ORIGINAL ARTICLE

The effect of diabetes exercise, brisk walking, and dietary management on blood glucose levels in patients with type 2 diabetes mellitus

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Abstract

Background and Study Aim: Effective lifestyle interventions are essential for identifying strategies to reduce blood glucose levels in patients with type 2 diabetes mellitus. Diabetes exercise, brisk walking, and dietary management are commonly applied approaches that support glycemic control and overall well-being. Although these interventions are widely practiced, their relative effectiveness in improving blood glucose regulation remains a matter of practical interest. From a pedagogical perspective, such interventions are also important in the context of health education by promoting safe exercise practices and culturally relevant approaches to sustaining healthy lifestyles. The aim of this study was to analyze and compare the effectiveness of these three interventions in lowering blood glucose levels and supporting health education.

Material and Methods: This study employed a randomized pretest-posttest experimental design with three intervention groups: diabetes exercise (Group 1), brisk walking (Group 2), and dietary management (Group 3). A total of 30 patients (23 women and seven men), aged 41–80 years (mean = 58.4 ± 10.76), were recruited according to inclusion and exclusion criteria. Groups 1 and 2 underwent 12 sessions of supervised exercise (Wednesday, Friday, and Sunday, 06:00–07:00). Each session consisted of 30 minutes of core training and 30 minutes of warm-up and cool-down activities. Diabetes exercise (Group 1) was performed with slow-to-moderate music rhythms. Brisk walking (Group 2) was conducted at 4–6 km/h. Group 3 received dietary guidance through a structured food manual outlining portion sizes, food types, and nutritional content. Blood glucose levels were measured using an Autocheck GCU 3-in-1 device.

Results: In Group 1, mean blood glucose levels decreased from 243 (pretest) to 193 (posttest), a reduction of 50. Group 2 decreased from 205 to 160, a reduction of 45. Group 3 decreased from 196 to 161, a reduction of 34. The Wilcoxon test indicated significant reductions within each group (Group 1: $p = 0.001 < 0.05$; Group 2: $p = 0.000 < 0.05$; Group 3: $p = 0.019 < 0.05$). However, the Kruskal-Wallis test showed no significant difference among the three groups ($p = 0.078$).

Conclusions: Diabetes exercise, brisk walking, and dietary management significantly reduced blood glucose levels after 12 sessions. However, no significant differences were observed among the three interventions. These findings highlight the importance of lifestyle-based strategies focused on physical activity and dietary regulation to improve short-term glycemic control. Future studies should consider larger sample sizes, the inclusion of control groups, and the evaluation of long-term outcomes and adherence. In addition, the results underline the pedagogical value of integrating safe exercise and dietary practices into health education programs.

Keywords: healthy lifestyle, physical activity, dietary management, diabetes mellitus, health education, pedagogy

Introduction

Type 2 diabetes mellitus is a chronic metabolic disorder characterized by impaired insulin regulation and elevated blood glucose levels. It is closely associated with obesity, sedentary behavior, and unhealthy dietary patterns, making its management a complex and multifactorial challenge. Persistent hyperglycemia contributes to the development of serious complications, including cardiovascular disease, neuropathy, nephropathy, and retinopathy, which significantly reduce patients' quality of life and increase healthcare burdens.

Blood glucose levels reflect the concentration of circulating glucose, which is the primary energy source for cells. In type 2 diabetes mellitus (T2DM), a combination of insulin resistance and pancreatic β-cell dysfunction impairs glucose uptake by peripheral tissues and increases hepatic glucose production [1, 2]. This condition leads to persistent

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fasting and postprandial hyperglycemia, typically assessed through fasting blood glucose, 2-hour postprandial glucose, and glycated hemoglobin (HbA1c). Chronic hyperglycemia is closely associated with microvascular and macrovascular complications, making glycemic control a central objective in T2DM management [3, 4].

Various interventions have been shown to lower blood glucose levels in patients with T2DM. Lifestyle modifications, including light-to-moderate or moderate-to-vigorous aerobic exercise, resistance training, or a combination of both, improve insulin sensitivity and enhance muscle glucose utilization [5]. Nutritional interventions, such as structured dietary programs involving portion and calorie control, are also important, particularly when supported by continuous education to improve adherence [6]. Additional strategies, including self-monitoring of blood glucose, weight management, adequate sleep, and stress reduction, further contribute to better glycemic outcomes [7]. This study focuses on diabetes exercise, brisk walking, and education-based dietary interventions as practical, accessible, and non-pharmacological approaches.

Diabetes exercise refers to structured physical activity tailored for patients with diabetes, typically combining low-to-moderate intensity aerobic movements with simple strengthening exercises [8]. Physiologically, repeated muscle contractions enhance glucose transporter type 4 (GLUT4) translocation to muscle cell membranes through both insulin-dependent and insulin-independent pathways [9]. Regular participation improves insulin sensitivity and lowers both fasting and postprandial glucose levels. Group-based sessions additionally promote motivation, safety, and adherence. Previous studies have confirmed that diabetes exercise effectively reduces blood glucose in patients with T2DM [10].

Brisk walking, a moderate-intensity aerobic activity, is widely recognized as a safe, simple, and standardized form of exercise. It enhances glucose uptake by active muscles through increased blood flow and contraction-mediated pathways, which facilitate glucose entry into cells independently of insulin [11, 12]. Regular brisk walking also improves cardiorespiratory fitness and body composition, thereby contributing to better insulin sensitivity. The frequency, intensity, and duration of walking are key determinants of its effectiveness in lowering blood glucose and HbA1c levels [5]. Therefore, brisk walking can lower blood glucose levels in patients with type 2 diabetes mellitus.

Dietary management through structured food guides emphasizes practical education and the application of nutritional principles tailored to individual needs. Well-designed food guides promote the selection of low-glycemic index carbohydrate sources, portion control, and appropriate distribution of carbohydrates throughout the day [13, 14]. These guides often incorporate culturally relevant portion sizes and utensils, aligning energy intake with metabolic requirements to minimize postprandial glucose surges and overall daily glycemic load. Furthermore, structured dietary tools can enhance self-efficacy, long-term adherence, and informed food choices, thereby supporting sustained glycemic control [15]. Taken together, these findings highlight the broader spectrum of lifestyle-based strategies, including structured exercise, brisk walking, and culturally adapted nutrition education, which underpin the pedagogical directions of health promotion and form the basis for subsequent research analysis.

In this context, recent studies have proposed various non-pharmacological strategies to improve glycemic control in patients with type 2 diabetes mellitus. Pharmacological reviews underline the importance of lifestyle interventions alongside medication [1, 2], while relaxation techniques and self-care behaviors have also been shown to contribute to lower blood glucose levels [3, 4]. Safe physical activity technologies are emphasized in international consensus statements, confirming the role of structured exercise in diabetes management [5, 6, 7]. Specific exercise formats, including diabetic gymnastics and motor-based programs, demonstrate measurable benefits [8, 10], consistent with the idea of art therapy through human motor actions. Likewise, brisk walking has repeatedly been recommended as a simple and safe form of aerobic exercise [11, 12]. Culturally adapted nutritional education, often delivered through counseling and illustrated dietary guides, reflects folk traditions of health promotion and supports sustained adherence [13, 14, 15]. Collectively, these findings provide the scientific and pedagogical basis for evaluating diabetes exercise, brisk walking, and dietary management as integrated health education strategies.

Analysis of research findings has shown that both structured exercise and dietary management play a significant role in improving glycemic control in patients with type 2 diabetes mellitus. Researchers emphasize that lifestyle-based strategies, including diabetes exercise, brisk walking, and nutrition education, provide practical, safe, and sustainable benefits that complement pharmacological treatment. At the same time, the complexity of patient adherence, variations in physiological response, and the integration of these approaches into daily routines remain important challenges. From a pedagogical perspective, these strategies are also important as elements of health education that promote safe physical activity and culturally adapted nutritional practices. In addition, they illustrate how non-pharmacological interventions can be incorporated into pedagogical models of health promotion, linking clinical outcomes with

educational value. This context creates the basis for evaluating and comparing specific lifestyle interventions in order to clarify their relative effectiveness in managing blood glucose levels.

The research problem arises from the urgent need for effective, safe, affordable, and sustainable lifestyle interventions for patients with T2DM, as well as the limited direct comparative evidence to guide the selection of the most effective strategies. To date, no study has directly compared the effects of diabetes exercise, brisk walking, and education-based dietary interventions on blood glucose reduction in patients with T2DM. Therefore, this study aimed to analyze and compare the effects of these three interventions in lowering blood glucose levels and their relevance for health education.

Materials and Methods

Participants

The study population consisted of patients with diabetes mellitus attending the Pakem District Community Health Center, Sleman Regency, Indonesia. The study sample included elderly patients with type 2 diabetes mellitus who met the following inclusion criteria:

- age >40 years,
- registered at the Pakem Community Health Center,
- willingness to participate by signing informed consent.

Exclusion criteria were:

- incomplete medical records,
- refusal or failure to provide written informed consent.

A total of 30 patients were recruited, comprising 23 women and 7 men, aged 41–80 years (mean = 58.4 ± 10.76 years). The demographic characteristics of the participants are presented in Table 1. The choice of elderly patients was justified by the fact that this group represents one of the most vulnerable populations, which requires focused health education and lifestyle interventions.

Research Design

This study employed a randomized pretest–posttest experimental design with three intervention groups and no control group. Thirty patients with type 2 diabetes mellitus underwent baseline (pretest) assessments and were then randomly allocated to one of three groups:

1. diabetes exercise,
2. brisk walking,
3. dietary management using a structured food guide.

The design also included an educational element, as participants were introduced to safe exercise practices and nutritional guidance.

Randomization was performed using a simple lottery method with a 1:1:1 allocation ratio. Allocation concealment was maintained through sequentially numbered opaque envelopes. Each group underwent a four-week intervention consisting of 12 sessions (three sessions per week). Post-intervention assessments (posttest) were conducted on the same glycemic outcome variables. Blood glucose levels were measured using the Autocheck GCU 3-in-1 Monitoring System [16, 17, 18].

This study was also approved by the university ethics committee (B/1778/UN34.16/PT.01.04/2025).

Intervention Program

The intervention program was conducted over four weeks with three sessions per week (Wednesday, Friday, and Sunday, 06:00–07:00 a.m.). Each session consisted of a 15-minute warm-up, a 30-minute main activity, and a 15-minute cool-down.

In the diabetes exercise group (Group 1) and the brisk walking group (Group 2), participants first engaged in joint physical activity consisting of static–dynamic warm-ups for approximately 30 minutes during the first week. The aim was to allow the body to adapt before beginning the main intervention program.

Table 1. Demographic characteristics of respondents

Patient Data	Category	Frequency
Age	41 - 45	4
	46 - 50	3
	51 - 55	5
	56 - 60	7
	61 - 65	3
	66 - 70	2
	71 - 75	5
	76 - 80	1
Diagnosis	Type 2 Diabetes Mellitus	22
	Type 2 Diabetes Mellitus with multiple complications (non-insulin dependent)	8

The intervention programs in Groups 1 and 2 were conducted according to the recommendations of the American College of Sports Medicine (ACSM) and modified according to specific needs [19]. Group 1 performed structured exercise movements using music with a slow-to-moderate tempo, following a rhythm of 4 counts of 8, as recommended in previous studies [10, 20]. Group 2 performed brisk walking at a speed of 4–6 km/h, in line with published guidelines [11]. To monitor adherence and intensity in Groups 1 and 2, smartwatches were used to record heart rate, step count, and duration of activity. The structured use of rhythm and movement may also be viewed as a form of motor-based art therapy, supporting motivation and adherence through pedagogical methods.

For Group 3, the intervention used food booklets officially published by the Indonesian Ministry of Health as a reference for dietary management [15]. These booklets contained photographs of food in appropriate portions, names of food types, nutritional content, and explanations of the effects of macro- and micronutrient deficiencies on the body.

Statistical Analysis

Data analysis was performed in three stages. First, descriptive statistics were used to summarize pretest and posttest values. Second, within-group comparisons of pretest and posttest values were conducted using the Wilcoxon signed-rank test, with statistical significance set at $p < 0.05$, according to standard recommendations [21]. Third, between-group comparisons of posttest values were performed using the Kruskal–Wallis test, followed by post hoc analyses if required [21]. Data analysis was carried out using SPSS version 27, in line with established guidelines [21].

Results

Data were collected twice, at baseline (pretest) and after the intervention (posttest). Descriptive statistics of blood glucose levels in each intervention group are presented in Table 2.

As shown in Table 2, all three groups demonstrated a decrease in mean blood glucose levels after the intervention. The reduction was most pronounced in the diabetes exercise and brisk walking groups, while the dietary management group also showed a favorable decrease. Overall, the results indicate that lifestyle-based interventions were effective in lowering blood glucose levels across all groups.

A Wilcoxon signed-rank test was performed to evaluate within-group differences between pretest and posttest values. The results are presented in Table 3.

As shown in Table 3, all three intervention groups demonstrated statistically significant reductions in blood glucose levels ($p < 0.05$). The negative Z values indicate a consistent decline across groups.

The second analysis used the Kruskal–Wallis test to examine the differences between the three groups. This non-parametric test was applied to analyze differences among more than two groups. The results of the Kruskal–Wallis test are presented in Table 4.

As shown in Table 4, the Kruskal–Wallis test indicated no statistically significant difference among the three intervention groups ($p = 0.078$). Therefore, no post hoc analysis was performed.

The consistent reductions in blood glucose levels across all groups also confirm the value of safe and structured exercise as an effective pedagogical tool in health promotion. In particular, the rhythmic character of diabetes exercise may be viewed as

Table 2. Descriptive statistics of intervention groups (mg/dL)

Blood glucose status	Group 1	Group 2	Group 3
Pretest	243.80 ± 78.40	205.60 ± 94.28	196.40 ± 92.29
Posttest	193.80 ± 63.32	160.60 ± 70.91	161.50 ± 78.65
Difference	50.00	45.00	34.90

Table 3. Wilcoxon signed-rank test results

Test statistic	Group 1	Group 2	Group 3
Z	−3.108	−3.503	−2.271
Asymp. Sig. (2-tailed)	0.001	0.000	0.019

Table 4. Kruskal–Wallis test results

Test statistic	Blood glucose levels
Kruskal–Wallis H	0.169
df	2
Asymp. Sig.	0.078

having an art therapy component, which is in line with previous recommendations and findings on diabetes-specific exercise programs [10, 17, 20]. Similarly, the effectiveness of brisk walking corresponds with published recommendations emphasizing its role in glycemic control [11, 12]. For the dietary management group, the use of illustrated food booklets functioned not only as nutritional guidance but also as a simple educational tool, consistent with recommendations for culturally adapted dietary education [14, 15]. Taken together, these findings demonstrate that lifestyle-based interventions can serve not only as clinical strategies but also as practical elements for health-oriented teaching and learning.

Discussion

The aim of this study was to analyze and compare the effects of diabetes exercise, brisk walking, and education-based dietary management on blood glucose reduction in patients with type 2 diabetes mellitus (T2DM). The findings showed that all three intervention groups achieved significant reductions in blood glucose levels after 12 sessions. However, no significant differences were observed between groups in the posttest analysis. The consistent within-group improvements confirm that non-pharmacological lifestyle interventions, particularly physical activity and dietary management, can effectively improve glycemic control in patients with T2DM within a relatively short intervention period. These results also show that such approaches can be viewed not only as clinical measures but also as educational practices that help patients acquire knowledge and skills for healthier living.

These findings are consistent with previous studies that reported reductions in blood glucose levels following diabetes exercise and brisk walking interventions. Several one-group pre–post and quasi-experimental studies have demonstrated glucose-lowering effects after structured exercise programs [8, 21, 22, 23, 24]. Similarly, the effectiveness of dietary interventions in this study aligns with existing evidence that dietary adherence is strongly associated with improved blood glucose levels [6]. Collectively, these results reaffirm the two fundamental pillars of T2DM management: physical activity and diet.

The use of a food guide as an educational tool proved to be effective and represents a practical, low-cost strategy that can be implemented in diverse healthcare settings. Illustrated food guides, which provide examples of portion sizes, low-glycemic carbohydrate options, and visual cues, help patients better understand and apply dietary changes in daily life, thereby potentially improving adherence [7]. From a pedagogical point of view, the use of illustrated food guides demonstrates how simple educational tools can translate scientific recommendations into practical daily habits, thereby enhancing patient self-efficacy. Improved dietary habits, such as portion control and healthier food selection, reduce overall glycemic load and postprandial glucose response [12], contributing to lower blood glucose levels.

The absence of significant differences between groups may be explained by several factors. These include the relatively small sample size, which limits statistical power; the possibility that all three interventions were similarly effective, resulting in minor between-group differences; and inter-individual variability in response and adherence [9, 25]. Furthermore, analyses based solely on posttest data without baseline adjustment may have reduced sensitivity in detecting group differences when pretest scores were not fully equivalent. These methodological limitations also underline the importance of developing educational strategies that strengthen adherence, motivate participation, and reduce variability in patient response.

Physical activity interventions, specifically diabetes exercise and brisk walking, appeared particularly effective. Previous studies have shown that 15 minutes of walking after each meal (a total of 45 minutes per day) can lower HbA1c by 0.4–0.94% [26, 27]. The physiological mechanisms underlying this effect include increased glucose transporter type 4 (GLUT4) translocation in skeletal muscle during contraction, which enhances glucose uptake independent of insulin. Additionally, muscle contractions increase blood flow and capillary recruitment, thereby improving insulin receptor activity and facilitating glucose clearance [5, 28]. In addition to clinical outcomes, the study highlights the pedagogical dimension of lifestyle interventions, showing that structured exercise and dietary education can serve as practical models for health promotion and patient training.

Taken together, the findings of this study emphasize the consistent benefits of lifestyle-based, non-pharmacological approaches in managing blood glucose levels among patients with type 2 diabetes mellitus. The comparable effects of diabetes exercise, brisk walking, and structured dietary guidance highlight their practical value as complementary strategies in routine diabetes care. These results contribute to the broader discussion on how accessible, low-cost interventions can be effectively applied in real-world healthcare settings to support glycemic control.

Limitations

The study's limitations include its relatively small sample size, the absence of a non-intervention control group, and reliance on posttest-only comparisons. Another limitation is the absence of a structured educational follow-up, which could have provided insights into how patients retain and apply

knowledge gained through exercise and dietary guidance. Future research should involve larger sample sizes, the inclusion of a non-intervention control group, and long-term outcome measures such as HbA1c. It would also be valuable to assess adherence levels more rigorously to strengthen the validity of findings. Future research should also evaluate the pedagogical effectiveness of lifestyle interventions, for example, how illustrated dietary guides or group-based exercise sessions contribute to long-term learning and health behavior change. From a practical perspective, the results of this study support the integration of diabetes exercise and brisk walking programs into routine diabetes care and demonstrate the potential of food guide-based dietary education as a feasible option in resource-limited settings. From a practical perspective, replication of this study with a more rigorous design is recommended to provide stronger clinical evidence for intervention guidelines.

Conclusions

This study demonstrated that diabetes exercise, brisk walking, and dietary management using a food guide significantly reduced blood glucose levels after 12 sessions, although no significant differences were found between the three interventions. Consistent within-group results confirm that lifestyle-based, non-pharmacological interventions focusing on physical activity and dietary modification can effectively improve glycemic control in a relatively short period. The physiological effectiveness of diabetes exercise and brisk walking is linked to enhanced GLUT4 translocation to muscle cell membranes and increased capillary perfusion, mechanisms that improve glucose uptake by muscles and enhance insulin sensitivity. Similarly, the use of a food guide that provides portion recommendations and low-glycemic food choices proved effective in improving dietary understanding and adherence. Beyond clinical outcomes, the study also emphasizes the pedagogical value of integrating structured exercise and dietary education into health promotion, showing their potential as practical tools for teaching patients safe and sustainable lifestyle practices.

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Conflict of Interest

The author declares no conflict of interest regarding this research or its findings.

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