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The Effect of Community-Based Diabetes Exercise on Self-Efficacy and Blood Sugar Levels

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ABSTRACT

People with diabetes mellitus (DM) need to manage their condition every day, and their confidence in doing so (self-efficacy) is closely tied to how well their blood glucose is controlled. Community programs in primary care seldom measure these two outcomes together. This study examined whether community-based diabetes exercise changed self-efficacy and blood glucose in patients with DM at the Deli Tua Community Health Center, Indonesia. We used a quasi-experimental one-group pretest–posttest design. Twenty-two patients who met the eligibility criteria were enrolled consecutively. They took part in supervised group diabetes exercise for about 25 minutes a day on four consecutive days. Self-efficacy was assessed with the Indonesian version of the Diabetes Management Self-Efficacy Scale (DMSES-I), and random blood glucose was checked with a glucometer. Because the data were normally distributed (Shapiro–Wilk, $p > .05$), the paired sample *t*-test was used. Mean self-efficacy rose from 34.14 ± 5.45 to 66.82 ± 9.67, while mean blood glucose fell from 225.64 ± 44.68 mg/dL to 179.32 ± 29.93 mg/dL ($p < .001$ for both). Group-based diabetes exercise in the community was associated with higher self-efficacy and lower blood glucose, and nurses can offer it as a simple, low-cost addition to routine diabetes care. The study had no control group, a small sample, and a short intervention, and it relied on random glucose rather than HbA1c. The results are therefore preliminary and should be tested in larger randomized trials with longer follow-up.

Keywords: blood sugar levels, community nursing, diabetes exercise, diabetes mellitus, self-efficacy

INTRODUCTION

Diabetes mellitus (DM) is one of the largest non-communicable disease problems in the world. Persistent hyperglycemia damages small and large blood vessels and leads to complications such as retinopathy, nephropathy, neuropathy, coronary heart disease, and stroke, which place a heavy load on patients, families, and health services. The International Diabetes Federation estimates that about 589 million adults aged 20–79 years were living with diabetes in 2025, and this number is projected to reach 853 million by 2050 (International Diabetes Federation [IDF], 2025). Indonesia is among the countries with the largest number of people with diabetes (Genitsaridi et al., 2026; IDF, 2025), so preventing complications through better day-to-day control is a pressing task for its health system.

Good control depends largely on what patients do outside the clinic: following a meal plan, staying physically active, taking medication as prescribed, checking blood glucose, and caring for their feet. Whether patients actually carry out these tasks is strongly influenced by self-efficacy, that is, their belief that they are able to perform the actions needed to reach a health goal (Fereidooni et al., 2024). Patients with higher self-efficacy tend to adhere better to treatment, adopt healthier habits, and achieve better glycemic control (Ernawati et al., 2021; Tiwari et al., 2025). Physical activity, for its part, improves insulin sensitivity and glucose uptake and is recommended for almost all adults with type 2 diabetes (Kanaley et al., 2022). These two lines of evidence have mostly developed separately. Studies usually look either at self-efficacy and self-management or at the effect of exercise on blood glucose, and rarely at both.

Community health centers are the first point of contact for most people with diabetes in Indonesia, and much of the long-term follow-up takes place there. Consultation time is short, however, and many patients receive advice on diet and medication without regular chances to practice self-care skills with support. Education-based programs have been shown to improve self-management (Kiçaj et al., 2024), but they rely mainly on information. Activities that let patients practice a skill together, with direct feedback from a nurse, may be easier to sustain in this setting and may build confidence in a different way from classroom teaching.

Self-management support delivered in groups may be one way to address both at the same time. A meta-analysis of 12 randomized trials showed that adding peer support to diabetes self-management education lowered HbA1c, and the effect was clearer when the programs were delivered in groups and lasted six months or less (Azmiardi et al., 2021). A later meta-analysis of 11 trials involving 2,187 middle-aged and older adults found a smaller but still significant reduction in HbA1c with peer support compared with usual care (Luo et al., 2025). In Indonesia, diabetes foot exercise (*senam kaki diabetes*) is a familiar activity in community health centers because it needs no equipment and can be led by nurses or health cadres. Studies in these settings have reported lower blood glucose after a series of foot exercise sessions (Indriyani et al., 2023; Intang et al., 2026).

What remains unclear is how one community exercise program affects psychological and physiological outcomes when both are measured in the same patients. Community studies often report blood glucose alone, while studies of self-efficacy usually test education programs rather than exercise (Ernawati et al., 2021; Kiçaj et al., 2024). Confidence and glycemic control depend on each other in daily self-management. Measuring them together gives a fuller picture

of what a primary care program can achieve and helps health centers plan activities that deal with both.

The study draws on Bandura's Social Cognitive Theory, which describes four sources of self-efficacy: mastery experiences, vicarious experiences, verbal persuasion, and physiological or emotional states. Exercising in a group touches several of these sources. Seeing other patients of similar age and condition finish the routine offers a vicarious experience, and encouragement from the instructor and fellow participants works as verbal persuasion. Completing each session successfully gives patients their own mastery experience, which the theory regards as the strongest source of self-efficacy. For this reason, we expected group exercise to raise self-efficacy in addition to its direct effect on blood glucose.

The research question was whether community-based diabetes exercise affects self-efficacy and blood glucose in patients with DM. We hypothesized that the program would increase self-efficacy and lower blood glucose. The aim of the study was therefore to analyze the effect of community-based diabetes exercise on both outcomes among patients attending the Deli Tua Community Health Center.

The findings are meant to inform nurses and other primary care staff who design non-pharmacological programs for people with diabetes. A program that improves patients' confidence as well as their glucose readings would fit the promotive and preventive role of community health centers and could help reduce the long-term burden of the disease in the community (Kiçaj et al., 2024).

METHODS

Research Design

This was a quantitative quasi-experimental study with a one-group pretest–posttest design. Respondents were measured before and after the intervention, so each person served as their own comparison. No control group was included because of logistical and time constraints at the single primary care site. We recognize that this leaves the results open to threats such as maturation, history, and testing effects, and we return to this point in the Limitation section.

Setting and Participants

The study took place at the Deli Tua Community Health Center, Deli Serdang Regency, North Sumatra, Indonesia. The population consisted of all 170 patients with DM registered at the

center. Patients were eligible if they had been diagnosed with DM, were older than 30 years, and had no cognitive impairment that would prevent them from following simple verbal instructions or completing the questionnaires on their own. Patients were excluded if they had diabetes-related complications (retinopathy, nephropathy, neuropathy, or cardiovascular disease), had undergone amputation, or had another condition that made exercise unsafe, such as severe orthopedic limitations or acute cardiorespiratory problems.

Sampling Technique and Sample Size

Sampling was purposive in the sense that only patients who met the criteria above were approached. In practice, eligible patients were enrolled as they came to the health center during the study period, so the method is best described as consecutive sampling within a purposively defined population.

The minimum sample size was calculated with the Slovin formula, $n = N / (1 + N \cdot e^2)$, using a population ($N$) of 170 and a margin of error (e) of 20%. This gave a minimum of 22 respondents, and all 22 eligible patients were enrolled. A 20% margin of error is large for a physiological outcome such as blood glucose and lowers statistical power. A power analysis (for example, with G*Power) based on an expected effect size, $\alpha = .05$, and power of .80 would have been more appropriate, and we recommend this approach for future studies.

Measures

Self-efficacy was measured with the Indonesian version of the Diabetes Management Self-Efficacy Scale (DMSES-I). The instrument has been validated in Indonesian patients with type 2 diabetes, with an item content validity index (I-CVI) of .922 and a Cronbach's alpha of .928 (Marlina et al., 2024). Higher scores indicate greater confidence in carrying out diabetes self-management.

Blood glucose was measured as random blood glucose (*gula darah sewaktu*, GDS) from capillary blood using a glucometer, following standard operating procedures. The same instruments and procedures were used at pretest and posttest, and all results were recorded on an observation sheet.

Intervention

The intervention was a structured group diabetes exercise program adapted from the community diabetes foot exercise protocol described by Indriyani et al. (2023). A trained facilitator or health cadre at the health center led and supervised every session. Each session lasted about 25 minutes and consisted of a short warm-up, a main set of rhythmic movements done together as a group to improve peripheral circulation and glucose use, and a cool-down with stretching. Sessions were held once a day for four consecutive days. The group format was kept on purpose so that participants could watch and encourage one another, in line with the theoretical reasoning described in the Introduction.

Data Collection Procedure

Data were collected between November 2025 and January 2026. The researchers first explained the purpose, benefits, and procedures of the study. After respondents signed the informed consent form, the pretest (DMSES-I and GDS) was carried out. The posttest, using the same instruments, was conducted after the fourth exercise session.

Data Analysis

Data were analyzed with SPSS version 26.0. Descriptive statistics were used to summarize respondent characteristics and the distribution of self-efficacy and blood glucose before and after the intervention. Normality was checked with the Shapiro–Wilk test. All variables were normally distributed ($p > .05$), so differences between pretest and posttest were tested with the paired sample *t*-test at a significance level of $p < .05$ (95% confidence level). The mean difference between pretest and posttest is also reported to show the size of the change. The relative change was calculated as the mean difference divided by the pretest mean and multiplied by 100.

Ethical Clearance

The study was approved by the Health Research Ethics Committee of the Deli Husada Deli Tua Health Institute (approval number 1747/KEP-IKDH/X/2025). Respondents were told about the objectives, benefits, procedures, and possible risks of the study and were given the chance to ask questions before signing the consent form. Participation was voluntary, and respondents could withdraw at any time without any consequence. Identities and personal data

were kept confidential and used only for research purposes, following the principles of beneficence, non-maleficence, autonomy, justice, and confidentiality.

RESULTS

Respondent Characteristics

Table 1 shows the characteristics of the 22 respondents.

Table 1. Frequency Distribution of Respondent Characteristics

Characteristics	Frequency (*f*)	Percentage (%)
Gender		
Male	8	36.4
Female	14	63.6
Age (years)		
30–45	4	18.2
46–55	14	63.6
56–60	4	18.2
Education		
Bachelor's Degree (S1)	5	22.7
Senior High School	8	36.4
Junior High School	6	27.3
Elementary School	3	13.6
Occupation		
Housewife	5	22.7
Farmer	2	9.1
Civil Servant	5	22.7
Self-employed	5	22.7
Entrepreneur	5	22.7

Most respondents were women (63.6%) and aged 46–55 years (63.6%). Senior high school was the most common level of education (36.4%), and elementary school the least common (13.6%). Housewives, civil servants, self-employed workers, and entrepreneurs each made up 22.7% of the sample, while farmers formed the smallest group (9.1%).

Self-Efficacy Before and After the Intervention

Table 2. Self-Efficacy Scores Before and After the Intervention (n = 22)

	N	Mean	Median	Mode	*SD*	Min	Max
Pretest	22	34.14	33.50	31	5.454	23	43
Posttest	22	66.82	67.50	55	9.669	46	85

Self-efficacy scores before and after the intervention are presented in Table 2. The mean score went from 34.14 at pretest to 66.82 at posttest. Both the lowest and the highest scores were

higher after the program (46 and 85) than before it (23 and 43), which points to a general upward shift rather than a change limited to a few respondents.

Blood Sugar Levels Before and After the Intervention

At pretest, the mean random blood glucose was 225.64 mg/dL (*SD* = 44.680). After the four sessions, it was 179.32 mg/dL (*SD* = 29.934), a mean reduction of 46.32 mg/dL, or about 20.5% of the baseline value. The values were also less spread out at posttest, as shown by the smaller standard deviation. The complete test results are given in Table 4.

Normality Test

Table 3. Data Normality Test (Shapiro–Wilk)

Variable	Statistic (*W*)	*df*	*p*
Self-efficacy – Pretest	.960	22	.499
Self-efficacy – Posttest	.972	22	.761
GDS – Pretest	.942	22	.215
GDS – Posttest	.926	22	.102

The Shapiro–Wilk significance values were above .05 for both variables at both time points (Table 3), so a parametric paired test was used.

Paired Sample *t*-Test

Table 4. Paired Sample t-Test Results

Pair	Variable	Mean	*N*	*SD*	*SE* Mean	*p*
1	Self-efficacy – Pretest	34.14	22	5.454	1.163	< .001
	Self-efficacy – Posttest	66.82	22	9.669	2.061	
2	GDS – Pretest	225.64	22	44.680	9.526	< .001
	GDS – Posttest	179.32	22	29.934	6.382	

Table 4 summarizes the paired sample *t*-test. Mean self-efficacy increased by 32.68 points, from 34.14 (*SD* = 5.454) to 66.82 (*SD* = 9.669), which is close to double the baseline value (+95.7%). Mean blood glucose decreased by 46.32 mg/dL, from 225.64 mg/dL (*SD* = 44.680) to 179.32 mg/dL (*SD* = 29.934). Both differences were significant ($p < .001$). The null hypothesis (H_0) was rejected, meaning that within this single-group design the intervention was associated with higher self-efficacy and lower blood glucose.

DISCUSSION

Changes in Self-Efficacy

At baseline, the mean self-efficacy score was low (34.14), which suggests that many respondents were not confident about managing their diabetes on their own. Low confidence matters because it limits how consistently patients follow their diet, stay active, take their medication, and monitor their glucose. Fereidooni et al. (2024) reached a similar conclusion and described self-efficacy as central to successful self-care in type 2 diabetes. Most of our respondents were middle-aged and had a secondary-school education, and these characteristics may partly explain the low starting point.

After the program, the mean score rose to 66.82 ($p < .001$). This fits the reasoning of Social Cognitive Theory. In the group sessions, participants watched peers of similar age and health status complete the exercises (vicarious experience) and received encouragement from the facilitator and from each other (verbal persuasion). Doing the routine successfully every day for four days also gave them first-hand mastery experience. Our results agree with Shaban et al. (2024), who found that a nursing intervention requiring active patient participation increased self-efficacy in adults with diabetes, and with Okafor et al. (2023), who reported higher self-efficacy after a structured education program for people with type 2 diabetes.

Even so, an almost twofold increase over four days is large and should not be read as a pure effect of the exercise. Without a control group, other influences cannot be ruled out. These include the extra attention patients received from health workers, informal support among participants outside the sessions, familiarity with the questionnaire at the second measurement, and the act of self-monitoring itself. Confidence reported right after a program may also fade if it is not reinforced, so later measurements are needed to see whether the gain lasts.

The profile of the sample should also be considered. Almost two thirds of the respondents were women and most were between 46 and 55 years old. This profile may simply reflect who usually takes part in activities at the health center, and men, younger adults, or older patients might respond differently to a group program. The occupational mix was broad, which suggests that the program was acceptable to people with different daily routines. Still, the small number of respondents in each subgroup did not allow comparisons, and the results may not apply in the same way to other groups.

Changes in Blood Glucose

The mean blood glucose before the intervention (225.64 mg/dL) indicates that most respondents were poorly controlled. Indriyani et al. (2023) also found high baseline glucose among patients who joined a community exercise program. Low physical activity, irregular eating, and inconsistent disease management may all have contributed. Physical inactivity in particular worsens insulin resistance and makes glycemic targets harder to reach (Kanaley et al., 2022).

After the program, mean glucose fell to 179.32 mg/dL ($p < .001$). Indriyani et al. (2023) and Intang et al. (2026) likewise reported lower blood glucose after diabetes foot exercise among community health center patients, and the latter study used the same one-group pretest–posttest design. The most likely physiological explanation is that muscle contraction increases glucose uptake and improves insulin sensitivity, effects that can appear after a single bout or a short series of exercise sessions (Kanaley et al., 2022). The group format may have added to this. Meta-analyses show that peer support built into self-management programs improves glycemic control, especially when it is delivered in groups with frequent contact (Azmiardi et al., 2021; Luo et al., 2025), and our participants met every day. As with self-efficacy, however, the decrease cannot be attributed to the exercise alone. Changes in diet, medication use, or clinical follow-up during the study period may also have played a part.

The clinical meaning of the reduction also needs care. For many non-pregnant adults, current guidelines recommend a preprandial capillary glucose of 80–130 mg/dL, a peak postprandial value below 180 mg/dL, and an HbA1c below 7% (American Diabetes Association Professional Practice Committee [ADA PPC], 2025). The posttest mean of 179.32 mg/dL is still far above the preprandial range and sits at the upper limit of the postprandial goal. Random readings are not tied to meal times, so they cannot be compared directly with either target. In short, the change was statistically significant, but a four-day program of 25-minute sessions is unlikely to bring patients into the target range by itself. Longer programs, more frequent or more intensive sessions, and combination with dietary advice and medication support are probably needed, and these options should be tested with longer follow-up.

Comparison with Previous Studies

Most earlier work on foot exercise in Indonesia used designs similar to ours. Intang et al. (2026) studied 15 women with type 2 diabetes at a community health center in Makassar using a one-group pretest–posttest design and also found a significant fall in blood glucose. Indriyani et al.

(2023) reported a comparable result at a health center in Lampung. These studies, like the present one, involved small samples and short programs, so together they show a consistent short-term effect but cannot yet establish how large or how lasting the effect is.

The international evidence is based mainly on randomized trials with HbA1c as the outcome. Azmiardi et al. (2021) found that peer support programs lasting six months or less produced significant HbA1c reductions, and Luo et al. (2025) reported a mean reduction of about 0.2 percentage points among middle-aged and older adults. These changes are modest compared with the 20.5% fall in random glucose observed here, but the outcomes are not directly comparable. Random glucose responds quickly to exercise, food, and medication, whereas HbA1c reflects average glucose over roughly three months. Our findings should therefore be seen as evidence of a short-term response that needs to be confirmed with longer-term measures. Studies of self-efficacy have mostly tested education programs (Okafor et al., 2023; Shaban et al., 2024). The present study adds that a short, practical exercise program delivered in a group can also be followed by a clear rise in self-efficacy.

Linking Self-Efficacy and Blood Glucose

This study measured confidence and blood glucose in the same patients over the same period, and both improved. The pattern is consistent with earlier work that links self-efficacy to better self-care and glycemic control (Ernawati et al., 2021; Fereidooni et al., 2024). Two mechanisms may be at work. The exercise acts directly on glucose metabolism (Kanaley et al., 2022), and higher confidence may make patients more likely to keep exercising and to follow other parts of their treatment after the program ends (Kiçaj et al., 2024). The present design cannot separate these mechanisms or test whether self-efficacy mediates the change in glucose, and the follow-up was too short to show whether behavior actually changed. A mediation analysis in a longer study with HbA1c as the outcome would answer this question more directly.

The study also has some strengths. It used an instrument validated for Indonesian patients, measured a psychological and a physiological outcome in the same respondents, and tested a program that was delivered under routine conditions at a community health center rather than in a research facility. The intervention was simple and was explained in enough detail to be repeated by other health centers.

Implications for Community Nursing Practice

For nursing practice, the results support adding structured group diabetes exercise to routine activities at community health centers, for example in chronic disease groups or community health posts. Nurses can lead the sessions, demonstrate the movements, give feedback, and encourage participants to support one another, which strengthens the sources of self-efficacy described above. The exercise needs no special equipment and can be run by trained cadres, so it suits settings with limited resources. It should be added to dietary counseling, medication management, and regular glucose monitoring rather than replace them (ADA PPC, 2025; Kiçaj et al., 2024).

CONCLUSION

Community-based diabetes exercise was associated with a significant rise in self-efficacy and a significant fall in blood glucose among patients with DM at the Deli Tua Community Health Center. Mean glucose after the program had not yet reached the recommended targets, but the improvement in both the psychological and the physiological outcome suggests that group exercise is a useful non-pharmacological nursing intervention alongside existing diabetes care. Because of the single-group design, the small sample, and the single study site, these conclusions are preliminary.

Primary care nurses and community health workers could include structured group diabetes exercise in routine diabetes management, together with dietary counseling and support for medication adherence. Future studies should use a randomized controlled design with a sample size based on power analysis, test longer or more frequent exercise programs, use HbA1c or standardized fasting glucose as the glycemic outcome, and record possible confounders such as diet and medication use. Follow-up beyond the end of the program is also needed to see whether the improvements are maintained.

LIMITATION

Several limitations should be kept in mind. First, the one-group pretest–posttest design does not allow causal conclusions. Changes in diet, medication adherence, routine clinical follow-up, extra attention from health workers, or repeated testing may have influenced the results. Second, the sample was small ($n = 22$) and was based on the Slovin formula with a 20% margin of error, which limits statistical power and the precision of the estimates. Third, respondents

came from one health center and were not selected at random, so the findings cannot be generalized to other populations or settings (Kiçaj et al., 2024).

Fourth, glycemic status was measured with a single random blood glucose reading at each time point. Such readings vary with recent food intake, the timing of medication, and day-to-day fluctuation, and they do not reflect longer-term control; HbA1c or standardized fasting glucose would be a stronger outcome (ADA PPC, 2025). Fifth, the program lasted only four days and the posttest was taken immediately afterward, so it is not known whether the changes persisted. Sixth, self-efficacy was self-reported and may have been affected by social desirability, since respondents knew the purpose of the program. A randomized controlled trial with a power-based sample size, several study sites, HbA1c as the outcome, and longer follow-up would provide stronger evidence.

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