JKKI: Jurnal Kedokteran dan Kesehatan Indonesia
Indonesian Journal of Medicine and Health
Journal homepage: https://journal.uii.ac.id/JKKI
P-ISSN 2085-4145 | E-ISSN 2527-2950

Motivational interviewing-based health coaching to improve diabetes knowledge and manage blood glucose: A quasi-experimental study

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Article Info:

Keywords: diabetes; health coaching; motivational interviewing; diabetes knowledge; blood glucose

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Article History:

Received: November 6, 2024
Accepted: April 4, 2025
Online: April 25, 2025

DOI: 10.20885/JKKI.Vol16.Iss1.art8

Original Article

ABSTRACT

Background: Diabetes management relies significantly on patient knowledge, which affects personal care practices and overall well-being. However, many patients face challenges in managing their condition due to insufficient support and motivation.
Objective: This study aimed to evaluate the effectiveness of a motivational interviewing-based health coaching program using the FIRA (Focus, Identify, Reflect, Act) model in enhancing diabetes knowledge and managing blood glucose, BMI, and blood pressure.
Methods: A quasi-experimental study was conducted involving 121 adult participants with type 2 diabetes, allocated into intervention (n = 61) and control (n = 60) groups. The intervention group received six bi-weekly health coaching sessions over three months, based on the FIRA model integrated with motivational interviewing techniques. Pre and post-intervention assessments were conducted to evaluate diabetes knowledge, fasting blood glucose, BMI, and blood pressure. Statistical analysis included paired t-tests for within-group comparisons and independent t-tests or Mann-Whitney U tests for between-group analyses, based on data distribution.
Results: The intervention group exhibited a significant improvement in diabetes knowledge (mean change=+3.80; $p<0.0001$), while the control group showed a decline (mean change=-2.97; $p<0.0001$). A significant reduction in fasting blood glucose was also observed in the intervention group (mean change -17.00 mg/dL; $p=0.015$), in contrast to a non-significant increase in the control group (mean change = +3.00 mg/dL; $p=0.365$). No significant changes were found in BMI and systolic blood pressure. Diastolic blood pressure increased significantly in the control group ($p=0.001$), while the decrease in the intervention group was not statistically significant ($p=0.432$); the between-group difference was also not significant ($p=0.226$).
Conclusion: Motivational interviewing-based health coaching effectively improves diabetes knowledge and blood glucose management. Further studies are recommended to explore long-term impacts and personalised strategies to optimise patient outcomes.

INTRODUCTION

Diabetes mellitus (DM) is being progressively identified as a crucial international health challenge, with projections suggesting that the disorder presently afflicts 537 million adults, a figure anticipated to escalate to 783 million by the year 2045.[1] This escalation presents a considerable challenge to public health, influenced by determinants including urbanisation, demographic shifts towards older populations, and lifestyle factors such as inadequate nutrition, sedentary behaviour, and excessive adiposity.[2] The proficient management of diabetes

necessitates a comprehensive strategy that not only targets glycemic regulation but also considers concomitant comorbid conditions, such as hypertension and dyslipidemia.[3,4]

The escalation of type 2 diabetes, which constitutes the predominant proportion of cases, is associated with worldwide surges in obesity rates and sedentary behavioural patterns.[5] A high body mass index (BMI) constitutes the primary contributing factor, responsible for over fifty percent of the disease's total impact, while other elements, such as dietary risks and tobacco use, are progressively recognised as important contributors.[6] As the incidence of diabetes escalates, especially among countries with limited and moderate financial resources, establishing effective approaches for prevention, immediate diagnosis, and all-encompassing management is of paramount importance.[7] These strategies must engage with the intricate interactions among socio-economic, environmental, and genetic determinants.[8,9]

Despite advancements in pharmacological treatments, diabetes management fundamentally relies on the patient's capacity for self-regulation, including nutritional regulation, regular activity, monitoring blood sugar levels, and adherence to prescribed therapies.[10] Many patients struggle with these tasks due to a lack of knowledge, motivation, or support, leading to poor glycemic control and increased healthcare costs.[11,12]

The dissemination of knowledge to patients and the implementation of behavioural strategies are paramount in the management of diabetes. Motivational interviewing (MI) reflects a strategy that is patient-oriented and highlights the significance of counselling methods, seeks to enhance a person's drive and dedication towards modifying their behaviours, and shows considerable promise in improving personal regulation and wellness results related to chronic diseases.[13,14] MI's principles of collaboration, evocation, and autonomy are well-suited for addressing complex behavioural changes in diabetes management.[15]

The FIRA (Focus, Identify, Reflect, Act) model, which integrates MI principles, offers a structured approach to health coaching that empowers patients and fosters sustainable behaviour change.[16,17] While promising in various healthcare settings,[18] its application in diabetes management remains underexplored.

This investigation sought to assess the efficacy of a health coaching intervention grounded in the FIRA model and MI techniques in improving diabetes knowledge, glycemic control, and other clinical outcomes among adults with diabetes. We hypothesised that participants receiving this intervention would show significant improvements in diabetes-related knowledge and self-management behaviours, culminating in superior clinical results when contrasted with individuals receiving conventional treatment. By investigating this intervention's impact, we aimed to contribute to the evidence supporting MI integration into diabetes care and explore its potential as a standard component of chronic disease management.

METHODS

Study design

A quasi-experimental methodology was employed, wherein participants were categorised into control and intervention cohorts. The intervention comprised health coaching sessions underpinned by motivational interviewing methodologies, emphasising strategies for diabetes management.

Population and sample

The research comprised a total of 121 individuals, including 60 participants assigned to the control group and 61 to the intervention group, currently receiving treatment at Puskesmas Bajeng in Gowa Regency, Indonesia, selected under the criteria of being no younger than 18 years, holding a confirmed diagnosis of type 2 diabetes mellitus (T2DM) for at least six months, able to communicate in Indonesian, and demonstrating a willingness to engage in the research. Patients with severe comorbidities, cognitive impairments, or who were pregnant were excluded. Sample size calculations were based on the anticipated effect size of the health coaching intervention on diabetes knowledge, measured with the Diabetes Knowledge Questionnaire (DKQ-24). Our objective was to identify substantial disparities in knowledge assessment scores among the

cohorts, with an aspiration for 80% statistical power and a significance threshold of 0.05. Drawing upon antecedent research, a standardised mean difference (Cohen's d) of roughly 0.5 was employed for the analytical computations.[19] Consequently, 60 participants were allocated to each group. Information on demographics, such as age, smoking habits, and the length of time living with diabetes, was gathered to evaluate their potential impact on changes in knowledge. There were no dropouts during the intervention, and all participants completed the six coaching sessions and follow-up assessments.

Intervention

Participants in the intervention group received health coaching based on motivational interviewing over three months, with bi-weekly face-to-face sessions. The intervention followed a Standard Operating Procedure (SOP) using the FIRA model integrated with motivational interviewing techniques.[20]

The first session focused on building rapport and understanding the patient's current condition while collaboratively setting initial diabetes management goals. In the second session, barriers and supports for achieving these goals were identified, empowering patients to recognise challenges and resources available to them. The third session allowed patients to reflect on their experiences and progress, reinforcing their motivation. In the fourth session, a detailed action plan tailored to the patient's needs was developed, emphasising realistic and achievable goals with strategies to overcome setbacks. The fifth session reviewed the action plan's implementation, encouraging discussions about experiences, obstacles, and strategies used. Feedback was provided and adjustments were made to ensure the plan remained relevant. Finally, the sixth session focused on sustaining the behavioural changes achieved, discussing long-term maintenance strategies and potential future challenges.

Although the FIRA model does not utilise a standardised scoring system, its application in this study was monitored using structured session logs completed by trained facilitators after each session. These logs ensured fidelity to the four core stages of the FIRA model and served to document the patient's engagement, goal-setting progress, and behavioural responses throughout the intervention. Supervision by the principal investigator was conducted regularly to ensure consistency across sessions.

This structured health coaching intervention aimed to provide continuous support, with each session building upon the previous one.[21] By incorporating motivational interviewing principles and the FIRA model, the intervention aimed to enhance patients' ability to manage their diabetes successfully. The overall study process, from preparation through intervention to evaluation, is illustrated in Figure 1 below to enhance clarity regarding the sequential procedures undertaken during the research.

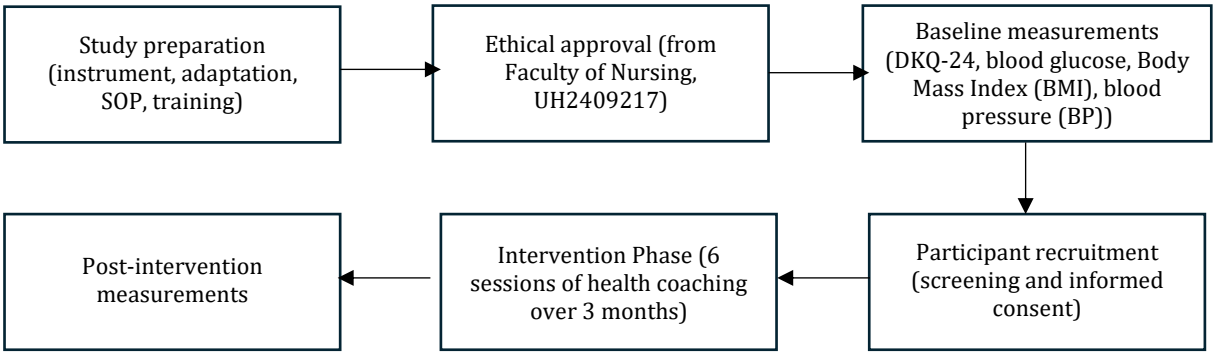

Figure 1. Study timeline depicting the six procedural steps of the health coaching intervention

Outcome measures

The principal objective of this investigation was to examine modifications in knowledge pertaining to diabetes, as measured by the DKQ-24, a well-validated tool developed to measure patients' understanding of diabetes management. The instrument used to assess respondent

knowledge was the Indonesian Version of the DKQ-24, which consists of 24 items. The instrument has a Cronbach's alpha value of 0.603 and a content validity index (CVI) of 0.81.[22] Respondents were given three answer options: yes, no, and don't know. If the respondent answered correctly, they were given a score of 1, while incorrect or "don't know" answers were scored as 0. Knowledge levels were categorised as high if the score was between 17-24, moderate between 10-16, and low between 0-9.[23,24] Secondary outcomes included fasting blood glucose levels, BMI, and both systolic and diastolic blood pressure, which were systematically recorded both prior to and following the intervention with standardised methods and calibrated equipment. All health coaching sessions based on the FIRA model, DKQ-24 assessments, and clinical measurements (blood glucose, blood pressure, BMI) were conducted by trained healthcare professionals, including certified nurses and a clinical psychologist, under the supervision of the principal investigator.

Blood glucose concentrations were evaluated utilising the Accu-Chek Active Glucometer (Roche Diagnostics, Mannheim, Germany), which delivers measurements ranging from 10 to 600 mg/dL with a precision of ±10 mg/dL for values below 100 mg/dL and ±10% for those exceeding this threshold.[25]

Blood pressure (BP) was evaluated utilising the Omron HEM-7120 Automatic Blood Pressure Monitor (Omron Healthcare, Kyoto, Japan), which employs an oscillometric technique with a precision of ±3 mmHg. Participants were positioned in a relaxed manner with their arms elevated to heart level, and measurements were conducted following a 5-minute rest interval. Two separate readings were documented, with a 2-minute gap between each, and the mean value was employed for subsequent analysis.[26]

The Body Mass Index (BMI) is computed from an individual's weight and measurements using the Seca 213 Portable Stadiometer (precision of 0.1 cm) and weight assessed via the Tanita BC-545N digital scale (precision of ±100 g), applying the formula weight (kg) / height (m^2)[27], with each measurement taken twice for accuracy and the mean value applied for final computation.

Data analysis

The dataset analysis employed both parametric and non-parametric statistical methods based on the distribution of residuals, utilising paired t-tests for variables with normally distributed residuals to assess intra-group variations in diabetes knowledge and clinical outcomes, while the Wilcoxon Signed-Rank Test was reserved for variables with non-normally distributed residuals. Group comparisons were executed through independent t-tests or the Mann-Whitney U test consistently guided by residual normality findings, with statistical significance denoted by a p-value below 0.05 and results presented as mean values with standard deviations (SD).[28]

Ethical statement

The project was validated by the ethical review board of the Faculty of Nursing at Hasanuddin University (UH2409217). All participants were informed of the study objectives, procedures, potential risks, and benefits, and provided written informed consent before participating in the study.

RESULTS

The effectiveness of the health coaching program based on motivational interviewing was evaluated using various clinical and knowledge-based outcomes, comparing the changes observed between the control and intervention groups. Table 1 describes the demographic and baseline clinical characteristics of the participants, with the statistical analysis showing no significant differences in age, diabetes duration, fasting blood glucose, BMI, or systolic blood pressure among the groups. However, notable disparities were found in hypertension status ($p=0.0361$) and pre-intervention diabetes knowledge ($p<0.0001$), with the intervention group displaying lower baseline knowledge scores.

Table 1. Baseline characteristics and clinical outcomes of participants in control and intervention groups

Parameter	Control	Intervention	p-value
Age (years, mean ± SD)	55.88 ± 9.29	55.00 ± 12.27	0.8424[1]
Duration of Diabetes (mean ± SD)	5.04 ± 3.68	6.50 ± 3.63	0.3023[1]
Hypertension (n (%))	11 (57.9%)	19 (95%)	0.0361[3*]
Family History (n (%))	10 (52.6%)	10 (50%)	1.0000[3]
Knowledge Pre (mean ± SD)	11.04 ± 2.58	14.40 ± 1.07	<0.0001[1*]
Fasting Blood Glucose Pre (mg/dL, mean ± SD)	185.38 ± 93.73	184.90 ± 77.11	0.9879[2]
Body Mass Index Pre (kg/m^2, mean ± SD)	28.70 ± 25.93	23.46 ± 0.99	0.3328[2]
Systolic Blood Pressure Pre (mmHg, mean ± SD)	117.50 ± 11.52	117.00 ± 11.60	0.9100[2]
Diastolic Blood Pressure Pre (mmHg, mean ± SD)	70.70 ± 9.25	72.30 ± 8.85	0.4500[2]

[1]Independent t-test; [2]Mann-Whitney U test; [3]Chi-square or Fisher's exact test (for categorical variables); [*]Statistically significant at α = 0.05

As illustrated in Table 2, the intervention group showed a considerable advancement in diabetes knowledge following the implementation of the health coaching program (mean change =+3.80; p<0.0001), while the control group experienced a notable decline in knowledge (mean change =-2.97; p<0.0001). This highlights the effectiveness of motivational interviewing-based health coaching in enhancing patient education.

Moreover, the intervention group revealed a statistically notable reduction in blood glucose concentrations (mean reduction =-17.00 mg/dL; p=0.015) in contrast to the control group, which exhibited a minimal, statistically non-significant elevation (mean change =+3.00 mg/dL; p=0.365). The intergroup analysis validated a statistically significant disparity in blood glucose alterations (p=0.017), thereby underscoring the intervention's potential efficacy in enhancing glycemic control among individuals diagnosed with diabetes.

In contrast, alterations in BMI were negligible and did not attain statistical significance within either cohort (p>0.05). The intervention group exhibited a tendency towards a more substantial reduction in BMI in comparison to the control group, as evidenced by an intergroup comparison p-value of 0.086. In the evaluation of blood pressure, no substantial changes were detected in systolic readings among the groups (p>0.05), whereas the intervention group exhibited a modest decline in diastolic pressure (mean decrease =-0.73 mmHg; p=0.432), in contrast to a significant increase in the control group (mean change =+5.79 mmHg; p=0.001), suggesting that although the difference in diastolic variations between groups was not statistically significant (p=0.226), the intervention might contribute to the stabilisation or reduction of blood pressure in diabetic patients.

Overall, these findings, as shown in Table 2 and illustrated in Figure 2, highlight the success of the health coaching program in enhancing critical diabetes-related outcomes, particularly diabetes knowledge and blood glucose levels. Although the intervention's influence on BMI and blood pressure was not statistically significant, it suggests potential advantages that merit additional exploration.

Table 2. Baseline and three-month follow-up data for each parameter in the control and intervention groups

Parameters	Time Point	Control Group (Mean ± SD)	Intervention Group (Mean ± SD)	p-value (between groups at 3 months)
Diabetes knowledge score	Baseline	11.04 ± 2.58	14.40 ± 1.07	<0.0001*
	3 months	8.07 ± 2.40	18.20 ± 1.22	<0.0001*
Fasting blood glucose (mg/dL)	Baseline	185.38 ± 93.73	184.90 ± 77.11	0.988
	3 months	188.38 ± 95.11	167.90 ± 72.30	0.017*
BMI (kg/m^2)	Baseline	28.70 ± 25.93	23.46 ± 0.99	0.333
	3 months	28.61 ± 26.00	22.90 ± 0.95	0.086
Systolic BP (mmHg)	Baseline	117.50 ± 11.52	117.00 ± 11.60	0.910
	3 months	117.40 ± 11.30	116.80 ± 11.00	0.872
Diastolic BP (mmHg)	Baseline	70.70 ± 9.25	72.30 ± 8.85	0.450
	3 months	76.49 ± 8.90	71.57 ± 8.81	0.226

* p-value<0.05

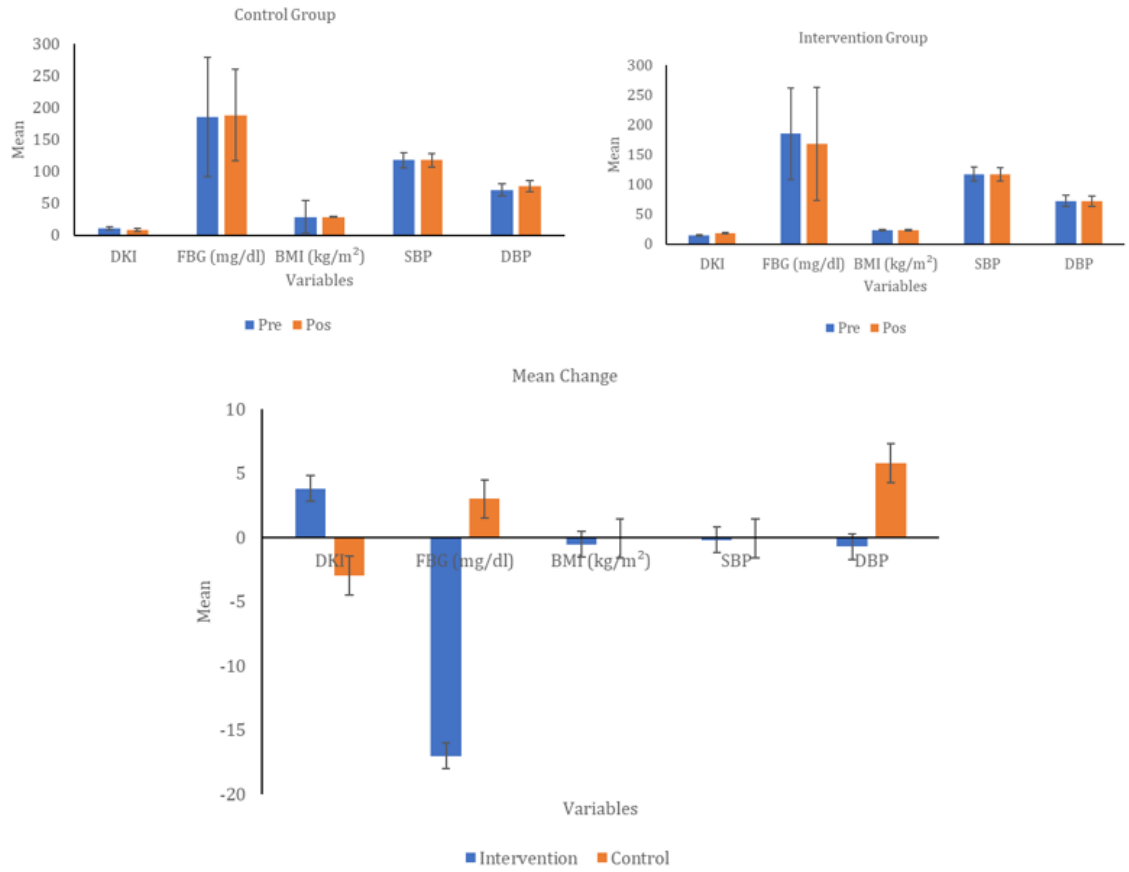

Figure 2. Comparative analysis of pre- and post-intervention outcomes for diabetes knowledge, blood glucose, BMI, and BP in control and intervention Groups

DISCUSSION

This research assessed the efficacy of a health coaching intervention grounded in motivational interviewing techniques on diabetes-related knowledge, glycemic control, BMI, and BP among adult individuals diagnosed with diabetes. The results indicate significant improvements in diabetes knowledge and reductions in blood glucose levels, along with trends toward improvements in BMI and BP.

The intervention group's increased diabetes knowledge highlights the efficacy of motivational interviewing as a patient education strategy. This finding aligns with previous studies demonstrating personalised health coaching's role in enhancing disease-specific knowledge and self-management among chronic condition patients.[27,28] The structured FIRA model, combined with motivational interviewing principles, effectively engages patients, addresses their needs, and empowers them in diabetes management.

The decline of diabetes knowledge in the control group highlights the necessity for ongoing education and support for chronic disease patients. Without continuous engagement, patients may lose the knowledge needed for effective management, potentially leading to poorer health outcomes.[30,31] This study supports the need for regular, structured educational interventions to maintain and enhance patient knowledge.

The intervention group's reduction in blood glucose levels demonstrates the potential of motivational interviewing-based health coaching to impact critical clinical outcomes. The findings align with scholarly literature suggesting that interventions aimed at enhancing patient empowerment and facilitating behavioural modifications can lead to improved glycemic regulation.[32,33] A 17.00 mg/dL reduction in blood glucose is clinically significant, as modest reductions can decrease diabetes-related complication risks. In juxtaposition, the control group

exhibited a marginal, statistically insignificant elevation in blood glucose levels, thereby eliciting apprehensions regarding the adequacy of standard care in the absence of supplementary support. Although no statistically significant alterations in BMI were observed, a discernible trend indicated more pronounced reductions within the intervention group. This suggests that motivational interviewing-based health coaching may contribute to weight management, though observed changes were modest. A longer intervention or additional focus on diet and physical activity may yield more significant results. These findings are consistent with studies reporting mixed results on educational interventions' impacts on BMI, indicating weight management's complexity in chronic conditions.[34]

No notable changes were noted in systolic BP; however, a considerable reduction in diastolic BP was evident within the intervention group. This suggests that while the intervention might have limited impact on systolic pressure, it shows promise in effectively lowering diastolic pressure. Considering the association between elevated diastolic pressure and heightened cardiovascular risk, this result holds significant clinical relevance.

The merits of this investigation encompass the quasi-experimental framework and the application of a comprehensive, theoretically-grounded intervention model. The validated instruments used for measuring outcomes enhance the reliability of the findings. The study's focus on motivational interviewing and the FIRA model offers a structured framework replicable in other settings. However, limitations exist. The quasi-experimental design limits the ability to establish causality, and the short intervention duration may have contributed to the modest changes observed in BMI and blood pressure. Moreover, this study did not control for several potential confounding variables that may influence these secondary outcomes, such as changes in dietary intake, physical activity levels, medication adherence, and psychosocial stress. These factors may have contributed to outcome variability and should be considered in future studies with extended follow-up periods.

The findings suggest that incorporating motivational interviewing into health coaching could enhance patient education and lead to meaningful glycemic control improvements. Health professionals should adopt these techniques as part of standard care, particularly in settings requiring ongoing patient engagement. Future investigations ought to examine the enduring consequences of motivational interviewing-oriented interventions and their influence on various clinical outcomes, including quality of life and diabetes-associated complications. Moreover, it is imperative to assess the efficacy of such interventions across diverse populations and contexts, taking into account differing levels of health literacy and accessibility to healthcare services.

CONCLUSION

This investigation elucidates the effectiveness of health coaching grounded in motivational interviewing techniques in augmenting diabetes-related knowledge and enhancing glycemic regulation among individuals diagnosed with diabetes. Although additional inquiry is warranted to thoroughly assess the comprehensive potential of this methodology, the results presented herein furnish compelling evidence to advocate for its incorporation into standard diabetes management practices. By empowering patients and bolstering their self-regulatory abilities, such interventions may assume a pivotal role in alleviating the diabetes burden and advancing patient health outcomes.

CONFLICT OF INTEREST

This manuscript is devoid of any conflicts of interest.

ACKNOWLEDGMENTS

We express our gratitude to the Research and Community Service Institute of Universitas Hasanuddin (LPPM Unhas) for supporting and funding this study under Grant Number 00311/UN4.22/PM.01.01/2024. We also thank the staff and community health workers at the Puskesmas for their assistance. This study would not have been possible without their contributions and dedication. The authors also acknowledge the developers of the Indonesian

Version of the Diabetes Knowledge Questionnaire 24 (DKQ-24), which was used as the instrument to assess respondents' knowledge in this study.

DATA AVALABILITY

The data obtained and analysed in this study are available upon reasonable request from the corresponding author. To protect privacy and adhere to ethical considerations, individual participant data will not be publicly shared. However, aggregated data and summary statistics supporting the study's findings can be provided for research purposes upon request.

SUPPLEMENTAL DATA

In this study, we provide supplementary data that supports the findings presented in this article. The supplementary materials include various tables and figures that offer a more in-depth analysis of participant characteristics and study outcomes. Table S1 presents comprehensive demographic details of the participants, including age, diabetes duration, and hypertension status. Figure S1 depicts a flowchart outlining the recruitment and retention process of study participants.

AUTHOR CONTRIBUTIONS

NJ conceived the study, developed the study design, led the intervention, and contributed to data analysis and manuscript writing. AS was instrumental in shaping the research methodology, overseeing participant recruitment and data gathering, as well as aiding in the analysis of results and manuscript revision. SM played a key role in implementing the intervention, managing data collection, and assisting with data analysis. GS delivered important perspectives on motivational interviewing methodologies, which were instrumental in the construction of the intervention framework, and comprehensively analysed the manuscript to improve its academic quality. All contributing authors have meticulously examined and endorsed the final manuscript, thereby confirming its precision and integrity.

DECLARATION OF USING AI IN THE WRITING PROCESS

We declare that AI tools were utilised in the preparation of this manuscript to enhance the writing process. The use of AI was undertaken for several purposes, including: Language and Grammar Enhancement. AI tools were employed to improve the clarity and readability of the text, ensuring that information is conveyed effectively. Data Organisation: AI assisted in structuring the manuscript and ensuring consistency in formatting throughout the document. Literature Review Assistance: AI was consulted to generate summaries of relevant literature and to help identify key references that support this research.

We affirm that the final manuscript has been critically reviewed by all authors and adheres to the standards of academic integrity and originality expected in scientific publication.

LIST OF ABBREVIATIONS

BMI: Body Mass Index; BP: Blood Pressure, DKQ-24: Diabetes Knowledge Questionnaire, 24 items; DM: Diabetes Mellitus; FIRA: Focus, Identify, Reflect, Act model; MI: Motivational Interviewing; SD: Standard Deviation; SOP: Standard Operating Procedure.

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