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A Community-Based Approach to Blood Glucose Control in Type 2 Diabetes: Diabetes Exercise and Health Education

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Abstract

Type II diabetes mellitus is a chronic disease that often leads to serious complications, especially when blood glucose levels are not well controlled. Blood glucose reduction can be achieved through various interventions, one of which is diabetes exercise combined with health education. This study aimed to evaluate the effect of diabetes exercise and health education on blood glucose levels and knowledge of patients with type II diabetes mellitus. The method used was a community service activity involving 60 respondents at Srondol Public Health Center, Semarang City. The program consisted of diabetes exercise sessions and health education on diabetes management. The results showed a significant decrease in blood glucose levels before and after the exercise intervention. In addition, there was an increase in respondents' knowledge regarding diabetes management after receiving health education. The Focus Group Discussion (FGD) revealed that respondents felt more motivated and experienced strong social support in managing their diabetes. In conclusion, diabetes exercise and health education were proven to be effective in reducing blood glucose levels and improving patients' knowledge of diabetes management. This program can be widely implemented in the community to support sustainable diabetes control.

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INTRODUCTION

Type II Diabetes Mellitus (DM) is a non-communicable disease that has become both a global and national health concern. According to data from the International Diabetes Federation (IDF) in 2021, approximately 537 million adults worldwide are living with diabetes, and this number is projected to rise to 643 million by 2030 and 783 million by 2045. Indonesia ranks fifth globally in the number of people with diabetes, with the prevalence of type II DM continuing to increase significantly each year. Based on the Indonesian Health Survey in 2023, the prevalence of DM rose from 14,9% to 10.9% among the adult population (Asriadi, et.al., 2024). Type II DM is the most common form of diabetes, accounting for approximately 90–95% of all DM cases. This disease is characterized by the body's impaired use of insulin (insulin resistance), resulting in chronically elevated blood glucose levels. Prolonged hyperglycemia can lead to various serious complications, both acute and chronic, such as cardiovascular diseases, nephropathy, retinopathy, neuropathy, and even limb amputation. Therefore, controlling blood glucose levels is a central aspect of managing type II DM (Istikharoh, et.al., 2025).

In Indonesia, many patients with type II DM still fail to achieve optimal blood glucose control. This is due to several factors, including a lack of knowledge about disease management, poor adherence to medication, and low physical activity levels. Within the community—especially among older adults and individuals with sedentary lifestyles—physical inactivity is a major contributor to poor blood glucose control (Yudiernawati, et.al., 2024). In many urban and semi-urban communities in Indonesia, people with type II DM tend to rely heavily on pharmacological therapy (medications) as the sole method of managing their blood sugar levels. In fact, effective glucose control requires a multimodal approach, including dietary regulation, physical activity, lifestyle modification, and psychosocial support. Another issue commonly encountered is the low awareness and motivation of patients to engage in regular physical exercise. Many patients are unaware that structured and consistent physical activities, such as diabetes exercise (diabetes exercise), can significantly improve insulin sensitivity and lower blood sugar levels (Widiyanto et al., 2022).

Diabetes exercise is a non-pharmacological intervention that is simple, inexpensive, and relatively safe for various age groups, including the elderly. However, in practice, diabetes exercise has not been consistently implemented in primary healthcare settings such as *Puskesmas* or *Posbindu PTM*. This issue is exacerbated by a lack of ongoing education and support programs that emphasize the importance of physical activity as part of type II DM management. Consequently, many patients remain unaware that physical inactivity can worsen their condition (Nurman & Safitri, 2025). Several studies have demonstrated that exercise-based interventions—particularly diabetes exercise—can help reduce blood glucose levels in type II DM patients. A study by Prahastuti et al. (2020) showed that performing diabetes exercise three times a week for 12 weeks significantly reduced fasting blood glucose levels. Another study by Santoso et al. (2019) found that diabetes exercise improved glycemic control, enhanced physical capacity, and improved the quality of life for individuals with type II DM. Diabetes exercise typically lasts for 30–45 minutes and involves light to moderate intensity movements, incorporating stretching, muscle strengthening, and cardiovascular exercises. This activity increases insulin sensitivity and helps muscle cells absorb more glucose from the bloodstream. Additionally, diabetes exercise has positive psychological effects, such as boosting motivation and enthusiasm for healthy living. The American Diabetes Association (ADA) recommends that people with type II DM engage in at least 150 minutes per week of moderate-intensity aerobic activity, along with muscle-strengthening exercises 2–3 times per week. Diabetes exercise aligns well with these recommendations as it combines aerobic and strength components in an enjoyable routine (Lubis & Kanzanabilla, 2021).

Despite the proven benefits of diabetes exercise, implementation in the field faces several challenges. Observations and interviews with healthcare workers at various Publich Health Center revealed that diabetes exercise programs are not yet routinely integrated into type II DM management activities. This is due to limited resources, such as a lack of trained instructors, inadequate facilities, and low patient participation stemming from insufficient understanding of the benefits of diabetes exercise. Moreover, there is still a scarcity of community-

based studies that illustrate the direct impact of diabetes exercise on blood glucose levels in primary healthcare settings—highlighting a research gap that needs to be addressed (Istikharoh et al., 2025). To overcome these challenges, a comprehensive strategy is required in the form of a structured and sustainable diabetes exercise program tailored to the characteristics of the local community. This program should adopt an educational and participatory approach, involving patients, families, community health workers caders), and healthcare professionals at primary care facilities.

METHOD

This community service activity targeted individuals with type II diabetes mellitus (DM) residing in the working area of Srondol Public Health Center (Puskesmas Srondol), Semarang City, particularly those enrolled in the Chronic Disease Management Program (Prolanis) who faced challenges in controlling their blood glucose levels. According to the data from the health center, in 2024 there are approximately 50–60 active type II DM patients who were Prolanis members and regularly attended monthly health check-ups. Most participants were elderly and late adults (aged 45–70 years), with lower-middle educational backgrounds and limited daily physical activity. They came from low to middle-income families and generally take oral antidiabetic medication regularly, but still struggle to achieve stable blood glucose targets.

In this activity, the target community members served as active participants in diabetes exercise sessions and as subjects for evaluating changes in blood glucose levels. Additionally, the activity involves: Healthcare personnel from the *Puskesmas* (nurses or health promoters) who act as field facilitators and liaisons with Prolanis participants; Community health cadres (2–3 individuals) who will be trained as diabetes exercise instructors; and A community service implementation team comprising nursing lecturers with expertise in community health nursing, medical-surgical nursing, and health education, along with students who will assist participants during the intervention.

The method for implementing this community service program is designed using a participatory and educational approach, consisting of the following phases: **Phase 1**: Preparation and Coordination, **Phase 2**: Initial Health Education and Counseling, **Phase 3**: Diabetes Exercise Training for Health Cadres, **Phase 4**: Routine Implementation of Diabetes Exercise to community in the health center area, and **Phase 5**: Monitoring and Evaluation

The instruments and tools used include glucometers, attendance and monitoring forms, standard operating procedures (SOP) for diabetes exercise, and educational media in the form of leaflets, booklets, and banners. Data collection will be conducted through direct observation, blood glucose measurements, pre- and post-test questionnaires, and group discussions. Data will be analyzed using both quantitative and qualitative approaches. Quantitative data (blood glucose levels, knowledge, attendance) will be analyzed using descriptive statistics (mean, standard deviation) and comparative tests (paired t-test or Wilcoxon test) to assess differences before and after the intervention. Qualitative data from focus group discussions (FGDs) will be analyzed using content analysis techniques to identify main themes related to participants' perceptions, barriers, and motivations regarding diabetes exercise.

RESULTS

The following is the evaluation result of the activity implementation:

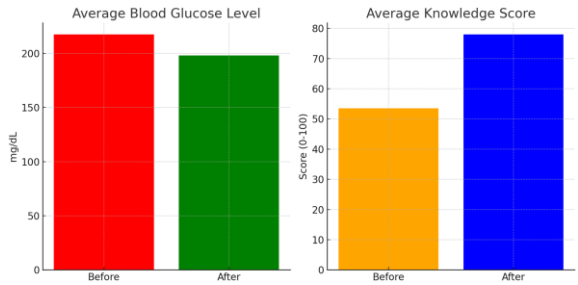

Figure 1. Overview of Blood Glucose Levels and Knowledge Before and After the Intervention

The diabetes exercise program conducted over 4 weeks (a total of 12 sessions) showed significant results in reducing participants' blood glucose levels. A total of 60 respondents actively participated in the activity. The table shows average blood glucose level before the exercise: 217.5 mg/dL, average blood glucose level after the exercise: 198.0 mg/dL, and average decrease in blood glucose level: 19.5 mg/dL. This decrease indicates that diabetes exercise has a positive impact in helping to control blood glucose levels, although long-term evaluation is still needed to maintain the achieved results.

In addition to the exercise sessions, participants also received health education on diabetes management. The evaluation was conducted using pre-test and post-test assessments and shows; average knowledge score before the education session: 53.5 (on a scale of 0–100), average knowledge score after the education session: 78.0, and average increase in knowledge: 24.5 points. This improvement reflects the effectiveness of the health education provided in enhancing participants' understanding of type II diabetes and its non-pharmacological management.

A Focus Group Discussion (FGD) was conducted at the end of the program involving representatives from the participants, community health volunteers (caders), and *Puskesmas* staff. The FGD results are summarized as follows: 1) The majority of participants felt more motivated to adopt a healthy lifestyle after experiencing the benefits of the diabetes exercise, 2) Participants stated that the exercise was easy to follow, enjoyable, and did not cause excessive fatigue, 3) A need was identified for regular guidance and the continuation of the program periodically by community health volunteers, 4) Volunteers expressed their readiness to continue the exercise program at least once a week under the supervision of *Puskesmas* staff, 5) Several participants hoped that the activity could be expanded to include neighboring RT/RW communities to broaden its benefits.

Figure 2. Documentation Of Exercise Activities

DISCUSSION

Type II Diabetes Mellitus is a chronic condition characterized by elevated blood glucose levels due to insulin resistance and impaired pancreatic beta-cell function. According to the American Diabetes Association (ADA, 2022), diabetes management is not solely reliant on pharmacological treatments but also requires lifestyle interventions, such as physical activity, diet, and stress management (Munir & Solissa, 2021).

A diabetes exercise program conducted over 4 weeks involving 60 respondents showed a reduction in average blood glucose levels from 217.5 mg/dL to 198.0 mg/dL. This 19.5 mg/dL decrease indicates that diabetes exercise plays a significant role in lowering blood glucose levels (Asriadi et al., 2024). This finding is consistent with the study by Setyorini et al. (2021), which reported that regular diabetes exercise three times a week for one month could lower blood glucose levels by 20–30 mg/dL in elderly patients with type II diabetes. Physical activity, such as exercise, increases insulin sensitivity, enhances glucose transport into muscle cells, and stimulates glucose burning during activity. This aligns with physiological theories stating that physical activity improves insulin effectiveness and reduces insulin resistance (Widiyanto et al., 2022).

Additionally, physical activity stimulates AMP-activated protein kinase (AMPK) activity, which promotes glucose transport through GLUT4 into muscle cells, thereby lowering blood glucose levels. This process occurs independently of insulin, which is particularly beneficial for patients with insulin resistance. However, it is important to note that this reduction is significantly influenced by the intensity and compliance of participants in attending the exercise sessions. Field observations showed that participants who consistently attended 10 or more sessions experienced a more significant decrease in glucose levels compared to those with lower attendance. This emphasizes the importance of continuity and consistency in the implementation of diabetes exercise programs (Istikharoh et al., 2025).

The involvement of community health workers and medical staff supervision also contributed to the success of this intervention. With social support and supervision, participants felt more motivated to routinely attend the sessions and did not feel alone in managing their condition (Asriadi et al., 2024). In addition to exercise, the community service program also included health education sessions on diabetes management. Participants' knowledge was assessed through pre- and post-tests. Results showed an average increase in knowledge scores from 53.5 to 78.0, or an improvement of 24.5 points. This increase demonstrates that health education plays an essential role in enhancing participants' understanding of their disease. According to the Health Belief Model (HBM), increased knowledge is the initial stage in

the process of health behavior change. When individuals understand the risks and preventive measures for a disease, they are more likely to take preventive actions (Rif'at, et.al., 2023).

The education content included definitions of type II DM, its causes and risk factors, complications, the importance of a healthy diet, and the benefits of diabetes exercise (Asriadi et al., 2024). This material was delivered through participatory methods using posters, leaflets, and small group discussions. This approach has proven effective in increasing information retention, especially among elderly participants. These findings are supported by Ramadhani et al. (2020), who found that group-based health education using interactive methods was more effective in increasing diabetes patients' knowledge compared to one-way lectures. Furthermore, education combined with physical activity is more effective in encouraging overall healthy lifestyle changes. However, it is important to note that increased knowledge does not always translate into behavioral change. Therefore, education must be continued regularly and accompanied by ongoing monitoring and motivation to ensure that participants apply the knowledge they have gained (Alhidayati, et.l., 2021).

An FGD was conducted at the end of the program to gather perceptions, experiences, and suggestions from participants, health cadres, and *Puskesmas* staff. The FGD results provided valuable insights into the factors influencing the program's success. Most participants expressed that diabetes exercise was very helpful in maintaining physical fitness and reducing complaints such as muscle aches, joint pain, and that they felt more refreshed after activities. They also reported decreased blood glucose levels and better dietary control after receiving education (Widiyanto et al., 2022).

In terms of motivation, participants felt more enthusiastic because the activities were conducted in groups, fostering a sense of togetherness. This aligns with Bandura's Social Cognitive Theory, which states that social support and role models from the surrounding environment strongly influence behavior change (Yudiernawati et al., 2024). Health cadres involved in the program expressed their willingness to continue the exercise sessions independently, at least once a week, with assistance from Public Health Center staff. This indicates the potential sustainability of the program if supported by adequate resources and training.

Some challenges identified from the FGD include: 1) Limited time for participants, as some are still working, 2) Limited availability of visual aids and educational materials, and 3) Participants' hopes for the program to become a regular *Puskesmas* activity and to be expanded to neighborhood (RT/RW) levels. These FGD-based recommendations are essential as a foundation for developing a more structured and integrated follow-up program within primary health services. Community involvement and cross-sector support (e.g., from sub-district offices, elderly health posts, etc.) are necessary to broaden the impact of this initiative.

This community service activity provides evidence that an integrated approach involving physical activity (diabetes exercise) and health education yields more optimal outcomes than when applied separately. This combination not only reduces blood glucose levels physiologically but also equips patients with the knowledge and awareness needed to maintain their health independently (Khasanah, 2024). This supports WHO's (2020) view that community-based interventions that integrate educational and physical activity components are effective in addressing non-communicable diseases, including diabetes. This community-based approach also reinforces the principle of community empowerment, where the community acts as the subject of change, not merely the object of intervention. By involving health cadres and encouraging active participation, this program fosters a supportive environment for sustaining healthy lifestyles (Nurman & Safitri, 2025).

CONCLUSION

Community service activities focused on controlling blood glucose levels in patients with type II diabetes mellitus through diabetes exercise and health education have shown significant and meaningful results in efforts to improve the quality of life for individuals with diabetes (Alhidayati et al., 2021). Based on the measurement results, regular diabetes exercise has been proven to reduce blood glucose levels in most respondents. Structured physical activity, such as diabetes exercise, helps improve insulin sensitivity and promotes glucose utilization by the muscles, thereby positively impacting blood sugar stability. In addition to the physiological aspect, there was also a significant improvement in community knowledge regarding

diabetes management following the provision of health education. The education not only enhanced respondents' understanding of the importance of diet regulation, physical activity, and medication adherence, but also increased their awareness of the need to comply with a healthy lifestyle. Adequate knowledge serves as a vital foundation for behavioral change and the formation of habits that support the management of chronic diseases such as type II diabetes mellitus.

Furthermore, the results of the Focus Group Discussion (FGD) revealed that respondents showed high enthusiasm for the activity. They felt supported, more motivated, and experienced strong social support through interaction with fellow participants (Kusumo, et.al., 2022). The FGD also indicated that regular activities such as exercise and group discussions created a sense of togetherness, which helped increase participants' motivation to undergo therapy and maintain control of their condition. In conclusion, interventions in the form of diabetes exercise and health education are effective approaches for controlling blood glucose levels and enhancing the knowledge of patients with type II diabetes mellitus (Munir & Solissa, 2021). These activities not only provide positive physical outcomes but also strengthen the psychosocial aspects of patients, ultimately contributing to more optimal and sustainable diabetes management at the community level.

SUGGESTION

Based on the results and findings of this activity, it is recommended that diabetes exercise and health education programs for patients with type II diabetes mellitus be sustainably integrated into primary healthcare services, particularly at community health centers (*Puskesmas*) or elderly health posts (Posyandu Lansia). Diabetes exercise has been proven to be an effective, low-cost, easy-to-implement non-pharmacological intervention that provides long-term benefits when performed regularly and in a structured manner. Therefore, primary healthcare facilities should facilitate the implementation of this activity at least once or twice a week, involving healthcare workers and community health volunteers (cadres) as facilitators.

In addition, it is essential to continuously improve public knowledge and awareness of diabetes management through ongoing, community-based health education tailored to local needs. Educational materials can be delivered in more interactive and practical formats, such as group discussions, educational video screenings, and hands-on practice related to diet regulation, the use of blood glucose monitoring devices, and relaxation techniques. Health education should not only be delivered by healthcare professionals but may also involve trained community health volunteers or patients who have successfully managed their diabetes as role models.

The FGD findings showed that group-based approaches provide positive psychosocial effects for patients. Therefore, developing support groups in the community is highly important to boost motivation, reinforce treatment adherence, and promote sustained healthy behavior changes. These groups can serve as platforms for sharing experiences, encouraging one another, and building supportive social networks for managing chronic diseases like diabetes.

To ensure program sustainability, cross-sector collaboration is essential—among healthcare providers, local government, community health volunteers, and local community organizations. With strong collaboration, community-based diabetes control programs can not only be implemented effectively but also serve as promotive and preventive intervention models that can be replicated in other areas. Furthermore, ongoing research or follow-up evaluations are necessary to assess the long-term impact of such activities on quality of life, treatment adherence, and diabetes complication rates in the community. Continuous evaluation will help refine program design and intervention strategies to be more effective, efficient, and impactful in addressing the challenges of non-communicable diseases in today's era.

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collaboration will continue for the improvement of public health.

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This community service activity was financially supported independently by the service team. The preparation for the activity included funding for the diabetes exercise sessions, provision of educational materials, as well as the necessary facilities for the implementation of the activities in the field.

CONFLICTS OF INTEREST

The service team states that there is no conflict of interest in this activity. The entire process of the community service activity was prepared and implemented collaboratively.

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