

## MODERATE ACTIVITY EXERCISE ON BLOOD SUGAR CONTROL IN TYPE 2 DM PATIENTS

*Latihan Aktivitas Sedang terhadap Pengendalian Gula Darah pada Pasien DM Tipe 2*

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### ABSTRAK

Rencana Aksi Global WHO 2030 tentang aktivitas fisik bertujuan mencegah dan mengatasi penyakit tidak menular (PTM) seperti diabetes melitus (DM). Diabetes melitus tipe 2 (DMT2) merupakan masalah kesehatan global dengan prevalensi yang terus meningkat, mencapai lebih dari 537 juta kasus pada 2021. Di Indonesia, Riset Kesehatan Dasar 2018 menunjukkan peningkatan prevalensi DM dari 6,9% menjadi 8,5%, menegaskan perlunya intervensi efektif. Penderita diabetes dapat melakukan olahraga CRIPE (continuous, rhythmic, interval, progressive, endurance) untuk mengendalikan gula darah. Penelitian ini bertujuan mengevaluasi efektivitas latihan aktivitas sedang dalam pengendalian gula darah pada penderita DMT2. Metode kuasi-eksperimen dengan desain pre-post test dan kelompok kontrol digunakan. Sampel terdiri dari 60 orang yang dipilih melalui multistage random sampling. Variabel meliputi kadar glukosa darah dan aktivitas fisik berupa senam diabetes yang dilakukan 3-5 hari per minggu selama 30-60 menit per hari. Hasil menunjukkan penurunan signifikan rata-rata gula darah pada kelompok intervensi, yang didominasi perempuan (93,3%) dan berusia 65-70 tahun (40,3%). Temuan ini membuktikan bahwa latihan aktivitas sedang efektif dalam mengendalikan gula darah pada penderita DMT2. Penelitian ini mendukung rekomendasi WHO untuk meningkatkan aktivitas fisik sebagai bagian dari manajemen diabetes dan pencegahan PTM.

**Kata kunci:** aktivitas, gula darah, penderita diabetes

### ABSTRACT

The WHO 2030 Global Action Plan on physical activity aims to prevent and treat non-communicable diseases (NCDs) such as diabetes mellitus (DM). Type 2 diabetes mellitus (T2DM) is a global health issue with a continuously rising prevalence, exceeding 537 million cases in 2021. In Indonesia, the 2018 Basic Health Research revealed an increase in DM prevalence from 6.9% to 8.5%, highlighting the urgency of effective interventions. Diabetics can engage in CRIPE (continuous, rhythmic, interval, progressive, and endurance) exercises to manage blood sugar levels. This study aimed to evaluate the effectiveness of moderate physical activity in controlling blood glucose levels in T2DM patients. A quasi-experimental design with pre-post tests and a control group was employed. The sample consisted of 60 participants selected through multistage random sampling. Variables included blood glucose levels and physical activity in the form of diabetes-specific exercises, performed 3-5 days per week for 30-60 minutes daily. Results showed a significant reduction in average blood glucose levels in the intervention group, which was predominantly female (93.3%) and aged 65-70 years (40.3%). These findings demonstrate that moderate physical activity is effective in controlling blood glucose levels in T2DM patients. This study supports WHO recommendations to promote physical activity as part of diabetes management and NCD prevention.

**Keywords:** activity, blood sugar, diabetics

## INTRODUCTION

Physical inactivity is recognized globally as one of the major risk factors contributing to non-communicable diseases (NCDs), including cardiovascular disease, stroke, diabetes, and several types of cancer. In response, the World Health Organization (WHO) launched the Global Action Plan on Physical Activity 2018–2030 to reduce the burden of NCDs through increased physical activity and healthier lifestyle practices. Regular physical activity not only plays a central role in preventing Type 2 Diabetes Mellitus (T2DM), overweight, and obesity but also contributes to better mental health outcomes and overall quality of life.

In Indonesia, data from the 2018 Basic Health Research (Riskesdas) indicate a rising trend in the prevalence of DM, increasing from 6.9% to 8.5%. Likewise, DM diagnosed by physicians rose from 1.2% to 2%. The city of Bandung alone recorded 43,906 individuals living with diabetes. Several modifiable risk factors also showed a significant upward trend, including adult obesity (from 14.8% to 21.8%), central obesity (from 26.6% to 31%), smoking (from 28.8% to 29.3%), insufficient physical activity (from 26.1% to 33.5%), and inadequate fruit and vegetable intake (from 93.5% to 95.5%). These indicators reflect an urgent public health challenge that requires comprehensive prevention and management strategies.<sup>1</sup>

Diabetes Mellitus significantly reduces productivity and quality of life and imposes substantial economic burdens due to long-term complications. One of the most critical aspects of clinical management is ensuring that patients adopt and maintain appropriate physical activity as part of their daily routines. As outlined in the four essential pillars of diabetes management—education, dietary regulation, exercise, and adherence to medication—physical

activity is a key determinant in achieving optimal glycemic control.<sup>2</sup>

Previous studies have consistently shown that physical activity enhances glucose uptake in muscles, improves insulin sensitivity, lowers glycated hemoglobin (HbA1c), and increases cardiorespiratory fitness (VO<sub>2</sub> peak). Despite strong evidence, helping patients integrate exercise habits into daily life remains a major challenge in diabetes care.<sup>3</sup>

Given the increasing prevalence of diabetes and the known benefits of exercise, there is a critical need to evaluate the effectiveness of moderate-intensity physical activity as part of diabetes management, particularly in community settings such as Bandung, where the burden of T2DM continues to rise.<sup>4,5</sup> The objective of this study was to determine the effectiveness of moderate-intensity physical activity in improving blood glucose control among patients with Type 2 Diabetes Mellitus.

## METHODS

The study employed a quasi-experimental pre–post test design with a control group to evaluate the potential causal relationship resulting from the intervention by comparing outcomes between the intervention group and the control group, which did not receive the intervention. The research was conducted from April to August 2024 in the working area of the Bandung City Health Center.

The study population consisted of patients diagnosed with type 2 diabetes mellitus (T2DM). The minimum required sample size was calculated using the two-proportion hypothesis test formula, resulting in a total sample of at least 60 participants, with 30 in the intervention group and 30 in the control group. Sample size determination was justified using the Slovin formula, and participants were selected through purposive sampling. The inclusion criteria required respondents to have prediabetic status and reside within the

Bandung City Health Center working area.

The study variables consisted of blood glucose levels and participation in moderate-intensity diabetic exercise performed 3–5 days per week for 30–60 minutes per session. Blood glucose levels were measured using Random Blood Glucose (RBG) testing to identify prediabetic conditions and monitor metabolic changes throughout the study period from baseline to the end of the intervention.

Data analysis included dependent t-tests to assess changes in blood

glucose levels before and after the intervention within each group, and independent t-tests to compare blood glucose outcomes between the intervention and control groups. Normality of numerical data was evaluated using the Shapiro–Wilk test, with p-values greater than 0.05 indicating normally distributed data. A significance level of  $p < 0.05$  was used for hypothesis testing. The study obtained ethical approval with registration number 17/KEPK/EC/VI/2022.

## RESULT

**Table 1. Respondent Characteristic (n=60)**

	Group	Intervention Group		Control Group	
		n	%	n	%
Age	50 – 55	6	20.0	7	23,3
	56 – 60	2	6,7	3	10,0
	61 – 65	10	33,3	9	30,0
	65 – 70	12	40,3	11	36,7
Gender	Male	2	6,7	7	23,3
	Female	28	93,3	23	76,7

Table 1 shows that most respondents in both groups were older adults aged 61–70 years, with the largest proportion in the 65–70 age range. In terms of gender, the majority of participants were

female in both the intervention and control groups. Overall, the demographic characteristics between the two groups were relatively comparable.

**Table 2. Average Initial and Final Blood Sugar Type 2 DM Patients in the Working Area of the Bandung City Health Center in 2022 (n=60)**

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Age	Group				P*
	Intervention		Control		
	Average	SD	Average	SD	
Initial GD	151,20	41,363	173,23	36.208	0,000
Final GD	145,80	40,912	167,10	39.810	0.004
95% CI	3.191 - 7.609		2.183 - 10.084		

Table 2 shows the average initial and final random blood glucose levels of type 2 diabetes mellitus (T2DM) patients in both the intervention and control groups. At baseline, the intervention group had a mean blood glucose level of 151.20 mg/dL (SD = 41.36), which was lower than the control group average of 173.23 mg/dL (SD = 36.21). After the intervention, the intervention group demonstrated a decrease in mean blood

glucose to 145.80 mg/dL (SD = 40.91), whereas the control group also showed a reduction to 167.10 mg/dL (SD = 39.81). Statistical testing indicated significant differences between groups at both the initial ( $p = 0.000$ ) and final ( $p = 0.004$ ) measurements. The 95% confidence interval results further support that the intervention contributed to a meaningful reduction in blood

glucose levels compared with the control group.

Table 3 shows a comparison of the mean blood glucose levels between the intervention and control groups among patients with Type 2 DM. The intervention group had a lower mean blood glucose level of 145.40 mg/dL,

compared to 167.10 mg/dL in the control group. The p-value of 0.038 indicates that the difference is statistically significant ( $p < 0.05$ ), meaning that moderate physical activity was effective in reducing blood glucose levels compared with patients who did not receive the intervention.

**Table 3. Mean Blood Sugar Intervention and Control Groups of Type 2 DM Patients in The Working Area of The Bandung City Health Center in 2022 (N = 60)**

Group	Group				p*
	Related	SD	SE Mean	SE Different	
Intervention	145,40	39.278	7,171	9.824	0.038
Control	167,10	39.810	7.268	9,824	

## DISCUSSION

The findings of this study demonstrate that the average blood glucose level among Type 2 DM patients who received Moderate Activity Exercise showed a statistically significant improvement, with a p-value of 0.038 ( $p < 0.05$ ). This indicates that the null hypothesis was rejected, meaning that the intervention had a measurable effect on blood glucose control compared with the control group in the Working Area of the Bandung City Health Center in 2022. These results suggest that regular moderate physical activity contributes positively to the regulation of blood glucose among individuals with Type 2 DM.<sup>6</sup>

Moderate physical activity performed 3–4 times per week for 20–30 minutes is recommended to support optimal glycemic control. Physiologically, increased muscle activity enhances glucose uptake. During exercise, the muscles utilize stored glucose to meet increased energy demands. As glycogen stores decrease, active muscle tissue increases glucose absorption from the bloodstream, leading to a reduction in circulating blood glucose levels.<sup>7</sup> This mechanism is supported by the body's biological systems responsible for maintaining glucose homeostasis, including nervous, hormonal, and metabolic regulation. Previous research

also indicates that regular physical activity accelerates post-exercise muscle glucose recovery and improves insulin sensitivity, thereby supporting better overall glycemic control.<sup>8,9</sup> Based on these findings, moderate activity exercise, when performed consistently, can be an effective intervention to improve blood glucose management and may enhance patient compliance in self-care behaviors for Type 2 diabetes management.

Regular physical activity performed for approximately 30 minutes with a frequency of three to five times per week is one of the key pillars in the management of Type 2 diabetes mellitus (T2DM). Exercise can directly increase insulin sensitivity and improve glycemic control both in the short and long term by enhancing glucose uptake and reducing circulating blood glucose levels. Additionally, regular exercise helps decrease body fat composition and improve cardiovascular function. Aerobic exercise is generally recommended for individuals with T2DM, as it is effective, practical, and can be adapted to different physical abilities and health conditions.<sup>7</sup>

However, exercise programs should be tailored to individual factors such as age, socioeconomic conditions, cultural practices, Body Mass Index (BMI), and the presence of diabetes-related complications. Patients with diabetes are also encouraged to increase daily



physical activity and reduce sedentary behaviors such as watching television. During exercise, attention should be given to potential risks such as dehydration and physical strain. Special consideration must also be given to foot care due to the increased risk of infections and complications in the lower extremities experienced by diabetic patients.

Attention also needs to be paid to potential hazards that may occur during physical exercise, such as dehydration and other physical hazards. In addition, special treatment and care for the feet must also be considered because DM sufferers are a group at high risk of suffering from infections in the feet.<sup>10, 11</sup>

Moderate-intensity physical activity is an accessible and low-cost form of exercise that can be performed for approximately one hour and is suitable for groups such as older adults, individuals with obesity, pregnant women, and those with diabetes mellitus. This aligns with previous research indicating that regular physical activity for around 30 minutes, three to four times per week, significantly contributes to diabetes management. Studies have shown that exercise can reduce Hemoglobin A1c (HbA1c) by approximately 0.66% in individuals with T2DM, and other findings note an average reduction of around 0.80%. Together, these findings reinforce the role of moderate physical activity as an effective and essential component in controlling blood glucose levels in T2DM patients.<sup>12</sup>

This study is supported by an increase in aerobic fitness, which has a protective effect on CVD mortality and the prevalence of diabetes, regardless of BMI. 9 There is an effect of aerobic exercise on blood glucose levels in the Takalar Regency gymnastics group.<sup>11</sup> There is a relationship between low-impact & rhythmic aerobic exercise on blood glucose levels. blood glucose in type-2 diabetes mellitus patients before and shortly after exercising. % and in

respondents who did not use OHO the decrease was 11.86% due to increased muscle insulin receptor sensitivity and increased number of active receptors due to open capillaries during exercise.<sup>13,14</sup>

Moderate physical activity done 3–5 times per week has been shown to be effective in lowering blood glucose and improving glycemic control in people with Type 2 DM.<sup>15</sup> A meta-analysis of 126 studies with a total of 6,718 participants found that the optimal dose of physical activity ranged from about 1,100 MET-minutes per week, which contributed to a decrease in HbA1c between –1.02% to –0.66%, depending on the patient's initial glycemic status.<sup>16</sup> Meta-regression analysis from the RCT review also highlighted that exercise frequency was one of the explanatory factors for the heterogeneity of the results: increased exercise frequency was associated with greater HbA1c decreases. Thus, a 3–5 days per week exercise protocol is considered as a balanced strategy between metabolic effectiveness and long-term feasibility for T2DM patients.<sup>17</sup>

The limitation of this researcher is that the implementation of moderate exercise has not been carried out in the morning routine hours and supervised by the family. This research is supported by the impact of moderate activity on broad health and quality of life benefits.

## CONCLUSION

There was a significant difference in the blood sugar measurement results, which means that there is an influence of moderate activity training in Type 2 DM patients. This research can be set as a standard operational procedure in handling diabetes mellitus in Primary health care.

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