The Effect of Diabetes Self-Management Education (DSME) on Self-Efficacy of Type 2 Diabetes Mellitus Patients at the Kassi-Kassi Public Health Center

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Abstract: Type 2 diabetes mellitus requires continuous self-management, yet many patients have limited confidence in performing daily care. This study evaluated the effect of Diabetes Self-Management Education (DSME) on self-efficacy among patients with type 2 diabetes mellitus at the Kassi-Kassi Community Health Center, Makassar. A non-randomized quasi-experimental pretest–posttest design with a control group was used. A total of 120 patients were recruited consecutively and divided into an intervention group (n=60) and a control group (n=60). The intervention group received four structured 60-minute face-to-face DSME sessions over two weeks, supported by modules, booklets, and educational videos, whereas the control group received usual care and an educational booklet. Self-efficacy was measured using the 20-item Diabetes Management Self-Efficacy Scale. Data were analyzed using paired and independent t-tests and Difference-in-Differences analysis. Mean self-efficacy increased from 38.43±6.54 to 90.90±5.87 in the intervention group and from 39.55±6.26 to 80.53±6.39 in the control group. The posttest mean difference was 10.37 points (95% CI: 8.15–12.59; p<0.001; Cohen's d=1.69). The Difference-in-Differences estimate was 11.49 points. Structured DSME was associated with a substantial short-term improvement in self-efficacy and may be considered for integration into routine primary diabetes care. Further multicenter randomized studies with longer follow-up and clinical outcomes are still needed.

Keyword: Type 2 Diabetes Mellitus, DSME, self-efficacy, health education.

INTRODUCTION

The epidemiological transition has shifted disease patterns in many countries, including Indonesia, from a predominance of infectious diseases toward an increasing burden of non-communicable diseases (NCDs). This transition has created a double burden for healthcare systems, particularly in communities characterized by low socioeconomic conditions and suboptimal access to healthcare services [1]. One of the most important NCDs is diabetes mellitus (DM), a chronic metabolic disorder characterized by persistently elevated blood glucose levels resulting from impaired insulin secretion, impaired insulin action, or a combination of both mechanisms [2]. Globally, the prevalence of DM continues to increase substantially. According to the International Diabetes Federation (IDF) Diabetes Atlas, approximately 537 million adults were living with diabetes in 2021, and this number is projected to increase to 643 million by 2030 and 783 million by 2045. Type 2 diabetes mellitus accounts for approximately 85–95% of all diabetes cases. These trends indicate that DM has become a major global health challenge, with substantial consequences for patients' quality of life, healthcare utilization, and health-system financing [3].

Indonesia has also experienced a concerning increase in the burden of DM. The number of people living with diabetes was estimated to increase from 6.9 million in 2010 to approximately 12 million by 2030 [4]. Furthermore, the IDF reported that the number of people with diabetes in Indonesia reached 10.7 million in 2019 and is projected to increase to 13.7 million in 2030 and 16.6 million in 2045. Data from the Indonesian Health Survey showed that the prevalence of diabetes increased from 6.9% in 2013 to 8.5% in 2018. Indonesia also ranked third in Southeast Asia, with a reported diabetes prevalence of 11.3%. These findings demonstrate that diabetes constitutes a serious public health problem requiring comprehensive and sustainable control measures.

Type 2 diabetes mellitus is strongly associated with lifestyle-related and demographic factors, including unhealthy dietary patterns, obesity, insufficient physical activity, and aging [5]. Its consequences extend beyond physical complications, such as cardiovascular disease, nephropathy, neuropathy, and retinopathy. Diabetes may also negatively affect patients' psychosocial well-being and reduce the quality of life of both patients and their families [6]. Therefore, successful diabetes management cannot rely exclusively on pharmacological treatment. It also requires patients to actively participate in daily self-care activities, including dietary management, physical activity, medication adherence, blood glucose monitoring, and the prevention of diabetes-related complications.

At the regional level, South Sulawesi Province recorded a DM prevalence of 1.7% in 2018, and DM was reported as the fourth leading cause of death in the province. A similar increasing trend has been observed in Makassar City, where DM cases continue to rise annually and diabetes remains one of the

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leading causes of death. Data from the Makassar City Health Office showed that the Kassi-Kassi Community Health Center had the highest number of patients with DM, with 1,505 cases recorded in 2024. This figure represented an increase from 1,446 cases in 2022 and 1,481 cases in 2023. The continued increase in the number of cases indicates that DM represents a serious health concern in the working area of the Kassi-Kassi Community Health Center and highlights the need for more effective disease-management strategies.

The success of DM management is strongly influenced by patients' ability to manage their condition independently. One important psychological factor contributing to successful chronic disease management is self-efficacy, which refers to an individual's belief in their ability to undertake the actions required to control their health condition. According to Bandura's Social Cognitive Theory, self-efficacy influences behavioral choices, the level of effort individuals are willing to exert, persistence in facing difficulties, and the ability to overcome barriers. In the context of type 2 DM, patients with higher self-efficacy are generally more likely to adhere to dietary recommendations, engage in regular physical activity, use medications appropriately, and perform blood glucose monitoring [3]. Conversely, low self-efficacy is associated with inadequate self-management, poor glycemic control, a greater risk of complications, and reduced quality of life.

Self-efficacy was selected as the dependent variable in this study because it represents a key cognitive determinant of the initiation, maintenance, and sustainability of health-related behaviors among patients with type 2 DM [7]. Most diabetes-management activities are performed independently by patients at home; therefore, the success of treatment depends considerably on patients' confidence in their ability to conduct daily self-care. Previous studies have demonstrated that self-efficacy is significantly associated with self-care behavior, glycemic control, and quality of life among patients with type 2 DM [3,6]. Consequently, improvement in self-efficacy is an important indicator for assessing the effectiveness of educational interventions in diabetes care.

Low levels of diabetes-related knowledge may contribute to poor self-efficacy and suboptimal self-management behavior [8]. Patient education is therefore recognized as one of the principal components of comprehensive DM management. The Indonesian Endocrinology Association recommends education as a key strategy for improving patients' understanding of the course of diabetes, the prevention of complications, and the skills required for effective diabetes self-management. Consistent with this recommendation, the American Diabetes Association recognizes Diabetes Self-Management Education and Support (DSMES) as a core component of diabetes care that can support glycemic control and reduce the risk of diabetes-related complications.

One practical implementation of DSMES is Diabetes Self-Management Education (DSME), a structured and continuing educational intervention designed to strengthen patients' capacity to manage diabetes independently. DSME focuses not only on improving knowledge but also on developing practical skills, motivation, problem-solving abilities, and social support, thereby enabling patients to make informed decisions regarding the management of their condition. Previous studies have shown that DSME can improve self-efficacy and self-care behavior among patients with type 2 DM [9,10]. Nevertheless, previous DSME studies have been conducted using different intervention formats, healthcare settings, delivery methods, and outcome measurements. Evidence regarding the implementation of a structured, face-to-face DSME intervention in Indonesian primary healthcare settings, particularly in a community health center with a high diabetes burden, remains limited.

At the Kassi-Kassi Community Health Center, a structured DSME program has not yet been routinely implemented. Diabetes education is generally delivered through brief and general counseling during healthcare visits, which may be insufficient to strengthen patients' confidence and practical ability to conduct continuous self-management. This gap is particularly important because the health center has recorded the highest number of DM cases in Makassar City. In contrast to general counseling, the intervention evaluated in this study consisted of four structured, face-to-face educational sessions supported by a DSME module, educational booklets, and videos. The study also compared changes in self-efficacy between an intervention group and a control group using a Difference-in-Differences approach to estimate the additional improvement associated with DSME beyond changes observed under standard healthcare services. Therefore, this study aimed to evaluate the effectiveness of structured DSME in improving self-efficacy among patients with type 2 diabetes mellitus at the Kassi-Kassi Community Health Center. The findings are expected to provide context-specific evidence for the integration of structured and sustainable DSME into routine primary healthcare services.

RESEARCH METHODS

Study Design and Place

This study used a non-randomized quasi-experimental control-group pretest–posttest design and

was conducted at the General Clinic of the Kassi-Kassi Community Health Center, Makassar City. The study involved an intervention group that received structured face-to-face Diabetes Self-Management Education (DSME) and a control group that received standard community health center services and an educational booklet. Self-efficacy was measured before and after the intervention using the Diabetes Management Self-Efficacy Scale (DMSES). The study design was described as follows: intervention group O_1–X_1–O_2 and control group O_3–X_2–O_4. O_1 and O_3 represented the pretest measurements, X_1 represented the structured DSME intervention, X_2 represented usual care and an educational booklet, and O_2 and O_4 represented the posttest measurements.

Population and Sample

The study population consisted of all patients with type 2 diabetes mellitus receiving examination and treatment at the General Clinic of the Kassi-Kassi Community Health Center. Based on records from January to December 2025, the accessible population consisted of 1,954 patients.

The minimum sample size was calculated using the Lemeshow formula for comparing two means:

$$n = \frac{2\sigma^2\left(Z_{1-\alpha/2} + Z_{1-\beta}\right)^2}{(\mu_1 - \mu_2)^2}$$

The calculation was based on a significance level of [insert α], statistical power of [insert power], expected mean difference of [insert value], and pooled standard deviation of [insert value], obtained from [insert reference]. The required sample size was 51 participants per group. After allowing for a 15% attrition rate, the sample size was increased to 60 participants per group, resulting in a total of 120 participants.

Participants were recruited using non-probability consecutive sampling until the required sample size was achieved. The inclusion criteria were patients diagnosed with type 2 diabetes mellitus for at least six months, aged ≥30 years, able to read and communicate effectively, without cognitive impairment, and willing to participate in all study sessions. Patients with severe complications or physical conditions that prevented participation in the educational sessions were excluded.

Control of Selection Bias and Confounding

Because participants were not randomly allocated, selection bias and baseline differences between groups could not be completely eliminated. To minimize these risks, both groups were recruited from the same source population using identical inclusion and exclusion criteria, measurement instruments, and assessment procedures. Baseline comparability between the intervention and control groups was examined for age, gender, educational level, duration of diabetes, and pretest self-efficacy scores. Categorical variables were compared using the chi-square test or Fisher's exact test, while continuous variables were compared using an independent-samples t-test. Variables showing baseline imbalance or considered clinically relevant were included as covariates in the adjusted analysis.

DSME Intervention and Data Collection

Data collection began after obtaining research permission and conducting a preliminary survey. Eligible patients received an explanation of the study and signed written informed consent before participation. Demographic and clinical information was obtained through interviews and medical records. Both groups completed a DMSES pretest. The intervention group then received four structured face-to-face DSME sessions over two weeks, with each session lasting 60 minutes. The intervention used a structured module, an educational booklet, and educational videos. The materials covered diabetes management, dietary and

Table 1: Operational Definitions

No	Variable	Operational definition	Measurement	Instrument	Category
1	DSME intervention	Four structured face-to-face educational sessions on diabetes self-management	Observation of implementation	DSME module and checklist	Intervention and control groups
2	Self-efficacy	Patient confidence in independently managing diabetes	Pretest and posttest	DMSES questionnaire	20–40 very low; 41–60 low; 61–80 high; 81–100 very high
3	Age	Age based on year of birth	Interview or medical record	Identity form	<40; 40–59; ≥60 years
4	Gender	Respondent's gender	Interview		Male; female
5	Education	Highest formal education completed			Elementary; junior high; senior high; higher education
6	Duration of diabetes	Time since diagnosis of type 2 diabetes mellitus	Interview or medical record		<5 years; ≥5 years

weight management, physical activity, blood glucose monitoring, medication adherence, foot care, and complication prevention.

The control group received standard community health center services and an educational booklet but did not participate in the structured DSME sessions. After all intervention sessions were completed, both groups completed the DMSES posttest using the same instrument.

Research Instruments

Self-efficacy was measured using the 20-item Diabetes Management Self-Efficacy Scale. The instrument covers four domains: nutrition and weight management, medication and foot care, physical exercise, and blood glucose control. Each item is scored on a five-point Likert scale, producing a total score of 20–100. Self-efficacy scores were categorized as follows: 20–40 as very low, 41–60 as low, 61–80 as high, and 81–100 as very high. All questionnaire items were valid, with correlation coefficients ranging from 0.361 to 0.812. The Cronbach's alpha value was 0.89, indicating high internal consistency.

Data Analysis

Data were analyzed using IBM SPSS Statistics version 28. Univariate analysis was used to present means, standard deviations, medians, frequencies, and percentages. Normality was assessed using the Kolmogorov–Smirnov and Shapiro–Wilk tests, while homogeneity of variance was assessed using Levene's test.A paired-samples t-test was used to compare pretest and posttest self-efficacy scores within each group. An independent-samples t-test was used to compare posttest scores between groups. Results were reported using mean differences, 95% confidence intervals, p-values, and Cohen's d effect sizes.

A Difference-in-Differences analysis was used to estimate the additional improvement associated with DSME:

$$DiD = (PostI - PreI) - (PostC - PreC)$$

The group-by-time interaction represented the intervention effect. Age, gender, educational level, and duration of diabetes were included in the adjusted analysis when relevant. The DiD estimate was reported with its standard error, 95% confidence interval, effect size, and p-value. Because only one pretest measurement was available, the parallel-trends assumption could not be directly tested and was acknowledged as a study limitation. All analyses used a two-sided significance level of $p < 0.05$. Values below 0.001 were reported as $p < 0.001$.

RESULTS

This study was conducted at the Kassi-Kassi Community Health Center, Rappocini District, Makassar City. The health center serves six densely populated urban subdistricts and has a high burden of non-communicable diseases, particularly type 2 diabetes mellitus. A total of 120 patients participated in the study, consisting of 60 participants in the

Table 2: Baseline Characteristics of Participants in the Intervention and Control Groups

Characteristics	Category	Intervention group, n (%)	Control group, n (%)	p-value
Gender	Male	19 (31.7)	14 (23.3)	0.307
	Female	41 (68.3)	46 (76.7)	
Education	Elementary school/equivalent	9 (15.0)	11 (18.3)	0.709
	Junior high school/equivalent	11 (18.3)	13 (21.7)	
	Senior high school/equivalent	25 (41.7)	26 (43.3)	
	Higher education	15 (25.0)	10 (16.7)	
	— Diploma	7 (11.7)	1 (1.7)	
	— Bachelor's degree	7 (11.7)	8 (13.3)	
	— Master's degree	1 (1.7)	1 (1.7)	
Age	≤40 years	5 (8.3)	5 (8.3)	0.137
	41–50 years	18 (30.0)	9 (15.0)	
	>50 years	37 (61.7)	46 (76.7)	
Duration of diabetes	<5 years	21 (35.0)	33 (55.0)	0.028
	≥5 years	39 (65.0)	27 (45.0)	
Baseline self-efficacy	Mean ± SD	38.43 ± 6.539	39.55 ± 6.258	0.340
Total		60 (100.0)	60 (100.0)	

Categorical variables were compared using the Pearson chi-square test. Baseline self-efficacy scores were compared using an independent-samples t-test. Higher education comprised diploma, bachelor's, and master's degrees.

Table 3: Normality and Homogeneity Tests for Self-Efficacy Scores

Measurement	Kolmogorov–Smirnov statistic	p-value	Shapiro–Wilk statistic	p-value	Conclusion
Intervention group pretest	0.124	0.023	0.962	0.057	Normal
	0.087	0.200	0.962	0.056	
Control group pretest	0.086	0.200	0.985	0.669	Normal
	0.088		0.989	0.867	
Homogeneity of posttest variance	Levene's F = 0.021	0.886	—	—	Homogeneous

Each normality test included 60 participants. A Shapiro–Wilk p-value >0.05 indicated that the data were normally distributed.

Table 4: Within-Group and between-Group Comparisons of Self-Efficacy Scores

Analysis	Intervention group	Control group	Effect estimate	95% CI	t-value	p-value	Effect size
Pretest, mean ± SD	38.43 ± 6.539	39.55 ± 6.258	Mean difference: −1.12	−3.43 to 1.19	−0.959	0.340	Cohen's d = −0.17
	90.90 ± 5.868	80.53 ± 6.392	Mean difference: 10.37	8.15 to 12.59	9.254	<0.001	Cohen's d = 1.69
Within-group change	52.47	40.98	—	—	—	<0.001 for both groups	—
Intervention-group change	38.43 to 90.90	—	52.47	50.18 to 54.76	−45.892	<0.001	d_{av} = 8.45
Control-group change	—	39.55 to 80.53	40.98	40.74 to 41.22	−341.503	<0.001	d_{av} = 6.48

d_{av} represents the standardized mean change calculated using the average pretest and posttest standard deviations. Values of approximately 0.20, 0.50, and 0.80 indicate small, moderate, and large effects, respectively.

intervention group and 60 participants in the control group.

Most participants were female in both the intervention and control groups, accounting for 41 participants (68.3%) and 46 participants (76.7%), respectively. Senior high school was the most common educational level in both groups. Most participants were older than 50 years, including 37 participants (61.7%) in the intervention group and 46 participants (76.7%) in the control group. Gender, education, age, and baseline self-efficacy did not differ significantly between the groups, with all p-values >0.05. However, the duration of diabetes differed significantly between the groups (p = 0.028). The intervention group had a higher proportion of participants with diabetes duration ≥5 years, whereas the control group had a higher proportion with diabetes duration <5 years. Therefore, diabetes duration was considered a potential confounding variable.

The Shapiro–Wilk p-values for all pretest and posttest measurements were >0.05, indicating that the self-efficacy scores were normally distributed. Levene's test also showed that the posttest variances were homogeneous between the groups (F = 0.021; p = 0.886). Therefore, the assumptions for paired-samples and independent-samples t-tests were satisfied.

The intervention group's mean self-efficacy score increased significantly from 38.43 ± 6.539 at pretest to 90.90 ± 5.868 at posttest. The mean increase was 52.47 points (95% CI: 50.18–54.76; p <0.001). The control group also showed a significant increase from 39.55 ± 6.258 to 80.53 ± 6.392, with a mean increase of 40.98 points (95% CI: 40.74–41.22; p <0.001). The increase in the control group should not be interpreted as an effect of the structured DSME sessions because the control participants did not receive the four-session intervention. Their improvement may have resulted from routine health services, exposure to the educational booklet, repeated questionnaire administration, or increased awareness associated with participation in the study. At posttest, the intervention group had a significantly higher self-efficacy score than the control group. The mean difference was 10.37 points (95% CI: 8.15–12.59; t = 9.254; p <0.001), with a Cohen's d of 1.69, indicating a large between-group effect.

Before the intervention, all participants in both groups were categorized as having low or very low self-efficacy. In the intervention group, 37 participants (61.7%) had very low self-efficacy and 23 participants (38.3%) had low self-efficacy. In the control group, 34 participants (56.7%) had very low self-efficacy and 26

Table 5: Distribution of Pretest and Posttest Self-Efficacy Categories

Group and measurement	Very low, n (%)	Low, n (%)	High, n (%)	Very high, n (%)	Total
Intervention group pretest	37 (61.7)	23 (38.3)	0 (0.0)	0 (0.0)	60
	0 (0.0)	0 (0.0)	3 (5.0)	57 (95.0)	
Control group pretest	34 (56.7)	26 (43.3)	0 (0.0)	0 (0.0)	
	0 (0.0)	0 (0.0)	30 (50.0)	30 (50.0)	

Table 6: Changes in Self-Efficacy Scores and the Unadjusted Difference-in-Differences Effect

Panel A. Changes in Self-Efficacy Scores within Each Group

Group	Pretest Mean	Posttest Mean	Mean Change
Intervention group	38.43	90.90	52.47
Control group	39.55	80.53	40.98

Panel B. Additional Effect Associated with the DSME Intervention

Effect	Estimate	Standard Error	95% CI	t-value	p-value	Standardized Effect Size
Difference-in-Differences	11.49	1.15	9.19–13.79	9.995	<0.001	1.82

The Difference-in-Differences estimate was calculated as the change in the intervention group minus the change in the control group: 52.47 − 40.98 = 11.49 points. A positive estimate indicates a greater increase in self-efficacy in the intervention group than in the control group.

participants (43.3%) had low self-efficacy. At posttest, 57 participants (95.0%) in the intervention group had very high self-efficacy and three participants (5.0%) had high self-efficacy. In the control group, 30 participants (50.0%) had high self-efficacy and 30 participants (50.0%) had very high self-efficacy. Thus, both groups showed improvement, although the shift toward very high self-efficacy was greater in the intervention group.

The mean self-efficacy score in the intervention group increased from 38.43 at pretest to 90.90 at posttest, resulting in a mean change of 52.47 points. In the control group, the mean score increased from 39.55 to 80.53, resulting in a mean change of 40.98 points. The unadjusted Difference-in-Differences estimate was 11.49 points, indicating that the increase in self-efficacy in the intervention group was 11.49 points greater than that observed in the control group. The estimated additional increase associated with the DSME intervention was statistically significant (estimate = 11.49; standard error = 1.15; 95% CI: 9.19–13.79; t = 9.995; p <0.001). The standardized effect size was 1.82, indicating a large additional effect. However, because the study used a non-randomized design and diabetes duration differed between the groups at baseline, the findings should also be confirmed using an adjusted Difference-in-Differences model that includes diabetes duration as a covariate.

DISCUSSION

Most participants with type 2 diabetes mellitus were older than 50 years, female, had completed senior high school, and had been living with diabetes for at least five years. This distribution is consistent with the epidemiological pattern of type 2 diabetes, in which prevalence increases with age because of declining insulin sensitivity, impaired pancreatic beta-cell function, and age-related changes in glucose metabolism. Gamboa Moreno *et al*. (2019) similarly reported a higher prevalence of diabetes among individuals aged ≥45 years [11]. The predominance of female participants may be associated with hormonal and metabolic changes, particularly reduced estrogen levels after menopause, as well as differences in physical activity, obesity risk, and healthcare utilization [2,12,13]. Women may also be more likely to access healthcare services and participate in educational programs, making them an important target group for diabetes education [14]. Although most participants had secondary education and substantial experience living with diabetes, these characteristics do not necessarily guarantee effective self-management without structured and continuous educational support [15].

Before the intervention, participants in both groups had low or very low self-efficacy, indicating limited confidence in independently managing diet, physical activity, medication adherence, foot care, and blood glucose monitoring [16]. Low self-efficacy may result from limited access to structured diabetes education, inadequate social support, and insufficient opportunities to practice self-management skills [17]. Patients often receive only brief information during routine consultations, which may not provide adequate

guidance for implementing diabetes-management recommendations consistently. This finding is consistent with previous research showing that patients who do not receive specific educational interventions often have inadequate confidence in diabetes self-management [18]. Although age, gender, educational level, and duration of diabetes were not significantly associated with posttest self-efficacy, the baseline difference in diabetes duration between the groups should be considered because the non-randomized design may not have fully eliminated residual confounding.

The DSME intervention was associated with a substantial increase in self-efficacy. In the intervention group, the mean score increased from 38.43 to 90.90, representing an improvement of 52.47 points, whereas the control group increased from 39.55 to 80.53, representing an improvement of 40.98 points. The Difference-in-Differences estimate of 11.49 points indicates that the intervention group achieved a greater improvement than the control group. The increase observed in the control group may be explained by the educational booklet, routine healthcare services, repeated questionnaire exposure, increased awareness resulting from study participation, or information obtained from other sources. Nevertheless, the greater improvement in the intervention group suggests that four structured face-to-face sessions supported by modules, educational booklets, and videos provided an additional benefit beyond standard care. The structured content covered diet, physical activity, medication adherence, blood glucose monitoring, foot care, and complication prevention, which are central components of diabetes self-management [19].

These findings are consistent with recent international studies evaluating structured diabetes education. Tanaka *et al*. reported that diabetes self-management education and support improved patient outcomes, particularly when the intervention was structured and adapted to patients' needs [20]. Oluchina also found that education based on a self-care model improved diabetes self-management behaviors and glycemic control [21]. Similar improvements were reported in evaluations of diabetes education programs in Saudi Arabia and other Gulf Cooperation Council countries [14,22]. The comparatively large improvement observed in this study may be related to the very low baseline self-efficacy scores, the use of multiple educational media, direct interaction with healthcare workers, and the short interval between the intervention and posttest. Based on Bandura's Social Cognitive Theory, DSME may strengthen self-efficacy through mastery experience, observation of practical demonstrations, verbal encouragement, and improved emotional control. Therefore, DSME not only increases knowledge but also strengthens patients' confidence in performing sustainable self-management [23].

The study has several strengths, including the use of a structured four-session DSME intervention, a comparison group, a validated DMSES instrument, and a Difference-in-Differences approach to estimate the additional intervention effect. However, the findings should be interpreted in light of several limitations. The non-randomized design may have introduced selection bias and residual confounding, particularly because diabetes duration differed between groups at baseline. The study was conducted at a single community health center with a short two-week intervention and follow-up period, limiting the generalizability of the findings and the ability to determine whether improvements were sustained. Self-efficacy was measured using a self-reported questionnaire, which may be influenced by recall and social desirability bias. The provision of an educational booklet to the control group may also have contributed to its substantial improvement. In addition, long-term clinical outcomes such as HbA1c, fasting blood glucose, medication adherence, and diabetes complications were not assessed, and the parallel-trends assumption could not be directly tested because only one pre-intervention measurement was available. Further multicenter randomized studies with longer follow-up and clinical outcome measurements are needed to confirm these findings.

STRENGTHS AND LIMITATIONS

This study has several strengths, including the use of a structured four-session DSME intervention, the inclusion of a comparison group, the use of a validated DMSES instrument, and the assessment of changes in self-efficacy using a Difference-in-Differences approach. Nevertheless, several limitations should be acknowledged. First, the non-randomized design may have introduced selection bias and residual confounding. Second, the study was conducted at a single primary healthcare center, limiting the generalizability of the findings. Third, the two-week follow-up period only captured short-term changes in self-efficacy and did not determine whether the improvement was sustained. Fourth, clinical outcomes such as HbA1c, fasting blood glucose, medication adherence, and diabetes complications were not evaluated. Fifth, self-efficacy was assessed using a self-reported questionnaire and may have been affected by social desirability bias. In addition, the

control group received educational booklets and showed substantial improvement, suggesting that educational exposure or contamination may have influenced the results. Finally, because only one pre-intervention measurement was available, the parallel-trends assumption underlying the Difference-in-Differences analysis could not be directly assessed.

CONCLUSION

This study found that a structured Diabetes Self-Management Education (DSME) intervention was associated with a greater short-term improvement in self-efficacy among patients with type 2 diabetes mellitus compared with usual care. The intervention may strengthen patients' knowledge, practical skills, and confidence in performing diabetes self-management activities, including dietary management, physical activity, medication adherence, blood glucose monitoring, and complication prevention. Structured DSME may therefore be considered for integration into routine primary healthcare services involving trained healthcare professionals. However, these findings should be interpreted cautiously because of the non-randomized design, single-center setting, short intervention and follow-up period, and absence of long-term clinical outcomes. Further multicenter randomized studies with longer follow-up and clinical indicators, particularly HbA1c and blood glucose levels, are needed to confirm the effectiveness, sustainability, and generalizability of DSME.

ETHICAL DECLARATION

This study received ethical approval from the Health Research Ethics Committee of the Faculty of Public Health, Hasanuddin University. The research was conducted among patients with type 2 Diabetes Mellitus at the Kassi-Kassi Public Health Center, Makassar City, Indonesia. All participants voluntarily agreed to participate and provided informed consent prior to data collection. The study adhered to ethical principles, including respect for participant autonomy, confidentiality, anonymity, and the exclusive use of data for research purposes.

LIST OF ABBREVIATIONS

ADA = American Diabetes Association

DiD = Difference-in-Differences

DM = Diabetes Mellitus

DMSES = Diabetes Management Self-Efficacy Scale

DSME = Diabetes Self-Management Education

DSMES = Diabetes Self-Management Education and Support

IDF = International Diabetes Federation

NCDs = Non-Communicable Diseases

PERKENI = Indonesian Endocrinology Association

SPSS = Statistical Package for the Social Sciences

T2DM = Type 2 Diabetes Mellitus

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this article.

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AUTHORS' CONTRIBUTIONS

N.D. contributed to the conceptualization, study design, data collection, data analysis, interpretation of the findings, and preparation of the original manuscript draft. A.Z. contributed to research supervision, methodological guidance, interpretation of the findings, and critical revision of the manuscript. R.A. contributed to supervision, validation of the analysis, interpretation of the results, and critical review of the manuscript. All authors read and approved the final manuscript and agreed to be accountable for all aspects of the work.

USE OF ARTIFICIAL INTELLIGENCE (AI)

Artificial intelligence (AI) tools were used solely for language editing, grammar checking, and manuscript formatting assistance. All study design, data collection, analysis, interpretation of findings, and final manuscript

content were completed, reviewed, and approved by the authors, who take full responsibility for the integrity and accuracy of the work.

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