarantine. There were 11, 13, and 15 participants in the Walking Meditation Group, the Traditional Walking Group, and the Control Group, respectively. HbA1c levels decreased significantly in both the WM and TW Groups, but blood sugar levels decreased significantly only in the WM Group. The percentage of blood sugar and HbA1c levels showed the greatest improvement in the WM Group. Significant improvement in diabetic neuropathy was observed in the WM Group. Compared with the Control Group, the results suggest that Buddhist WM is a new treatment and prevention method with an easy and low-intensity form of exercise that is suitable for middle-aged patients with type 2 diabetes.

**Key Words:** Diabetes Neuropathy, Fasting Blood Glucose, Hemoglobin A1c, Walking Meditation

## INTRODUCTION

The prevalence and incidence of type 2 diabetes mellitus are high, accounting for up to 90% of all diabetes cases. Type 2 diabetes mellitus is a metabolic disorder characterized by abnormalities in insulin secretion. The disease results from the destruction of insulin-producing pancreatic beta cells ( $\beta$ -cells), leading to insulin resistance, wherein insulin is unable to bind to the insulin receptors (IR). Insulin resistance builds up tolerance to insulin, making the hormone less effective in absorbing glucose into the cells, resulting in a high blood sugar called hyperglycemia (12). Without proper control of blood sugar levels, patients with type 2 diabetes experience diabetic neuropathy, retinopathy, and peripheral vascular disease (27), which may lead to coronary artery, cerebrovascular, and chronic kidney diseases (2).

Diabetic neuropathy is a complication found in 25 to 60% of the patients with chronic diabetes (27). This complication results from peripheral nerve degeneration, causing numbness, burning, and a pricking sensation at the tip of the feet. Diabetic neuropathy also involves the central nervous system. Increased blood sugar levels lead to cell inflammation and myelin sheath damage, inducing ineffective nerve signaling (32). In patients with diabetes, stress and anxiety also contribute to the inflammation of the central nervous system, which correlates with the functions of the peripheral nervous system (23).

Buddhist walking meditation involves the concentration of walking movements. This practice has a direct psychological impact on the mental health of patients by reducing stress and anxiety related to cortisol hormones (1). Walking meditation also affects the peripheral vascular system, lowers blood sugar level along with hemoglobin A1C level (HbA1c level) (10), stimulates the nervous system, alleviates nerve inflammation, improves nerve signaling (22), and enhances sensation at the tip of the feet (20). However, no study has been conducted on the effects of walking meditation on diabetic neuropathy.

Accordingly, the purpose of this study was to determine the effects of Buddhist walking meditation on diabetic neuropathy and blood sugar and cortisol levels in middle-aged patients with type 2 diabetes. The results were compared with those collected from traditional walking and control groups to develop treatment guidelines for patients with type 2 diabetes.

## METHODS

### Subjects

The subjects were patients with type 2 diabetes aged 35 to 55 years who attended the Chronic Disease Clinic at the Nuea Khlong Hospital in Krabi Province. Inclusion criteria were moderate risk in an assessment for diabetic neuropathy, HbA1c of 6.5 to 8%, and fasting blood glucose of 100 to 140 mg/dL with no insulin injections. During the process, the medications for the subjects remained unchanged, and the subjects did not present with coronary artery disease, lower limb injuries that could limit walking, and had not attended any exercise program for at least 6 months. Exclusion criteria included at least

80% participated in the exercise program, problems in the musculoskeletal system, and injuries during meditation practice. By calculating the sample size using G-Power 3.1.9, the subjects were randomly allocated into the Walking Meditation (WM) Group, the Traditional Walking (TW) Group, and the Control Group with 15 subjects in each group. During the process, six subjects completed less than 80% of the exercise program due to coronavirus infections and quarantine. Therefore, there were 11, 13, and 15 subjects in the WM Group, the TW Group, and the Control Group, respectively.

## 2. Exercise Training

The exercise program was practiced for 12 weeks in both the WM and TW Groups. The program was divided into two parts consisting of Anapanasati, a meditation on in-and-out breathing, followed by 3-stage Buddhist meditation walking. The 3-stage Buddhist meditation walking is a meditation practice of Pra Ajaan (a well-respected teaching monk) at the Tiger Cave Temple in Krabi Province. The three stages consist of lifting, moving, and treading, focusing on the sensation of movement of the feet in a walking state. The walking meditation group practiced Anapanasati for 10 minutes, followed by meditation walking for 30 minutes, with a Rating of Perceived Exertion Scale (RPE scale) of 10 to 13. The session was conducted three times a week on Tuesdays, Thursdays, and Saturdays for the WM Group. The TW Group walked in a traditional movement with an RPE scale of 12 to 15 on Mondays, Wednesdays, and Fridays. The RPE scale was applied in the first week of the exercise program to establish the assessment criteria for the following weeks. The Control Group did not receive any suggestions regarding health issues or basic dietary control. After the program was completed, knowledge of WM and TW was also provided to the Control Group.

### Exercise Training Program

Both the WM and the TW programs consisted of two phases. In phase 1 (weeks 1 and 2), the subjects underwent exercise training with the researcher. In phase 2 (weeks 3 through 12), the subjects performed the program at their residences. The prescribed exercise program was followed through video calls from the researcher and visits from Village Health Volunteers (VHV).

## Procedures

### 3. Measurement

**3.1 Physical Fitness Test:** Body Mass Index (BMI) was calculated using the following equation: body weight in kg/height in m<sup>2</sup>.

**3.2 Blood Analysis:** After 8 hours of overnight fasting, starting from midnight, a blood sample was collected at 8 a.m. to measure fasting blood glucose and HbA1c at The Department of Medical Technology at the Nuea Khlong Hospital in Krabi Province.

**3.3 Diabetic Neuropathy:** A 10-g nylon Semmes–Weinstein monofilament evaluation was used to detect the presence or loss of protective sensation. The force applied to the tip of the feet was limited to 10 g to prevent stimulation of large nerve fibers that are related to sensory perception. The method was applied in four sites: the big toe, the first

metatarsal bone, the third metatarsal bone, and the fifth metatarsal bone. The patients were required to close their eyes and answer whether they were able to sense the pressure applied (yes/no) and where they felt the pressure applied. Reports of no feeling from sites 1 to 4 have demonstrated the risks of sensory loss.

**3.4 Statistical Analysis:** The data were analyzed using the mean  $\pm$  standard deviation. The qualifications of the subjects were compared using one-way analysis of variance (ANOVA). Comparisons of the data collected between pre- and postexercise programs were conducted using a paired *t*-test within the group and one-way ANOVA and chi-square test between the groups. Statistical significance was set at  $P \leq 0.05$ .

## RESULTS

There were no significant group differences in any subject qualifications before the exercise program (Table 1). Age, body mass, height, BMI, pulse wave velocity, and ABI did not change during the program. The HbA1c levels decreased significantly in both the WM Group and the TW Group, but blood sugar levels decreased significantly only in the WM Group. The percentage of blood sugar and HbA1c levels showed the greatest improvement in the WM Group (Table 2), and a significant improvement in diabetic neuropathy was observed in the WM Group (Table 3).

**Table 1. The Characteristics of the Participants in the Study.**

<b>Group</b>	<b>WM</b>	<b>TW</b>	<b>Control</b>
	<b>N = 11</b>	<b>N = 13</b>	<b>N = 15</b>
<b>Age: <math>\bar{x} \pm SD</math></b>	51.64 $\pm$ 3.67	50.46 $\pm$ 5.33	50.47 $\pm$ 4.76
<b>Weight: <math>\bar{x} \pm SD</math></b>	57.18 $\pm$ 6.06	63.20 $\pm$ 9.18	63.77 $\pm$ 10.88
<b>Height: <math>\bar{x} \pm SD</math></b>	156.18 $\pm$ 7.47	158.54 $\pm$ 6.97	156.87 $\pm$ 9.80
<b>BMI: <math>\bar{x} \pm SD</math></b>	23.62 $\pm$ 3.82	25.16 $\pm$ 3.49	25.83 $\pm$ 3.22

**Table 2. Changes in Blood Biochemistry Data during the Walking Interventions.**

Group	WM (N = 11)		TW (N = 13)		Control (N = 15)	
	Pre	Post	Pre	Post	Pre	Post
<b>Fasting Blood Glucose</b>	127.64±12.19	116.09±19.38*	126.13±11.58	133.47±12.52	120.62±14.03	128.69±25.64
<b>HbA1c</b>	6.91±0.44	7.12±0.66*	7.12±0.66	7.04±0.88*	6.95±0.59	7.54±0.75
<b>% Change of FBS</b>	0	-8.78±13.74*#	0	6.10±8.40*	0	8.76±9.50
<b>% Change of HbA1c</b>	0	-4.96±5.08*#	0	-1.14±7.77*	0	8.76±9.50

Data are presented as mean ± SD. P<0.05

**Table 3. Changes in the Effects of Perception of the Test Sensation.**

Peripheral Neuropathy	WM	TW	Control
	(N = 11)	(N = 13)	(N = 15)
<b>Low</b>	45.45*	45.45	9.09
<b>Medium</b>	23.08	61.54	15.38
<b>High</b>	0.00	66.67	33.33

Data are presented as percentage. P<0.05

## DISCUSSION

The findings in the present study indicate that both Walking Meditation (WM) and Traditional Walking (TW) significantly improved the patients' blood sugar and HbA1c levels. After the program, changes in cortisol hormone levels were observed in the WM Group, and diabetic neuropathy showed a significant improvement in patients with type 2 diabetes.

Both the WM Group and the TW Group presented a decrease in blood sugar levels, which is consistent with previous studies (2,10). However, the results showed that walking exercises affected metabolism and the cardiovascular system. Previous studies have shown that walking programs contribute to lowering HbA1c levels, but do not have a decreasing effect on fasting blood glucose levels during the 24 hours after exercise (7). Walking has an impact on reducing blood sugar levels. In an additional study, meditation practices changed lifestyle behaviors, raised awareness of healthy living, and developed more interest in exercising (27). The correlation between meditation and other forms of exercise also significantly reduces blood sugar levels in subjects (26), which can be further applied in daily life.

In addition, meditation exercises were studied in light patients to determine stress levels. It has been found that concentration can help patients with type 2 diabetes improve their body function (30), as well as reduce distraction and improve perception of central to peripheral functions (8,15) In addition, previous studies have described the effects of meditation as helping to motivate participants to change their behavior. This also makes it part of increasing physical activity. Therefore, this study was conducted. In this group of participants, there was a statistically significant decrease in glucose levels compared with the other groups.

Diabetic neuropathy in patients with type 2 diabetes is a complication resulting from the inability to control blood sugar levels in the body (11) and inflammatory peripheral neuropathy (32). In this study, only the WM Group showed improvement in diabetic neuropathy through monofilament evaluation. In a previous study, practicing meditation lowered nerve inflammation, stimulated cell efficiency, and improved nerve conduction velocity (23). Moreover, the practice provided the WM Group with the greatest reductions in blood sugar and HbA1c levels (10,30). This is an important variable for the reduction of toe numbness complications in patients (3). Furthermore, previous studies have used meditation in research on other groups of patients, such as patients with Parkinson's disease of which the meditation has been showed to decrease the severity of the disease and level of stress in the patient. Walking meditation has also been found to contribute to an improvement in confidence during exercise by reducing the patients' stress levels (36). This is an important factor in decreasing diabetic neuropathy in patients with type 2 diabetes mellitus.

### Limitations in this Study

This study had several limitations that should be addressed. First, pulse wave velocity and ABI could not be assessed due to coronavirus disease 2019 (COVID-19) preventive measures, including the travel-related control that resulted in the inconvenience of moving certain equipment on site. This led to the absence of vascular function

assessments after the exercise program. Second, some of the participants were unable to complete the program because of COVID-19 infection. Lastly, knowledge on self-care and diabetes diet was provided to the subjects without controlling their daily intakes.

## CONCLUSIONS

Both Walking Meditation (WM) and Traditional Walking (TW) walking exercise programs have beneficial effects in decreasing blood sugar and HbA1c levels in patients with type 2 diabetes. However, the WM exercise program was more effective in terms of lowering stress as it was associated with cortisol hormone levels that improved the nervous system, enhanced peripheral sensation, and reduced diabetic neuropathy. Compared with the Control Group in this study, the results suggest that Buddhist WM is a new treatment and prevention method with an easy and low-intensity form of exercise that is suitable for middle-aged patients with type 2 diabetes.

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## ACKNOWLEDGMENTS

The authors thank the participants for their participation in this study. We also thank the Nuekhlong Hospital, Krabi, for their assistance with data collection.

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