Improving Health Profiles and Type 2 Diabetes Mellitus Knowledge of Community Groups in Karanglo Village, Grogol, Sukoharjo, Central Java, Indonesia Through the SEE Method

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Abstract Central Java ranks fourth among regions for the highest number of diabetes melitus (DM) cases, following Jakarta, Yogyakarta, and East Kalimantan. Grogol District in Sukoharjo Regency had the greatest prevalence of DM cases in 2019, accounting for 18.41% of the total. Diabetes melitus significantly impairs the overall well-being of individuals as it affects individuals across all age groups, including those who can work and those who cannot. If left unmanaged, it can lead to a range of outcomes. The Karanglo Village community is considered at high risk for diabetes melitus (DM) due to a history of health ailments and elevated blood glucose levels. Furthermore, this region is still lacking any health education interventions. This activity aimed to do earlier screening and monitoring of blood sugar levels, as well as providing health education, using the SEE approach (Screening, Health Education, and Exercise) to monitor diabetes melitus. The program was implemented in the period from November 2023 to January 2024, which includes a total of 27 participants, all of whom are female. The implementation of the programs involves the following methods: conducting blood sugar level screenings, engaging in diabetes exercises twice a week, providing health education in six meetings that cover topics such as the epidemiology and etiology, risk factors and prevention, symptoms and diagnosis, complications and management of DM, as well as blood glucose monitoring. Apart from using tools in the form of presentation slides, health education also utilized educational posters. At the end of the program, there was an increase in knowledge by 21.5% (p=0.024) based on pretest and posttest scores, improvements in blood sugar levels, total cholesterol levels, and body mass index. To follow up on the program, a group of independent blood sugar observers has been formed who is responsible for further monitoring blood sugar in program participants.

1. INTRODUCTION

The prevalence of diabetes melitus is steadily rising and frequently goes undetected. The prevalence of a predominantly middle-class economic status in developing countries has exerted a significant impact on alterations in dietary habits, food preferences, and patterns of physical activity. The prevalence of obesity, metabolic syndrome, and type 2 diabetes melitus is highly connected with changes in lifestyle and food choices. Most (79%) of cases

of type 2 diabetes in young people are found in countries with low to moderate per capita income. To effectively address this epidemic, it is imperative to implement rigorous measures for prevention and treatment, including integrating novel ideas (Misra et al., 2019).

A report from the Indonesian Ministry of Health, only 30% of Indonesians possess knowledge about their non-communicable disease status, such as diabetes melitus. The remaining 70% are unaware of their illness due to the absence of symptoms or signs until complications develop. Out of the three people, only one person obtained regular treatment. According to data from Riskesdas in 2018, the prevalence of diabetes melitus in Indonesia, as diagnosed by medical professionals is highest among individuals aged 15 years or older. Most of those affected are females who reside in both rural and urban areas, with varied levels of education (Kementerian Kesehatan RI, 2019).

In 2019, Central Java Province ranked fourth in Indonesia in terms of the number of patients with diabetes melitus (DM), following Jakarta, Yogyakarta, and East Kalimantan. The health service data in Sukoharjo district reveals a total of 18,596 cases of DM, with the Grogol District Health Center accounting for the highest number of cases at 3,424 (18.41%), and the Weru District Health Center reporting the fewest at 591 cases (3.18%) (Dinas Kesehatan Kabupaten Sukoharjo, 2019; Kementerian Kesehatan RI, 2019).

Type 2 diabetes melitus is a complex disease that arises from an interaction of genetic and environmental factors, all of which play equally significant roles in its development. The prevalence of diabetes among individuals with a familial history of the disease indicates a significant impact of genetic variables on its development. Diabetes is classified as a lifestyle illness due to its association with not just hereditary or genetic factors, but also other factors such as age, obesity, insulin resistance, diet, physical activity, and unhealthy habits. These factors significantly contribute to the development of the disease. The gradual development of diabetes sometimes renders the indications and symptoms ambiguous (Betteng, 2014).

Diabetes management can be achieved by consistently paying attention to several main attitudes, including diet, physical activity, control of blood sugar levels, appropriate medication, etc., which if managed well can reduce the risk of further complications. However, many diabetes sufferers do not practice proper self-awareness such as monitoring fasting blood sugar levels regularly (Ernawati et al., 2021).

One strategy for preventing the rise in the diabetic population is to conduct regular screenings and continually monitor blood glucose levels. Society keeps facing challenges in this aspect as a result of constrained resources and capacities. In addition, it is crucial for the population to engage in regular physical activity and have a balanced diet. Therefore, it is imperative to offer health education on the risk factors, prevention, and management of diabetes. The community group in Karanglo Village, Madegondo Village, Grogol District, Sukoharjo Regency has not been provided with health education or involved in community service activities, despite being a vulnerable group for diabetes due to several risk factors. In response to the health-related grievances we received, we have undertaken initiatives for this particular community. The primary health concerns expressed were related to the symptoms of diabetes. To address this, blood sugar levels were assessed both before and after the implementation of the program. The program included diabetes exercises, health education, and the establishment of cadre to regularly monitor diabetes cases in the community periodically.

2. METHOD

The community service activities was carried out from November 2023 to January 2024 in the Karanglo Village community group, Grogol District of Sukoharjo Regency, Central Java Province of Indonesia. The program is executed through a series of activities that encompass observation and brainstorming, activity concept planning, coordination and communication, program implementation, and evaluation and monitoring (Figure 1).

The SEE method was developed by the team for this community service activity, serving as a reference rather than a standardized approach. The acronym SEE represents the interventions implemented: screening, education, and exercise. Screening was conducted prior to the commencement of education and physical activity, primarily through initial blood glucose checks. Health education sessions on diabetes melitus, including information on its risk factors and preventive measures, were held over six sessions. Exercise sessions, focused on diabetes management, were scheduled biweekly, lasting 1.5 hours per session over a three-month period. The duration details of the program activities can be seen in Figure 2.

The target population consisted of residents from RT 002 RW 008 in Karanglo Village, Madegondo Village, Grogol-Sukoharjo. The accessible population included a gymnastics group of women aged 45 and older, with 27 participants from a total of 30 targeted individuals. The age of 43 years was considered the threshold for the risk of developing diabetes melitus. The sampling method used was total sampling.

Data collection was conducted through several methods: (1) blood sugar levels were measured by checking fasting blood sugar using an Accu-check glucometer at the beginning and end of the program. Blood pressure, total cholesterol levels, body weight, and height were also assessed to evaluate the risk of complications and to calculate body mass index (BMI), (2) data on participants' knowledge of diabetes melitus was gathered on six topics: epidemiology and etiology, risk factors and prevention related to nutrition, risk factors and prevention concerning physical activity, symptoms and diagnosis, complications, and management. This was done through pretest and posttest questionnaires, which were developed by the speakers for each topic.

Data analysis was performed using a paired t-test for all variables, including blood sugar levels, cholesterol, blood pressure, BMI, and knowledge.
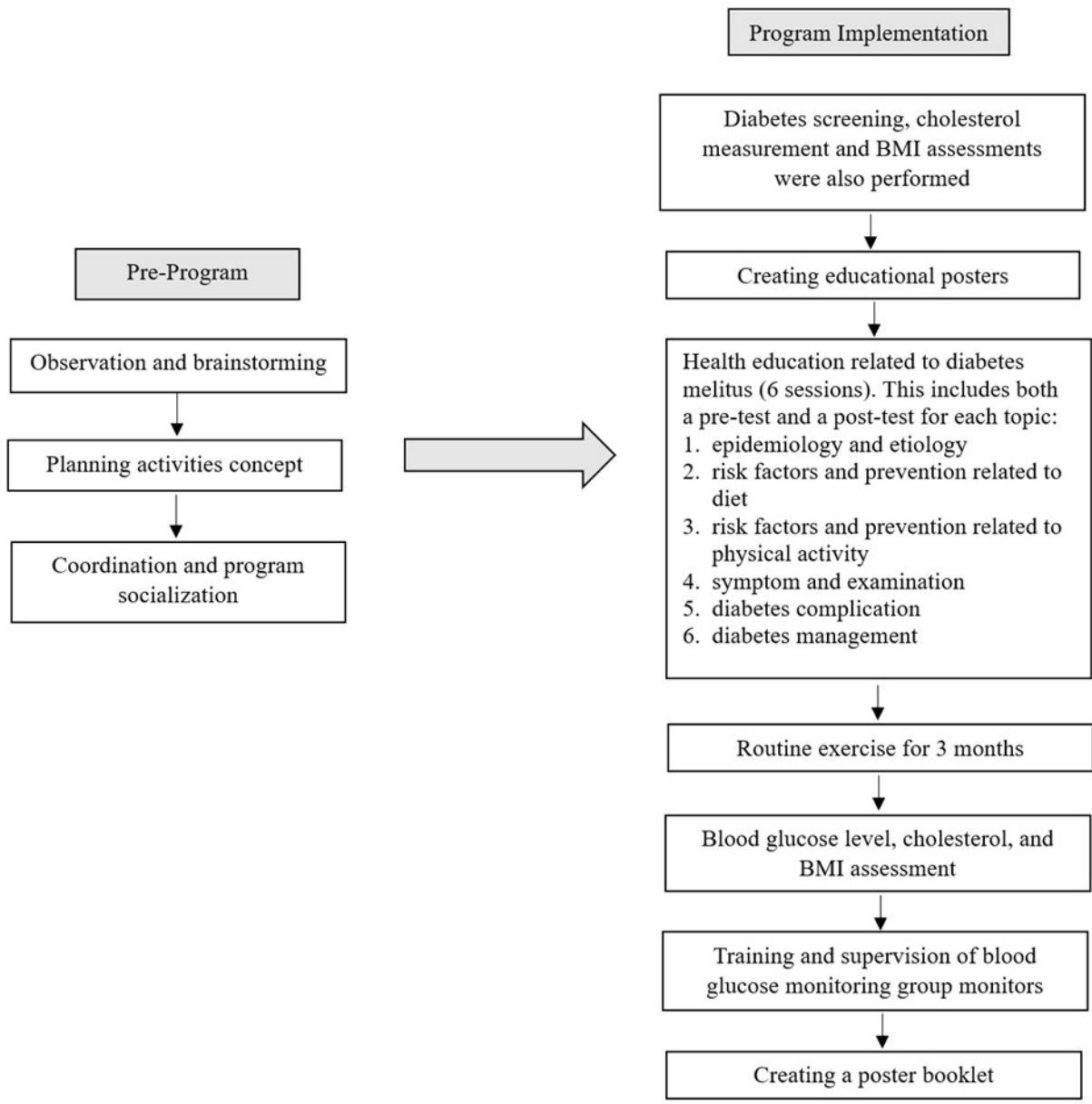
Program Implementation

Diabetes screening, cholesterol measurement and BMI assessments were also performed

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Creating educational posters

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Health education related to diabetes melitus (6 sessions). This includes both a pre-test and a post-test for each topic:
1. epidemiology and etiology
2. risk factors and prevention related to diet
3. risk factors and prevention related to physical activity
4. symptom and examination
5. diabetes complication
6. diabetes management

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Routine exercise for 3 months

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Blood glucose level, cholesterol, and BMI assessment

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Training and supervision of blood glucose monitoring group monitors

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Creating a poster booklet

Pre-Program

Observation and brainstorming

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Planning activities concept

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Coordination and program socialization

Figure **1** . Program preparation and implementation

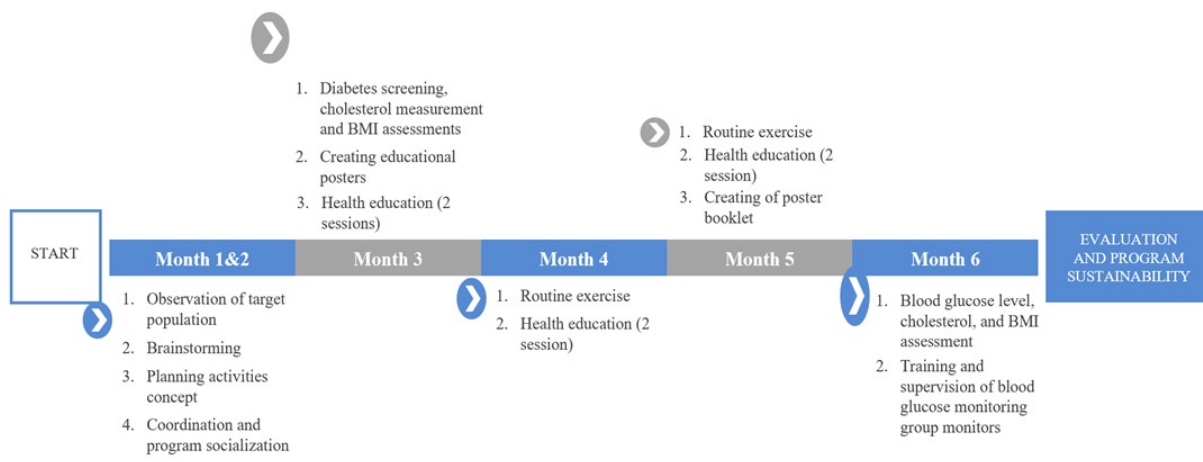Figure **2** . Duration of the program activities

2.1 Observation and brainstorming

The team performed a survey at partner locations, which include community groups in Karanglo Village, Madegondo, Grogol District, Sukoharjo Regency, and engaged in dialogue with partners around overall health and specifically diabetes melitus. The discussion revealed a public health issue: the potential risk of diabetes melitus and its associated problems. In addition, partners have never before been provided with community service activities such as health education/counseling or any other interventions.

2.2 Planning activity concept

The community service team drafted a proposal for an activity plan and assembled a group of educators, laboratory technicians, and students to carry out various activities. These activities included screening blood sugar levels, conducting diabetes exercises, providing diabetes education, monitoring diabetes, forming a team for independent blood sugar checks, and developing plans for program sustainability. The local village government granted authorization for the implementation of the activity plan within the Karanglo Village community group, following the specified activity processes.

2.3 Coordination and communication

Coordination was conducted among team members and partners to ensure the effective implementation of activities such as screening blood sugar levels, conducting diabetes exercises, providing diabetes education through counseling sessions that included pretest and posttest assessments, monitoring diabetes, and establishing independent blood sugar check teams. Multiple meetings were scheduled to discuss the refinement of concepts and the organization of necessary resources for the successful implementation of the program. The activity program was initially introduced to the community through communication, which took place on November 25, 2023.

2.4 Program implementation

The community service team engaged in the following actions: (1) diabetes screening, which involved the measurement of initial blood sugar levels using an Accucheck brand glucometer, (2) practicing diabetes exercises for 3 months, (3) designing educational posters, (4) health education provided focused on diabetes melitus and consisted of 6 topics. The contents covered various aspects such as epidemiology and etiology, risk factors and prevention related to diet, risk factors and prevention related to physical activity, symptoms and examination, as well as complications and management of diabetes. The community took pretests and posttests for each topic, (5) monitoring diabetes through post-intervention blood sugar level assessments, (6) establishing a group of diabetes monitors, (7) supplying blood sugar level measurement devices, (8) creating a program film, and (9) producing a booklet about diabetes.

2.5 Evaluation and monitoring

To monitor and evaluate progress, blood glucose levels were measured after diabetic exercise and education sessions, which included diabetes counseling, as part of the program. In order to monitor the diabetes status of the community, a group of two independent persons was formed. Their responsibility was to frequently measure the blood sugar levels of the community and be supervised by the community service team. To assess the effect of completing the program on enhancing community awareness of diabetes, a paired t-test was conducted on the pretest and posttest scores collected before and after the program.

3. RESULT AND DISCUSSION

The community service program was successfully implemented. The entire sequence of activities, including program communication, screening for blood sugar and cholesterol levels, health counseling, exercise, and post-education checks of blood sugar and cholesterol levels, proceeded without any major obstacles, following the predetermined schedule and plan. The community service partner showed great enthusiasm and actively engaged in the program activities.

Table **1** . Characteristics of community activity program participants

General Profile	n (27)	Percentage (%)
Sex		
Female	27	100
Male	0	0
Age		
<45 year	0	0
>45 year	27	100
Level of Education		
Junior high school	18	66
Senior high school	4	14.8
Bachelor	5	18.5
Working status		
Work	12	44.4
Not work	15	55.5

Table 1 indicates that the participants in the activity were entirely women, with most of them above the age of 45. A large percentage of individuals have education levels that are classified as elementary or middle school, meaning they have a low degree of education. Consequently, they tend to work as self-employed individuals. Gender disparities, based on biological, lifestyle, cultural, environmental, and socioeconomic factors, as well as diverse demographic backgrounds, such as place of residence, contribute to variations in susceptibility, progression, and symptoms of diabetes melitus. Data of another study indicates that women exhibit a longer average length of sickness and a higher BMI compared to men. This, in turn, elevates the risk factor for diabetes in the form of obesity. These associations are believed to be linked to hormonal factors that affect energy metabolism, body composition, vascular

function, and response to inflammation (Ciarambino et al., 2022).

In a study conducted in Wuhan, China revealed the incidence of type 2 diabetes in the population of Wuhan. In China and Asia as a whole, there was a higher prevalence of women compared to men who were at risk of developing diabetes. The primary factors contributing to this risk were age, BMI (body mass index), and central obesity. However, women were more focused on managing and controlling diabetes by maximizing the utilization of existing healthcare facilities (Yan et al., 2022).

All participants in the activity were aged over 45 years (100%). Individuals above the age of 40 were at a higher risk of developing diabetes compared to younger individuals. Diabetes melitus had a higher prevalence among the elderly population and was linked to factors such as obesity, elevated triglyceride levels, reduced HDL levels, and increased total cholesterol levels (Al Mansour, 2019). During the post-menopausal stage, women experienced a decline in the production of estrogen. This hormonal change was believed to contribute to alterations in body form, as well as the buildup of abdominal fat and perivisceral fat, consequently leading to obesity.

Estrogen deficiency leads to insulin resistance. On a global scale, the occurrence of diabetes is greater in males, but type 2 diabetes melitus is more prevalent in females, particularly in women who are going through menopause and the elderly. An investigation conducted in Majmaah City, Riyadh Province, Saudi Arabia revealed that age (p<0.001), employment (p<0.001), and marital status (p<0.001) were significantly associated with type 2 DM (Al Mansour, 2019).

Additional modifiable predictors of obesity and type 2 diabetes melitus in developing countries include social factors such as poor education level, occupation, physical activity, income, and unhealthy food (Ciarambino et al., 2022). The program mostly involved individuals with limited education levels, with just approximately 30% possessing a bachelor's degree. Women with a higher level of education demonstrate greater self-care and a heightened level of control in comparison to women with a lesser level of education. This is linked to the capacity to achieve enhanced health literacy, enabling individuals to acquire a deeper understanding of the necessary measures for diabetes management. Obese women indicate poorer knowledge of diabetes and a lower understanding of how to manage the disease (Yan et al., 2022).

Blood sugar level screening is performed to determine the baseline blood sugar levels before providing diabetes education, including diabetes exercises and health counseling on diabetes melitus (Figure 3). Pre-communication has been done regarding checking first blood sugar levels, instructing participants to abstain from eating for 8 hours. The examination is conducted not only to assess blood glucose levels but also includes measurements of body weight (BW) and height (HT) to figure out the body mass index (BMI), as well as a check for total cholesterol. Diabetes melitus is prevalent among the elderly population

and is linked to factors such as obesity, elevated triglyceride levels, reduced HDL levels, and increased total cholesterol levels (Al Mansour, 2019).

The following step was to give health education through counseling sessions about diabetes melitus (Figure 4). Before receiving counseling, participants are administered a pretest to assess their starting level of knowledge. The information was provided concurrently and concluded with a posttest to assess knowledge after the presentation. During this activity, the community service team gave educational posters. According to Meturan et al. (2024), Diabetes education, through the integration of counseling and blood sugar level assessment, has the potential to enhance knowledge and self-awareness, thus benefiting in the prevention of diabetes.

Participants in this program engaged in regular diabetes exercises twice a week under the guidance of an instructor (Figure 5). Preventing diabetes can be achieved by enhancing physical activity. It is recommended that patient participate in regular exercise, preferably 3-4 times a week that is continuous, rhythmic, interval-based, progressive, and endurance-focused for roughly 30 minutes. Additionally, it is important to avoid a sedentary or inactive lifestyle.

Figure 3. Screening of blood glucose level

Figure 4. Health education of diabetes melitus

Effective diabetes care requires continuous commitment to key factors such as food, physical activity, blood sugar control, and proper medication. By effectively managing these aspects, the chance of developing future complications can be reduced. Nevertheless, an enormous percentage of individuals with diabetes fail to adhere to appropriate self-care efforts, such as consistently

checking their fasting blood sugar levels. Diabetes management focuses on key elements: education, strict diet planning, changes in lifestyle, regular physical activity, and behavioral patterns (Ernawati et al., 2021; Mikhael et al., 2020). Committing to regular physical activity is crucial for the prevention and control of diabetes. Regular physical activity aids in weight reduction, lowers blood sugar levels, decreases cholesterol levels, alleviates stress, and enhances insulin sensitivity in body tissues, resulting in reduced blood sugar levels (Mukhtar et al., 2020).

Figure 5 . Exercise twice a week along program

The series of community service activity programs concluded with an assessment of the program's implementation, the result of monitoring blood glucose levels post-program, and the results of pretest and posttest scores after education. Following that, all participant were chosen and trained to carry out their own blood sugar checks. After having a rating by the team, two participants successfully demonstrated proficiency in doing the examination procedure accurately. This team is tasked for regularly monitoring the blood glucose levels of partners and monitoring their compliance. By monitoring blood sugar levels, it is anticipated that the risk of diabetes melitus can be prevented, leading to a diabetes-free and healthy society.

Based on the examination results in Table 2, it shows that there has been an improvement in all parameters measured which include fasting blood sugar levels, blood pressure, total cholesterol, and BMI. According to Kopitar et al. (2020), the most significant variables for predicting the occurrence of diabetes melitus are the history of hyperglycemia, age, cholesterol levels, triglyceride levels, physical activity, and the use of antihypertensive medicines. Currently, the factors that are most widely used for screening are the history of hyperglycemia and age. The Light Gradient Boosting Machine (LightGDM) prediction model indicates that triglyceride and cholesterol levels are

the most critical variables in predicting diabetes melitus. Approximately 60-70% of individuals diagnosed with diabetes exhibit elevated levels of triglycerides. Hence, several crucial factors contribute to the development of diabetes, including age, gender, body weight, BMI, waist circumference, blood pressure, HDL cholesterol, and so on (Kopitar et al., 2020).

Education-based intervention impacts knowledge, physical activity, dietary habits, health literacy, and self-confidence. Diabetes self-management education is crucial for empowering individuals with diabetes to make healthy lifestyle choices, such as engaging in regular exercise, consuming vegetables and fruit, and stopping smoking. Such actions have a significant impact on clinical outcomes and the overall improvement of health status. The beneficial effects of diabetes self-management education on individuals with diabetes can be shown by increases in their knowledge, attitudes, self-management practices, and medical status, encompassing improvements in blood glucose levels, HbA1c, and lipid profiles. The effectiveness of health education is heavily influenced by the individuals responsible for implementing the guidance and the support provided by the system (Ernawati et al., 2021; Mikhael et al., 2020).

Based on Table 3, it can be seen that there was an increase in knowledge about diabetes for the 6 materials provided during counseling with an average increase of 21.5%. Thus, it can be said that this educational program has succeeded in providing a better understanding of diabetes melitus in terms of epidemiology and etiology, risk factors and prevention from dietary aspects, risk factors and prevention from physical activity aspects, symptoms and diagnosis, complications and management of diabetes melitus. Diabetes education by combining counseling and blood sugar level screening can increase knowledge and self-awareness to prevent diabetes. The use of posters is quite effective as an educational facilities at an affordable cost and easy to make. Study conducted by Aisyah & Bestari (2023) in group of PKK Griya Sakinah 1 Gedongan Village, Colomadu Distcrict, Karanganyar Regency showed that that education increases activity participants' knowledge about the prevalence, risk factors and prevention of diabetes melitus. There is a significant difference in people's knowledge about diabetes between before and after being given education (p=0.001) (Aisyah & Bestari, 2023). Study by Meturan et al. (2024) revealed that education conducted using posters in the community of Dian Darat Village, Southeast Maluku, has the potential to enhance knowledge about diabetes by 62% (Meturan et al., 2024).

Table 2 . Results of clinical parameters measurement of program participants

Parameters	Pre-program	Post-program	P value*
Fasting blood glucose (mg/dL)	97.7	93.8	0.208
Blood pressure (mmHg)	137/85	137/83	0.932
Total cholesterol	203	195	0.218
Body Mass Index (BMI)	24.7	24.6	0.034

*p-value of paired t-test

Table 3 . Pretest and posttest score for educational topics (Mean±SD)

Topic	Pretest	Posttest	Increase (%)
Epidemiology dan Etiology	43.2±27.7	65.3±35.4	51.2
Risk Factors and Prevention Aspects of Diet	55.8±29.4	76.8±24.5	37.7
Risk Factors and Prevention Aspects of Physical Activity	53.8±25.2	63.8±30.1	18.6
Symptoms and Diagnosis	76.3±17.6	81.3±19.3	6.5
Diabetes Melitus Complication	57.1±21.1	64.3±26.3	12.5
Management of Diabetes melitus	61.4±14.1	62.9±14.8	2.3
Average increase			**21.5**
P value of paired-t test			**0.024**

Lifestyle interventions, which involve self-management strategies for diabetes, can considerably enhance glycemic control and lead to weight loss, resulting in a 5% improvement in BMI compared to the baseline. The type of intervention (individual or group) and the duration of the program are important factors in achieving these outcomes. This not only affects the regulation of blood sugar in diabetes but also minimizes the risk factors associated with cardiovascular disease (García-Molina et al., 2020). A study conducted on the population of Hosanna in southern Ethiopia, consisting of 627 individuals, revealed that the prevalence of diabetes was significantly influenced by several risk factors, particularly alcohol consumption, obesity, inactivity, and hypertension. Therefore, implementing a health education program that emphasizes the significance of regular physical activity and highlights the potential risks of alcohol consumption is a crucial assessment to reduce the potential outcomes of diabetes (Dereje et al., 2020).

Participation commitment concerning numerous factors such as dietary preferences, physical exercise, attention to medication procedures, and monitoring blood glucose levels may reduce the occurrence of illness and death caused by diabetes. Factors such as place of residence, socioeconomic status, and strong social support play a beneficial role in encouraging patient engagement in activities to raise awareness about diabetes care (Shrivastava et al., 2013).

4. CONCLUSION

This program achieved a 21.5% increase in participants' knowledge about diabetes melitus and showed improvements in physical performance through lower cholesterol levels, as well as maintaining blood sugar levels within normal ranges. Periodic monitoring of diabetes melitus should be conducted regularly by a group of participants trained to check blood sugar levels. This step needs to be implemented to track the prevalence of diabetes melitus in the community. In the future, it is advisable to conduct screenings for both fasting blood sugar levels and postprandial blood sugar levels, as women tend to have a higher incidence of impaired glucose tolerance after meals.

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CONFLICT OF INTERESTS

The authors declare there is no conflict of interest.

REFERENCES

Aisyah, R. & Bestari, R. S. (2023). Peningkatan pengetahuan masyarakat tentang prevalensi dan faktor risiko diabetes melitus serta upaya pencegahannya melalui edukasi. *JPM Medika*, 35–40. https://doi.org/10.23917/jpmmedika.v3i1.1587

Al Mansour, M. A. (2019). The prevalence and risk factors of Type 2 Diabetes melitus (DMT2) in a semi-urban Saudi population. *Int. J. Environ. Res. Public Health, 17*(1), 7. https://doi.org/10.3390/ijerph17010007

Betteng, R. (2014). Analisis faktor resiko penyebab terjadinya diabetes melitus tipe 2 pada wanita usia produktif di Puskesmas Wawonasa. *Jurnal e-Biomedik, 2*(2). https://doi.org/10.35790/ebm.2.2.2014.4554

Ciarambino, T., Crispino, P., Leto, G., Mastrolorenzo, E., Para, O., & Giordano, M. (2022). Influence of gender in diabetes melitus and its complication. *International Journal of Molecular Sciences, 23*(16), 8850. https://doi.org/10.3390/ijms23168850

Dereje, N., Earsido, A., Temam, L., & Abebe, A. (2020). Prevalence and associated factors of diabetes melitus in Hosanna Town, Southern Ethiopia. *Annals of Global Health, 86*(1), 18. https://doi.org/10.5334/aogh.2663

Dinas Kesehatan Kabupaten Sukoharjo. (2019). Profil Kesehatan Kabupaten Sukoharjo 2019. *Dinas Kesehatan Kabupaten Sukoharjo*.

Ernawati, U., Wihastuti, T. A., & Utami, Y. W. (2021). Effectiveness of Diabetes Self-Management Education (DSME) in Type 2 Diabetes melitus (T2DM) patients: Systematic literature review. *Journal of Public Health Research, 10*(2), jphr.2021.2240. https://doi.org/10.4081/jphr.2021.2240

García-Molina, L., Lewis-Mikhael, A.-M., Riquelme-Gallego, B., Cano-Ibáñez, N., Oliveras-López, M.-J., & Bueno-Cavanillas, A. (2020). Improving type 2 diabetes melitus glycaemic control through lifestyle modification implementing diet intervention: A systematic review and meta-analysis. *European Journal of Nutrition, 59*(4), 1313–1328. https://doi.org/10.1007/s00394-019-02147-6

Kementerian Kesehatan RI. (2019). *Hasil utama Riskesdas 2018*. Badan Penelitian dan Pengembangan Kemenkes RI.

Kopitar, L., Kocbek, P., Cilar, L., Sheikh, A., & Stiglic, G. (2020). Early detection of type 2 diabetes melitus using machine learning-based prediction models. *Scientific Reports, 10*(1), 11981. https://doi.org/10.1038/s41598-020-68771-z

Meturan, D. M., Ethica, S. N., & Sukeksi, A. (2024). Improvement of awareness of diabetes melitus disease risks and self-monitoring motivation through blood sugar screening and counseling for Dian Darat Village Community, Southeast Maluku. *Indonesian Journal of Community Engagement, 10*(1), 16–22. https://doi.org/10.22146/jpkm.79774

Mikhael, E. M., Hassali, M. A., & Hussain, S. A. (2020). Effectiveness of diabetes self-management educational programs for type 2 diabetes melitus patients in middle east countries: A systematic review. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy, 13*, 117–138. https://doi.org/10.2147/DMSO.S232958

Misra, A., Gopalan, H., Jayawardena, R., Hills, A. P., Soares, M., Reza-Albarrán, A. A., & Ramaiya, K. L. (2019). *Diabetes in developing countries. Journal of Diabetes, 11*(7), 522–539. https://doi.org/10.1111/1753-0407.12913

Mukhtar, Y., Galalain, A., & Yunusa, U. (2020). A modern overview on diabetes melitus: A chronic endocrine disorder. *European Journal of Biology, 5*(2), 1–14. https://doi.org/10.47672/ejb.409

Shrivastava, S. R., Shrivastava, P. S., & Ramasamy, J. (2013). Role of self-care in management of diabetes melitus. *Journal of Diabetes & Metabolic Disorders, 12*(1), 14. https://doi.org/10.1186/2251-6581-12-14

Yan, Y., Wu, T., Zhang, M., Li, C., Liu, Q., & Li, F. (2022). Prevalence, awareness and control of type 2 diabetes melitus and risk factors in Chinese elderly population. *BMC Public Health, 22*(1), 1382. https://doi.org/10.1186/s12889-022-13759-9