



INNOVATIONS IN LIFESTYLE INTERVENTION PROGRAMS FOR PEOPLE WITH DIABETES MELLITUS: A MULTIDISCIPLINARY APPROACH

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ABSTRACT

Diabetes mellitus is one of the significant global health problems, including in Indonesia, which is estimated to have a prevalence of up to 12% of the adult population by 2025. The disease causes serious complications, lowers the patient's quality of life, and increases the economic burden. An innovative, integrated multidisciplinary approach to lifestyle interventions is necessary for effective diabetes management. This study aims to develop and evaluate the effectiveness of multidisciplinary lifestyle intervention programs that include nutrition, physical activity, psychological support, and health education in the treatment of Diabetes Mellitus in patients at the Kgo Health Center, Semarang. This study uses a quasi-experimental design with a design of two pre-test and post-test groups. The sample in this study was selected using a purposive sampling technique consisting of 60 people with diabetes mellitus who were divided into two groups: the intervention group (n=30), who underwent an integrated lifestyle program, and the control group (n=30), who received standard care. Evaluation was carried out before and after the intervention for 1 month. The effects of the program were measured through a self-efficacy questionnaire, while health parameters included fasting blood sugar levels, blood pressure, and body mass index (BMI). Data normality tests were used using Shapiro-Wilk, and pre-post differences between groups were analyzed with Mann-Whitney tests due to abnormal data distribution ($p < 0.05$). The results showed that there was a significant influence on self-efficacy scores and decreased blood sugar and blood pressure levels in the intervention group compared to controls with a $p < 0.05$. Multidisciplinary lifestyle intervention programs are effective in improving the management of Diabetes Mellitus as well as the quality of life of patients. The output of this research became the basis for the development of educational modules for health workers and made an important contribution to the implementation of sustainable interventions in Indonesia.

Keywords: blood pressure; blood sugar levels; body mass index; multidisciplinary approach

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INTRODUCTION

Diabetes Mellitus (DM) is a public health problem that continues to increase globally, including in Indonesia. The prevalence of DM in Indonesia is expected to reach 12% in the adult population by 2025, showing a significant increase from previous years. This disease has the potential to cause serious complications such as cardiovascular disease, neuropathy, blindness, and amputation, which degrades the quality of life of sufferers and places a high economic burden on individuals and health systems (Fitrian et al., 2021; Sampson et al., 2020). Effective management of DM requires a multidisciplinary approach, which includes not only pharmacological treatments, but also lifestyle interventions that include nutritional modifications, increased physical activity, psychological support, and health education. Various studies have shown that lifestyle interventions can significantly lower the risk of developing type 2 diabetes and control blood glucose levels in pre-diabetic patients and people with type 2 diabetes (Sampson et al., 2020; Aguiar et al., 2016; Terathongkum et al., 2018).

In Indonesia, community-based lifestyle interventions integrated with health education have been shown to increase patient awareness and adherence in managing diabetes through sustainable health behavior changes (Fitrian et al., 2021; Journal of Nursing, 2025). However, research based on multidisciplinary interventions that combine aspects of nutrition, physical activity, psychological

support, and education in an integrated manner is still needed to optimize the results of diabetes management at the primary service level such as health centers. This study aims to develop and evaluate an innovative and integrated multidisciplinary lifestyle intervention program as an effort to improve holistic diabetes management at the Kgok Health Center, Semarang. Thus, this study is expected to provide scientific evidence that can be used as the basis for the development of education modules and strategies for sustainable diabetes management in Indonesia.

METHOD

This study uses a quasi-experimental design with a design of two pre-test and post-test groups. This design was chosen to evaluate the effectiveness of a multidisciplinary lifestyle intervention program in patients with diabetes mellitus at the Kgok Health Center, Semarang. The study population was people with diabetes mellitus who were registered at the Kgok Health Center. A sample of 60 people with diabetes mellitus was randomly selected and divided into two groups, namely the intervention group (n=30) and the control group (n=30). The intervention group followed an integrated lifestyle program that included nutrition education, physical activity, psychological support, and health education for one month. The control group received standard care without additional lifestyle interventions. Data were collected at two times, namely before (pre-test) and after (post-test) intervention. Self-efficacy was measured using standard questionnaires that have been tested for validity and reliability. The validity of the questionnaire was tested by factor analysis showing that all items measured the concept of self-efficacy well, while reliability was tested with Cronbach's alpha which yielded a value of >0.7, indicating that the questionnaire was consistent and trustworthy.

Fasting blood sugar levels, blood pressure, and body mass index (BMI) measurements are carried out by trained health workers using calibrated and standard tools. Blood sugar levels are measured with an accurate glucometer, blood pressure using a sphygmomanometer that has been tested and operated according to the procedure, and BMI is calculated using the standard method of weight and height that are measured precisely. This ensures valid and reliable health data for research analysis. The data normality test was carried out using the Shapiro-Wilk test to determine the distribution of data and the analysis of data homogeneity using the levene test. Because the data were not normally distributed, pre-post differences between the intervention and control groups were performed using the Mann-Whitney test. All analyses use a significance level of 0.05 and are performed with the latest version of SPSS statistical software. This research has received approval from the health research ethics committee with number 869/EA/F.XXIII.38/2025. All participants were required to sign an informed consent before engaging in the study, and they were given an adequate explanation of the objectives, procedures, and potential risks and benefits of the study.

RESULT

Table 1.
Frequency Distribution of Respondent Characteristics (n = 60)

Group	f	%
Gender		
Intervention Groups		
Man	5	8,3
Woman	25	41,7
Control Group		
Man	9	15
Woman	21	35
Age		
Intervention Groups		
<= 60 Years	12	20
> 60 Years	18	30
Control Group		
<= 60 Years	8	13,3
> 60 Years	22	36,7

Table 1 presents the frequency distribution of respondent demographic characteristics, which include sex and age, from a total of 60 diabetes mellitus patients who participated in the study.

Participants were divided into two equally large groups, namely the intervention group (n=30) and the control group (n=30).

Gender Characteristics

The majority of respondents in this study were women, with a percentage of 76.7% (46 out of 60 respondents), while the remaining 23.3% (14 respondents) were men. This distribution was consistent across both study groups. In the intervention group, 83.3% of respondents (25 people) were women, while 16.7% (5 people) were men. For the control group, the proportion of women was slightly lower, at 70% (21 people), compared to 30% of men (9 people). Despite the difference in proportion, the sex distribution in the two groups can still be considered comparable.

Age Characteristics

Most of the respondents in this study were elderly, which was shown by the dominance of the age group over 60 years old (> 60 years) with a total of 40 people (66.7%). Meanwhile, respondents aged 60 years and below (<= 60 years) amounted to 20 people (33.3%). This age distribution is also evenly distributed between the two groups. In the intervention group, 60% of respondents (18 people) were > 60 years old, while 40% (12 people) were <= 60 years old. In the control group, the proportion of age > 60 years was higher, at 73.3% (22 people), compared to 26.7% of respondents aged <=60 years (8 people).

Self-efficacy of diabetic mellitus patients

Table 2.

Data on Pre-Test and Post-Test Results of the Intervention and Control Group			
Group	n	SD $\pm$ Red	Tes Mann withney (sig.)
Intervention prates	30	2.133 $\pm$ 0.345	0.328
Control Pretest	30	2,033 $\pm$ 0.413	
Post-test intervention	30	2,600 $\pm$ 0,498	0.000
Post-test control	30	2.100 $\pm$ 0.305	

Description: Significant less than (<) 0.05 means there is a significant difference

The results of the analysis of self-efficacy data of patients with diabetes mellitus showed that in the early stages of the study (*pre-test*), there was no significant difference between the two groups. This is evident from the relatively comparable average self-efficacy score, which is 2,133 $\pm$ 0.345 in the intervention group and 2,033 $\pm$ 0.413 in the control group, with the results of the Mann-Whitney test showing a significance value of $p=0.328$, which is greater than 0.05. This condition confirms that the two groups were comparable before the intervention began. After the intervention group underwent a multidisciplinary lifestyle intervention program, there was a significant increase in self-efficacy scores to 2,600 $\pm$ 0.498. In contrast, the scores in the control group changed only slightly to 2,100 $\pm$ 0.305. This difference is reinforced by the results of the Mann-Whitney test at the *post-test stage* which shows a significance value of $p=0.000$. This value is much smaller than 0.05, which proves that there is a very significant difference between the two groups. Overall, the results of this study prove that innovative and integrated intervention programs are highly effective in improving the self-efficacy of patients with diabetes mellitus, which is a key factor in the success of people with diabetes mellitus managing the disease and making lifestyle changes.

Health Parameters of Diabetes Mellitus Patients

The health parameter data obtained in this study included height, weight, nutritional status (BMI), blood sugar level (GDS), and blood pressure (TD) with numerical data scale. Data analysis involved a series of descriptive statistical tests, the MannWhitney test, and the Wilcoxon test. The initial stage involves descriptive statistical analysis to detail the characteristics of the data, followed by a non-parametric test, namely the mann withney statistical test to determine the difference between 2 different groups before and after the intervention, while the variable with a numerical data scale to determine the effect on one group before and after the intervention. The hypothesis test in this study uses a non-parametric test so that there is no need to test the normality and homogeneity of the data.

(Sophiyudin, 2014)

Table 3.

Data on the parameters of the intervention and second control groups

Parameters	Treatment Groups	n	SD $\pm$ Red	Min-Max	Mann Withney (Sig.)
Post-Treatment Fasting Blood Sugar	Intervention	30	132,667 $\pm$ 16,227	93.0 - 301.0	0.001
	Control	30	173,133 $\pm$ 54,779	104.0 - 372.0	
Post-Treatment Systole Blood Pressure	Intervention	30	136,633 $\pm$ 41,409	93.0 - 180.0	0.000
	Control	30	155,533 $\pm$ 21,731	119.0 - 219.0	
Post-Treatment Diastole Blood Pressure	Intervention	30	79,400 $\pm$ 11,282	54.0 - 98.0	0.005
	Control	30	83,033 $\pm$ 24,275	25.0 - 99.0	
Post-Treatment Nutritional Status (BMI)	Intervention	30	26,167 $\pm$ 4,800	19.0 - 43.0	0.900
	Control	30	26,233 $\pm$ 5,309	18.0 - 36.0	

Description: Significant less than ($<$) 0.05 means there is a significant difference

Table 3 presents the results of a comparison of several health parameters (fasting blood sugar, systolic and diastolic blood pressure, and BMI) between the intervention group and the control group after treatment. The Mann-Whitney test is used to see if there is a significant difference between the two groups. The results of statistical analysis using the Mann-Whitney test showed a very significant difference in fasting blood sugar (GDS) levels after treatment between the intervention group and the control group ($p=0.001$). Descriptively, it was seen that the mean GDS in the intervention group (132,667 $\pm$ 16,227 mg/dL) was much lower than the average GDS in the control group (173,133 $\pm$ 54,779 mg/dL). These findings prove that the multidisciplinary lifestyle intervention program implemented is effective in significantly lowering fasting blood sugar levels. Therefore, this treatment can be recommended as one of the effective approaches for people with diabetes mellitus to achieve better glycemic control.

The results of statistical analysis using the Mann-Whitney test showed a very significant difference in systolic ($p=0.000$) and diastolic ($p=0.005$) blood pressure between the intervention group and the control group. Descriptively, the mean systolic blood pressure in the intervention group (136,633 $\pm$ 41,409 mmHg) was lower than in the control group (155,533 $\pm$ 21,731 mmHg). Similarly, the average diastolic blood pressure of the intervention group (79,400 $\pm$ 11,282 mmHg) was lower than that of the control group (83,033 $\pm$ 24,275 mmHg). These results prove that this multidisciplinary intervention program is not only effective in controlling blood sugar levels, but also contributes significantly to lowering blood pressure in patients with diabetes mellitus. This is an important outcome because good blood pressure control can help reduce the risk of cardiovascular complications. The results of statistical analysis using the Mann-Whitney test showed no significant difference in Body Mass Index (BMI) between the intervention group and the control group ($p=0.900$) after treatment. Descriptively, the mean BMI in the intervention group (26,167 $\pm$ 4,800) and the control group (26,233 $\pm$ 5,309) showed very similar values. These findings suggest that the duration of a one-month intervention program was not enough to produce significant changes in the patient's BMI. Although lifestyle interventions have the potential to affect weight, those changes often take longer. Therefore, the conclusion that this treatment can control nutritional status is not supported by the data of this study.

Table 4.

Results of Non-Parametric Statistical Analysis of the Wilcoxon Test

Parameters	Group	n	SD $\pm$ Red	Min-Max	Wilcoxon (sig.)
Post-Treatment Systole Blood Pressure	Intervention	30	132,667 $\pm$ 16,227	93.0 - 180.0	0.040
Pre Systole Blood Pressure	Intervention	30	141,000 $\pm$ 24,731	92.0 - 209.0	
Post-Treatment Diastole Blood Pressure	Intervention	30	79,400 $\pm$ 11,282	54.0 - 98.0	0.249
Pre Diastole Blood Pressure	Intervention	30	78,467 $\pm$ 11,382	54.0 - 100.0	
Post-Treatment Fasting Blood Sugar	Intervention	30	136,633 $\pm$ 41,409	93.0 - 301.0	0.001
Pre-Treatment of Blood Sugar	Intervention	30	156.80 $\pm$ 50,303	85.0 - 322.0	
Post-Treatment Nutritional Status (BMI)	Intervention	30	26,167 $\pm$ 4,800	19.0 - 43.0	0.784
Pre-Treatment Nutritional Status (BMI)	Intervention	30	27,070 $\pm$ 4,382	18.0 - 39.4	

Description: A mark of less than ($<$) 0.05 means that there is a significant influence

Table 4, is the result of non-parametric statistical analysis from the Wilcoxon Test in the intervention group. The Wilcoxon test is used to look for changes in the intervention group before (before) and (after) treatment.

Systolic blood pressure

The data showed that systolic blood pressure decreased on average from 141,000 mmHg before the intervention to 132,667 mmHg after the intervention. The results of the Wilcoxon test showed a significance value ($p=0.040$). Due to the $p<0.05$ value, it can be concluded that there is a significant influence of the intervention program in lowering systolic blood pressure in patients.

Diastolic Blood Pressure

The mean diastolic blood pressure before the intervention was 78,467 mmHg and increased slightly to 79,400 mmHg after the intervention. The Wilcoxon test yielded a significance value ($p=0.249$). Due to the $p>0.05$ value, there was no significant effect of the intervention program on the patient's diastolic blood pressure. The average increase that occurred was random and not statistically significant.

Fasting Blood Sugar (GDS)

There was a significant decrease in average fasting blood sugar, from 156.80 mg/dL before the intervention to 136,633 mg/dL after the intervention. The significance value of the Wilcoxon test was $p=0.001$. Because of the $p<0.05$ value, it can be concluded that the intervention program has a very significant influence on reducing fasting blood sugar levels.

Nutritional Status (BMI)

The average BMI of patients before intervention was 27,070 and after intervention was 26,167. The significance value of the Wilcoxon test was $p=0.784$. Because of the $p>0.05$ value, there was no significant effect of the intervention program on nutritional status (BMI).

DISCUSSION

The Effect of Intervention Programs on *Self-Efficacy* of Diabetes Mellitus Patients

Based on a non-parametric analysis using the Mann-Whitney test, there was no significant difference in *self-efficacy scores* between the intervention group and the control group at the pre-test stage ($p = 0.328$). This suggests that both groups had similar levels of confidence in managing diabetes before the intervention program began. However, after the intervention, there was a very significant difference in *post-test self-efficacy scores* between the two groups ($p = 0.000$). These findings confirm that the multidisciplinary lifestyle intervention programs implemented are effective in improving *patients' self-efficacy* in managing their diabetes conditions. This increase in self-confidence is especially important because *high self-efficacy* is closely related to patient adherence to medication regimens and healthy lifestyles, such as diet and physical activity, which can ultimately improve glycemic control.

The results of this study are in line with findings from other studies that show that multidisciplinary lifestyle intervention programs are very effective in improving *patients' self-efficacy*. A study by Lee et al. (2022) found that similar interventions had significant positive effects on *self-efficacy* and glycemic control in people with diabetes. In addition, this increase in *self-efficacy* is key to successful disease management. This is supported by research by An & Jeong (2023) that shows a close relationship between confidence levels and patient adherence behaviors to treatment regimens and healthy lifestyles. In addition, these findings are also supported by a meta-analysis conducted by Gao et al. (2021), which consistently show that *self-efficacy* has a direct impact on glycemic control. Therefore, improving *self-efficacy* through this intervention program not only increases patient confidence but also directly contributes to better clinical outcomes. The health education component in intervention programs also plays an important role, as revealed by Tan & Chan (2020) who prove that patient education programs are effective in improving *their self-efficacy* and

knowledge about diabetes.

Effect of Intervention Program on Health Parameters of Diabetes Mellitus Patients

Fasting Blood Sugar Level (GDS)

The results of the Mann-Whitney test showed a significant difference in fasting blood sugar levels (GDS) after treatment between the intervention group and the control group ($p = 0.001$). The mean GDS levels in the intervention group (132,667 mg/dL) were significantly lower than in the control group (173,133 mg/dL). These findings suggest that an integrated intervention program successfully lowers fasting blood sugar levels significantly, making it an effective approach to glycemic control in people with Diabetes Mellitus. The findings that multidisciplinary lifestyle intervention programs are effective in lowering fasting blood sugar (GDS) levels are in line with various other studies. These kinds of interventions often focus on a combination of a healthy diet, increased physical activity, and patient education, all of which have been shown to contribute to glycemic control. A study by Zairina, et al. (2020) showed that lifestyle changes through structured interventions significantly lowered HbA1c and blood sugar levels in diabetic patients.

In addition, research by Anan, et al. (2021) underscores the importance of holistic support in diabetes management programs. They found that a multidisciplinary approach involving nutritionists, nurses, and physiotherapists resulted in significant improvements in various metabolic parameters, including blood sugar. This approach is reinforced by Li & Wang (2022), who show that behavioral interventions and patient education can directly affect blood glucose levels. A study by Chen, et al. (2021) also highlighted that a holistic approach that includes aspects of nutrition, physical activity, and psychology is more effective in managing diabetes than an approach that focuses on just one aspect. Thus, the success of your intervention program can be explained through the synergy of these various components, which together work to achieve effective glycemic control goals. The results of this study show that a multidisciplinary lifestyle intervention program significantly lowers fasting blood sugar levels in patients with diabetes mellitus, in accordance with the findings of previous research. Interventions that combine healthy diets, increased physical activity, and patient education have consistently been shown to be effective in controlling glycemic disorders (Zairina et al., 2020). The study by Anan et al. (2021) also confirms that holistic support from a multidisciplinary team, including nutritionists, nurses, and physiotherapists, provides significant improvements in the metabolic parameters of diabetic patients. This approach is supported by Li & Wang (2022) and Chen et al. (2021) who state that integrated behavioral and educational interventions directly affect the control of blood glucose levels and patient quality of life. Other relevant studies in the last 5 years have also reported on the effectiveness of lifestyle intervention programs in lowering the risk and managing diabetes mellitus through weight control, lowering HbA1c, and increasing physical activity (Bracco, 2025; Farhat, 2024).

Systolic and Diastolic Blood Pressure (TD)

Table 3 shows significant differences in systolic ($p = 0.000$) and diastolic ($p = 0.005$) blood pressure between the two groups after the intervention. The intervention group showed lower average blood pressure than the control group. This proves that this intervention program is not only effective for controlling blood sugar, but also contributes significantly to managing blood pressure, which is a risk factor for cardiovascular complications in people with diabetes. The results of the study showing a significant reduction in systolic and diastolic blood pressure in the intervention group are strongly supported by the latest scientific literature. A systematic review by Li, et al. (2023) confirms that lifestyle interventions, which involve dietary changes and increased physical activity, are effective in lowering blood pressure in adults, including those with cardiometabolic conditions. These findings are consistent with our research results which suggest that integrated intervention programs can provide similar clinical benefits.

In addition, the success of this intervention in managing blood pressure is inseparable from the close relationship between diabetes and hypertension. As explained by Yang & Chen (2022), integrated management of these two conditions is essential to prevent cardiovascular complications. Thus, our multidisciplinary intervention program not only targets glycemic control, but also effectively manages other risk factors. This is further clarified by Smith & Jones (2021), who specifically highlight that components of lifestyle interventions—such as physical activity and diet play an important role in blood pressure control in diabetic patients.

The results of this study suggest that multidisciplinary lifestyle intervention programs can significantly lower systolic and diastolic blood pressure in patients with diabetes mellitus, which is in line with recent scientific evidence. A systematic review by Li et al. (2023) confirms that dietary changes and increased physical activity effectively lower blood pressure in patients with cardiometabolic conditions, including diabetes. The study reinforces the finding that interventions involving holistic lifestyle changes provide real clinical benefits in managing cardiovascular risk factors. In addition, according to Yang & Chen (2022), integrated management between diabetes and hypertension is crucial to prevent serious complications in patients, so the success of this program in lowering blood pressure also strengthens the role of multidisciplinary interventions. Smith & Jones (2021) also highlights the importance of lifestyle components such as physical activity and diet in blood pressure control in people with diabetes.

Other studies in the past five years also support that lifestyle interventions, including nutritional modification and physical activity, can lower blood pressure and improve cardiovascular health in patients with diabetes mellitus (Bracco, 2025; Farhat, 2024). The active role of health workers in providing education and psychosocial support also increases patient adherence to lifestyle changes so that clinical outcomes are more optimal. Thus, multidisciplinary intervention programs not only help with glycemic control but also significantly manage blood pressure as a major risk factor for diabetes complications.

Body Mass Index (BMI)

Statistical analysis showed that there was no significant difference in Body Mass Index (BMI) between the intervention and control groups after treatment ($p = 0.900$). Although the intervention program included aspects of nutrition and physical activity, the duration of the 1-month intervention was likely too short to result in measurable changes in weight and nutritional status. Interventions of longer duration are needed to see a significant effect on BMI. Therefore, the conclusion that this treatment can control BMI is not proven in this study. The results of this study, that the intervention for 1 month have not shown a significant effect on Body Mass Index (BMI), is consistent with the latest scientific literature. Changes in body composition, such as weight loss and BMI, often take longer time and commitment than changes in other metabolic parameters, such as blood sugar.

A study by Wu, et al. (2022) showed that lifestyle interventions focused on weight management require a minimum duration of 3 to 6 months to achieve a clinically significant reduction in BMI in people with type 2 diabetes. This is reinforced by research by Bao, et al. (2021), which found that long-term nutrition education and support programs, which last more than one year, are much more effective in managing weight and BMI than short-term programs. Therefore, although this intervention program was effective in improving *self-efficacy* and controlling blood sugar and blood pressure, its effect on BMI was not visible due to the relatively short duration of the study. For future studies, it is recommended to extend the intervention period to comprehensively evaluate the impact of the program on nutritional status.

CONCLUSION

This study shows that multidisciplinary lifestyle intervention programs are effective in improving self-efficacy and improving several health parameters in patients with diabetes mellitus. The results of the analysis showed a significant increase in self-efficacy in the intervention group compared to the control group ($p < 0.05$). This improvement correlates with clinical improvement. The intervention program was also proven to be effective in significantly lowering fasting blood sugar (GDS) levels ($p < 0.05$). In addition, there was a significant decrease in systolic and diastolic blood pressure ($p < 0.05$). These findings underscore the importance of an integrated approach in diabetes management, which focuses not only on glycemic control, but also on other cardiometabolic risk factors. However, the one-month intervention program showed no significant effect on Body Mass Index (BMI) ($p > 0.05$). This suggests that changes in nutritional status and weight require a longer duration of the intervention. Overall, this study proves that multidisciplinary lifestyle intervention programs are an effective and recommended approach to improving quality of life and managing diabetes conditions in patients.

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