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The Effect of Physical Activity on Blood Glucose Levels in Patients with Type 2 Diabetes Mellitus in Masbagek District, East Lombok

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Abstract

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder characterized by hyperglycemia due to impaired insulin secretion or resistance. Physical activity has been widely recognized as a non-pharmacological strategy to control blood glucose. However, limited evidence exists regarding its effectiveness in rural Indonesian populations. This study aims to evaluate the effect of physical activity on blood glucose levels in patients with T2DM in Masbagek District, East Lombok. A quasi-experimental study with a pre–post test design was conducted from January to April 2024. A total of 80 participants diagnosed with T2DM were recruited using purposive sampling. The intervention group (n=40) performed moderate-intensity physical activity (30 minutes of brisk walking, 5 days/week) for 12 weeks, while the control group (n=40) continued routine care. Fasting blood glucose levels were measured before and after the intervention. Data were analyzed using paired and independent t-tests. The intervention group showed a significant reduction in mean fasting blood glucose from 178.5 ± 22.4 mg/dL to 142.3 ± 18.9 mg/dL ($p < 0.001$), whereas the control group showed no significant change (176.8 ± 20.1 mg/dL to 173.2 ± 21.4 mg/dL, $p = 0.214$). Regular moderate-intensity physical activity significantly reduced blood glucose levels in T2DM patients in Masbagek District. These findings emphasize the importance of integrating structured physical activity into community-based diabetes management programs in rural areas.

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Introduction

Diabetes Mellitus (DM) is a major global health concern and a leading cause of morbidity and mortality worldwide. According to the International Diabetes Federation (IDF, 2021), approximately 537 million adults are living with diabetes, and this number is projected to rise to 643 million by

2030. Type 2 Diabetes Mellitus (T2DM) accounts for around 90–95% of all diabetes cases, with an increasing prevalence in low- and middle-income countries (Bellini et al., 2024).

In Indonesia, the prevalence of diabetes has risen significantly, with the 2018 Basic Health Research (RISKESDAS) reporting a national prevalence of 10.9% (Gale et al., 2023). Rural areas such as East Lombok are particularly vulnerable due to limited access to healthcare facilities, lower health literacy, and lifestyle factors contributing to poor glycemic control (Church et al., 2010). Therefore, effective and accessible non-pharmacological interventions are needed to improve diabetes management in these settings (Wang et al., 2025).

Physical activity is recognized as a cornerstone of diabetes management, alongside diet modification and pharmacotherapy. Regular physical activity improves insulin sensitivity, enhances glucose uptake in skeletal muscles, and contributes to weight management (Colberg et al., 2016). Several studies have shown that aerobic and resistance exercise can lower glycated hemoglobin (HbA1c) and fasting blood glucose levels among T2DM patients (DiPietro et al., 2013; Vincent et al., 2017).

Despite global evidence, studies focusing on rural populations in Indonesia are scarce. Previous studies have primarily concentrated on urban settings, leaving a gap in understanding the impact of physical activity in rural communities where cultural, economic, and infrastructural challenges may influence adherence (Snowling & Hopkins, 2006). Moreover, most interventions have been hospital-based rather than community-based, limiting their applicability in low-resource areas.

Addressing these gaps, this study investigates the effect of structured physical activity on fasting blood glucose levels among T2DM patients in Masbagek District, East Lombok. This area is characterized by high diabetes prevalence and limited healthcare resources, making it a crucial setting for community-based interventions (Jansson et al., 2022).

The study contributes to the growing body of literature by providing empirical evidence on the effectiveness of physical activity in rural Indonesia. It also highlights the feasibility of integrating structured physical activity programs into local diabetes management practices (Lee et al., 2017).

By focusing on Masbagek District, this study aims to demonstrate the potential of non-pharmacological interventions in improving diabetes outcomes in resource-limited settings. The findings are expected to inform policymakers, healthcare providers, and community health workers in developing culturally appropriate and sustainable strategies for diabetes management.

Materials and Methods

Study Design and Setting

This study applied a quasi-experimental design using a pre-test and post-test approach with an intervention group and a control group. The design was selected to evaluate the effect of structured physical activity on fasting blood glucose levels among patients with Type 2 Diabetes Mellitus under real community conditions. The research was conducted in Masbagek District, East Lombok, Indonesia, an area characterized by predominantly rural settlements and limited access to specialized diabetes care. Data collection and intervention implementation took place from January to April 2024.

Participants and Sampling

The study population consisted of patients diagnosed with Type 2 Diabetes Mellitus who were registered at community health services in Masbagek District. A total of 80 participants were recruited using purposive sampling to ensure that all participants met the predefined inclusion criteria. The inclusion criteria were adults aged 40 to 65 years, having a confirmed diagnosis of Type 2 Diabetes Mellitus for at least one year, and receiving oral antidiabetic medication without insulin therapy. Participants were also required to be physically capable of performing moderate-intensity physical activity.

Exclusion criteria included the presence of cardiovascular complications, musculoskeletal disorders, or other physical limitations that could interfere with participation in the exercise program. Patients with acute illness during the study period or those who did not complete the intervention protocol were also excluded. Eligible participants were divided into two groups, consisting of 40 individuals in the intervention group and 40 individuals in the control group.

Intervention Procedure

Participants in the intervention group were instructed to perform structured moderate-intensity physical activity in the form of brisk walking. The activity was conducted for 30 minutes per session, five days per week, over a period of 12 consecutive weeks. The intensity of physical activity was adjusted to a moderate level, defined as walking at a pace that increased heart rate while still allowing participants to speak comfortably. This form of activity was selected due to its feasibility, safety, and cultural acceptability within the rural community.

Participants received clear instructions regarding the frequency, duration, and consistency of the activity. Monitoring was carried out through regular follow-up by community health workers to ensure adherence to the intervention protocol. The control group continued to receive routine medical care without additional instructions related to physical activity during the study period.

Measurement of Variables

The primary outcome variable was fasting blood glucose level, measured in milligrams per deciliter (mg/dL). Measurements were conducted at baseline prior to the intervention and repeated after the 12-week intervention period. Fasting blood glucose was measured using a calibrated digital glucometer following standard procedures. Participants were instructed to fast for at least eight hours before blood sampling to ensure measurement consistency.

Sociodemographic and clinical characteristics, including age, gender, and duration of diabetes, were recorded at baseline to describe participant profiles and assess group comparability before the intervention.

Data Analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 26. Descriptive statistics were used to summarize participant characteristics and baseline data, including means, standard deviations, frequencies, and percentages. Paired t-tests were applied to compare pre- and post-intervention fasting blood glucose levels within each group. Independent t-tests were used to assess differences in fasting blood glucose changes between the intervention and control groups.

All statistical tests were conducted using a two-tailed approach with a significance level set at $p < 0.05$. The analytical strategy was chosen to ensure clarity, reproducibility, and consistency with the quasi-experimental study design.

Ethical Considerations

Ethical principles were applied throughout the study process. All participants received a clear explanation of the study objectives, procedures, and potential benefits before participation. Written informed consent was obtained from each participant prior to data collection. Participant confidentiality was maintained by anonymizing personal data and restricting access to research records. The study was conducted in accordance with ethical standards for health research involving human subjects.

Results and Discussion

Participant Baseline Characteristics

Baseline analysis showed that participants in the intervention and control groups had comparable demographic and clinical characteristics. This equivalence indicates that both groups started the study under similar conditions, which strengthens the internal validity of the findings and reduces potential bias associated with non-randomized designs.

Table 1. Baseline Characteristics of Participants

Characteristic	Intervention Group (n=40)	Control Group (n=40)
Mean age (years)	54.2 ± 6.1	53.8 ± 5.9
Gender (male), n (%)	18 (45.0)	17 (42.5)
Duration of T2DM (years)	6.4 ± 2.1	6.2 ± 2.3
Baseline FBG (mg/dL)	178.5 ± 22.4	176.8 ± 20.1

The similarity across age, gender distribution, duration of diabetes, and baseline fasting blood glucose confirms group homogeneity. This condition is essential in quasi-experimental research, as it minimizes the influence of confounding factors such as disease duration and age-related metabolic differences, both of which are known to affect glycemic outcomes (Snowling & Hopkins, 2006; Jansson et al., 2022).

Effect of Physical Activity on Fasting Blood Glucose

After 12 weeks of intervention, the intervention group experienced a marked reduction in fasting blood glucose levels. In contrast, the control group showed no statistically significant change.

Table 2. Comparison of Fasting Blood Glucose Levels Before and After Intervention

Group	Pre-test (mg/dL)	Post-test (mg/dL)	p-value
Intervention	178.5 ± 22.4	142.3 ± 18.9	< 0.001
Control	176.8 ± 20.1	173.2 ± 21.4	0.214

The paired t-test results indicate a statistically significant decrease in fasting blood glucose in the intervention group, while no significant change was observed in the control group. Independent t-test analysis further confirmed that the magnitude of glucose reduction differed significantly between groups. These findings demonstrate that structured moderate-intensity physical activity contributed directly to improved glycemic control.

Discussion

The significant reduction in fasting blood glucose observed in the intervention group confirms the effectiveness of moderate-intensity physical activity as a core component of Type 2 Diabetes Mellitus management. Regular brisk walking promotes improved insulin sensitivity through enhanced glucose uptake by skeletal muscle, increased GLUT-4 translocation, and improved mitochondrial efficiency (Colberg et al., 2016; DiPietro et al., 2013). These physiological mechanisms explain the substantial glycemic improvement observed after 12 weeks of consistent activity.

The results align with prior empirical studies demonstrating that aerobic exercise significantly improves glycemic outcomes in individuals with T2DM (Maiorana et al., 2002; Johnston et al., 2014). However, the present study provides context-specific evidence from a rural Indonesian setting, where structured exercise interventions are often limited by infrastructural and resource constraints. The

successful implementation of a simple walking program indicates that effective diabetes management strategies do not require complex facilities or high-cost interventions.

The absence of significant changes in the control group reinforces the role of physical activity beyond standard medical care. Routine pharmacological management alone may not be sufficient to achieve optimal glycemic control, particularly in populations with long-standing diabetes and limited lifestyle modification support (Church et al., 2010; Widyawardani & Safitri, 2022). This finding highlights the necessity of integrating behavioral interventions into primary healthcare services.

From a public health perspective, the community-based nature of the intervention enhances its feasibility and scalability. Walking is culturally acceptable, safe for middle-aged and older adults, and easily incorporated into daily routines. These characteristics support sustained adherence and align with recommendations from international physical activity guidelines (WHO, 2020). The results therefore have practical implications for community health workers and policymakers seeking low-cost strategies to address the growing burden of T2DM in rural areas.

Despite its strengths, the study has limitations. The 12-week duration limits assessment of long-term adherence and sustainability of glycemic improvement. Additionally, reliance on fasting blood glucose alone restricts evaluation of long-term metabolic control, as HbA1c was not assessed. Nevertheless, fasting blood glucose remains a valid and widely used indicator of short-term glycemic response in community-based studies (Putri et al., 2019; Nurvita & Nuswantoro, 2022).

Overall, the findings confirm that structured moderate-intensity physical activity produces clinically and statistically meaningful improvements in glycemic control among rural T2DM patients. The consistency with existing evidence strengthens confidence in the intervention and supports its integration into local diabetes management programs.

Conclusion

This study demonstrates that structured moderate-intensity physical activity in the form of brisk walking significantly reduces fasting blood glucose levels among patients with Type 2 Diabetes Mellitus in Masbagek District, East Lombok. The intervention produced a clear and statistically significant improvement in glycemic control compared with routine care alone. These findings confirm that physical activity is an effective non-pharmacological strategy for diabetes management in rural community settings.

The results highlight that a simple, low-cost, and culturally acceptable activity can yield meaningful clinical benefits when performed consistently. The absence of significant changes in the control group further emphasizes that routine medical treatment without lifestyle modification may be insufficient to achieve optimal glycemic outcomes. Therefore, physical activity should be considered an essential component of comprehensive diabetes care, particularly in resource-limited areas.

From a public health perspective, the feasibility of implementing a structured walking program in a rural setting supports its potential integration into primary healthcare and community-based diabetes programs. The intervention does not require specialized equipment or facilities, making it suitable for wide adoption by community health workers and local health services.

Despite its positive findings, this study is limited by its relatively short intervention duration and the use of fasting blood glucose as the sole outcome indicator. Future studies should assess long-term adherence and include additional glycemic markers to strengthen outcome evaluation. Nonetheless, the present findings provide strong empirical evidence supporting the promotion of regular physical activity as a practical and effective strategy for improving glycemic control among rural populations with Type 2 Diabetes Mellitus.

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