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Effect of Motivational Interviewing on Glycemic Control, Diabetes Distress and Self-efficacy among Patients with Type 2 Diabetes in Ethiopia: A Quasi-Experimental Study

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Abstract

Aim: to assess the effects of Motivational interviewing (MI) on HbA1C, diabetes distress and self-efficacy among patients with Type 2 diabetes(T2D) in Tigray in 2023/2024. Methods: The study employed a quasi-experimental design among 160 adult patients with type 2 diabetes. Glycemic control was assessed using HbA1c test, while data on self-efficacy and diabetes distress were collected using validated and standardized Problem Area in Diabetes (PAID and Diabetes Self-efficacy (DSE) scales. Data analyses were performed using none parametric tests and Difference in Difference (DID) analysis method. Statistical significance was set at p-value of <0.05. Result: A Wilcoxon signed-rank test revealed that the HbA1C level, diabetes distress and self-efficacy scores were reduced and increased significantly in the intervention group compared to the control group [8.0 (6, 15) vs 8.0 (5, 12); P < 0.001], [9.0 (4, 20) vs 5.5 (0, 17); P = 0.008], and [25.0 (16, 29) to 28.0 (16, 31); P < 0.001], respectively. The Difference in Difference (DID) analysis also revealed that Motivational interviewing significantly decreased HbA1c level with-1.5 (P= 0.01), decreased diabetes distress and increased self-efficacy with -3.32 (P < 0.001) and 3.41 (P= 0.008),), respectively, for the intervention group compared to the control group. Conclusion: This study demonstrated that compared to routine diabetes education, Motivational interviewing intervention significantly reduced HbA1C, diabetes distress and improved self-efficacy.

Key words: Type 2 Diabetes, Diabetes Distress, self-efficacy, glycemic control, motivational interviewing

1. Introduction

Effective self-management is crucial for diabetes care practices such as diet, exercise, blood glucose monitoring, medicine adherence and foot care (Murray, 2024). Combined self-care practices improve glycemic control, prevent complications, and enhance life expectancy(Ahmad & Joshi, 2023). However, adherence to these practices is often poor. For example in Ethiopia, only 15.1% of patients effectively monitored their blood sugar, and over 60% had inadequate glycemic control (Dedefo et al., 2019). Another study showed 45.5% of patients scored below average on diabetes self-care activities (SDSCA) (Gurmu et al., 2018). Poor adherence may stem

from a lack technical skills, insufficient motivation, and limited access to necessary resources particularly among older adults with chronic conditions(Clark et al., 2008).

Self-efficacy plays a critical role in various health behaviors, including smoking cessation, weight management, nutrition, alcohol consumption, and AIDS prevention (Maibach & Murphy, 1995). Similarly it is a key factor influencing the effectiveness of diabetes control (Sarkar et al., 2006). Moreover, it is essential for adhering to self-management recommendations and maintaining psychosocial wellbeing (Steed et al., 2003; Sherifali et al., 2015). The concept of self-efficacy is widely used to study self-management in individuals with diabetes(Sarkar et al., 2006; Hurley & Shea, 1992). Research highlights self-efficacy is a strong predictor of well-being in type 2 diabetes patients(Calli & Kartal, 2021).

Patient education programs have gathered significant attention for their impact on diabetic self-management. Numerous studies demonstrated the effectiveness of behavioral and educational interventions in improving glycemic control. However, their long-term effects and efficacy on other outcomes such (Norris et al., 2001; Gary et al., 2003; Ismail et al., 2004; Shojania et al., 2006; Minet et al., 2010; Ricci-Cabello et al., 2014; Haider et al., 2019; Carpenter et al., 2019; Berhe et al., 2020; Lestari et al., 2021) self-efficacy, blood pressure, lipid profile, body weight, self-management skills, health behavior, and psychosocial factors (Deakin et al., 2005; Duke et al., 2009; Loveman et al., 2010; Ricci-Cabello et al., 2014; Carpenter et al., 2019) remains inconclusive because of in some studies it shows a significant effect but in other studies do not show effect on the outcome variables(Norris et al., 2001; Gary et al., 2003; Ismail et al., 2004; Shojania et al., 2006; Minet et al., 2010; Ricci-Cabello et al., 2014; Haider et al., 2019; Carpenter et al., 2019; Berhe et al., 2020; Lestari et al., 2021).

Motivation Interviewing (MI) has been delivered through various methods, including one-on-one sessions, group sessions, and integration into daily clinical practice. However, one study found no significant differences between individual and group delivery methods (EPHI, 2018). Another study showed that MI based education program significantly improved patients' perceived competence in managing diabetes compared to a control group (WHO, 2024).
A systematic review and meta-analysis study showed that MI significantly improves various patient outcomes including total cholesterol, fasting blood glucose, body mass index, blood pressure, waist circumference and physical activity (Thepwongsa et al., 2017). Review of literature showed that most studies were focus on intermediate outcome (EPHI, 2016) with limited evaluation of MI's effects on diabetes self-efficacy and distress. Despite this, MI adaptability across diverse cultures and clinical settings makes it valuable tool for healthcare providers (Defar et al., 2024).

Improving patient care requires investment in research to provide evidence for policymakers to develop strategies that enable health care providers to effectively diagnose and manage diabetes in Sub-Saharan African setting (van Crevel et al., 2017). In Ethiopia including Tigray region, most studies focus on glycemic control, dyslipidemia, self-care practices and diabetes prevalence (Padma et al., 2012; Mukeshimana et al., 2015; Ishak et al., 2017; Mariye et al., 2018; Bonger et al., 2018) with limited exploration of MI effect on patients outcomes. Despite its growing international use across healthcare domain, MI's effectiveness among Ethiopian diabetic patients remains uncertain and under-researched. This study aimed to evaluate the effect of MI on diabetes management self-efficacy, glycemic control and diabetes distress among type 2 diabetic patients in the Tigray region, Ethiopia to generate local data and encourage further research on MI.

2. Methods and Materials

Study design: A quasi-experimental design was used to conduct the study. The reasons why we use it were its ability to estimate intervention effects in natural settings, where randomized controlled trials (RCTs) are not feasible. Moreover, it is also used when random assignment is unethical, impractical, or impossible especially in real-world settings like education, health, and policy research. Furthermore, this study design can increase external validity of the study (Miller et al., 2020; de Vocht et al., 2021; Singh & Singh, 2021; Waddington et al., 2022; Jelena & Jelena, 2022). TREND reporting guideline for quasi-experimental studies was used to write the report (Haynes et al., 2021).

Study period and setting: the study was conducted at Ayder Comprehensive Specialized hospital (ACSH) diabetes clinic and Mekelle general hospital (MG) chronic care unit in Mekelle city of Tigray, Ethiopia, between November 2023 and August 2024. Pre-intervention assessment was conducted from Nov. to Dec. 2023; MI intervention was carried out from Jan to June. 2024, and post-intervention assessment was conducted from July to Aug 2024. The intervention group was selected from Ayder Hospital, while the control group was from Mekelle Hospital. Generally, ACS Hospital and MG Hospital are quite different, as they are tertiary and general hospitals, respectively. However, the diabetes care setup, staffing, and services in both hospitals are similar.

Recruitment and participants: Participants were recruited in person using systematic random sampling by researcher. Patients with type 2 diabetes aged >18 years and had follow-up for at least three months were included in the study but patients with pregnancy, cognitive immurement and sever comorbidity such as advanced stage of cancer were excluded from the study.

Sample size: The sample size was calculated using a power analysis method with medium effect size (d - Cohen's) d = 0.50 for HbA1c was used based on Burke et al. (2003) recommendation of behavioral change for lifestyle modification using MI guided counseling (Burke et al., 2003). The calculation was performed using G*Power software version 3.1.9.4 (Faul et al., 2007) indicated that 128 participants (64 per group) were needed for statistical analysis. Considering an average attrition rate of 26% in MI studies (Burke et al., 2003), the sample size was increased to 160 (80 per group) to account for potential dropouts.

Assignment: The participants were divided into two equal groups: the intervention group (MI group) and the control group (non-MI group) and the study hospitals were assigned as intervention or control site randomly.
Blinding: To diminish demand characteristics and similar biases participants and those assessing the outcomes were not informed of the study objective and participants assignment.

Measures: demographic data such as age, gender, marital status, occupational status, education level, duration of diabetes, treatment regimen and family arrangement were collected using interviewer administered questionnaire. In addition, data related to self-efficacy and diabetes distress were collected using validated and standardized scales. Moreover, lab tests were done to measure fasting blood glucose (FBG) and HbA1c. Blood pressure (BP), weight and height measurements also done.

Target values were FBG <7 mmol/l, HgbA1C <7%, BP <140/80 mmHg (previously BP <130/80 mmHg)and BMI ≤25 kg/m² (American Diabetes Association, 2013).
The primary outcome measure was HbA1c level, while secondary outcomes were self-efficacy and diabetes distress, assessed using validated and standardized scales. Diabetes distress was measured with the Problem Areas in Diabetes Scale (PAID-20). The PAID-20 consists of five items, each rated on a five-point Likert scale, yielding a total score ranging from 0 to 100. A score ≥ 40 indicates possible diabetes-related emotional distress. Berhe et al identified that Cronbach's α for PAID scale approximates 0.82 implying high levels of internal consistency. Furthermore, as evidence of validity, research indicates that PAID scale, as measured by this scale, strongly predicts diabetes distress (Berhe, 2025) (Polonsky et al., 1995; McGuire et al., 2010).

The confidence in managing diabetes treatment regime was assessed by revised version of Diabetes Management Self-Efficacy Scale (DMSES). This instrument consisted of 15 items across five domains: healthy diet (7 items), physical activity (2 items), blood glucose self-monitoring (3 items), medication (2 items), and foot care (1 item). It uses a 10-point Likert scale, often with options ranging from "not at all confident" to "totally confident" with higher scores indicating greater self-efficacy. Similarly A study by Eun-Hyun Lee et al showed that Cronbach's α for DMSE scale was above 0.80 indicates high reliability. Moreover, evidence of validity revealed that DMSE scale can strongly measures self-efficacy of diabetes self-management (Messina et al., 2018). Baseline and post-intervention data were collected for demographics, clinical measures, Hgb.A1c, diabetes-related distress, and diabetes management self-efficacy.

Intervention: Participants in the intervention group from Ayder Comprehensive Specialized Hospital (ACSH) participated in small group (2-5 participants per session) educational sessions guided by motivational interviewing (MI) principles and sessions. These sessions were held monthly over six months, with each lasting

15-30 minutes. Moreover, participants of this group also received usual care at every visit (every 2 months) and provided by doctors (GPs and/or diabetes care specialists), nurses, other healthcare assistants, or a combination of health care providers (GPs, internist, nurses or other healthcare assistants). The MI guided educational content covered six key topics: understanding diabetes, diabetes complications, healthy diet, self-blood glucose monitoring, physical exercise, and foot care. Each session began with an introduction to relevant background information, followed by discussions that addressed individual barriers and strategies for overcoming them. To increase compliance or adherence to intervention, whether or not participants attended was recorded using attendance sheet each session. Moreover, Participants also received a phone call reminder before each session.

Interventionist (MI counselor): The intervention was delivered by the principal investigator (KK), The training focused on assessing ambivalence, eliciting self-motivational statements, addressing barriers, solving problems, and exploring discrepancies between patients' current self-efficacy and ideal diabetes management.[48] MI techniques and principles were utilized to enhance participants' motivation and resolve ambivalence toward adopting healthy behaviors.

The first session was conducted immediately after baseline data collection (T0), with subsequent sessions held at four-week intervals. Discussions emphasize the benefits of positive change and the consequences of maintaining current behaviors and one main topic was discussed in each session. The discussion was supported by MI-guided educational materials, visual aids, and a fact sheet which was prepared based on literature review. a standardized procedure and the discussions were flexibly adapted during the course of each session

Control group: Participants in the control group from Mekelle Hospital received usual care, including routine diabetes education. The usual care was provided to all participants at every visit (every 2 months). This care was provided by doctors (GPs and/or diabetes care specialists), nurses, other healthcare assistants, or a combination of health care providers (GPs, internist, nurses or other healthcare assistants). This education covered healthy diet, physical exercise, medication adherence, foot care, and self-monitoring of blood glucose. The education sessions were held monthly over six months lasted 15-30 minutes. Unlike the intervention group, the control group's diabetes education did not incorporate principles and strategies of MI.

Lost to follow up: to minimize loss to follow-up (LTFU), participants received a reminder call from the counselor one to three days prior to their next scheduled appointment. If a participant missed their scheduled appointment, the counselor would contact the participant by telephone to reschedule the appointment at their earliest convenience.

Information Contamination: to reduce the risk of information spillover between groups, participants were selected from two separate hospitals. Moreover, participants were selected from scattered residential areas or sub districts ("Tabias"). This ensured that the participants from the intervention and control groups attended their respective hospitals separately and minimized public gatherings as much as possible.

Usual Care: The usual diabetes care was separate from the intervention. All participants, regardless of group assignment, received similar routine follow-up care at their outpatient clinic. This included laboratory tests such as FBS, lipid profile, urinalysis, etc. In addition, BP and weight measurements were conducted, and participants attended regular medical consultations with their physician. Individualized counseling and recommendations were provided based on examination results and biochemical test findings. Participants with chronic complications were referred to or linked with specialty clinics for further diagnosis and management.

Data collection: Baseline measures were collected during the participant recruitment and enrollment phase of the study. Six months post-intervention, outcome measures were assessed for participants in both groups. Two nurses with clinical backgrounds served as research assistants and were involved in recruitment, baseline data collection, and outcomes assessments. They also conducted both baseline and post-intervention data collections. To ensure data quality, the research proposal was followed precisely.

Data quality assurance: To ensure data quality, the principal investigator and supervisors provided one day training for the data collectors about the purpose of the study, how to recruit participants and data collection tools. Before this study, a pre-test was conducted on 20% of the sample size (32 participants) in non-selected

areas two weeks before the actual data collection period which tested the acceptability and feasibility of the study protocol and data collection tools. Moreover, the questionnaire was pre-tested on 5% of the sample size in non-selected areas two weeks before the actual data collection period. Necessary amendments were made to the questionnaire and contextualize the standardized outcome measure scales. During the data collection period, the principal investigator and supervisors reviewed and checked the collected data daily for completeness and consistency on-site.

Data analysis: All data analyses were performed using SPSS version 20.0. Categorical variables were analyzed using Pearson's chi-square test, and results were expressed as frequencies and percentages. The HbA1C, Diabetes Distress and self-efficacy of diabetes self-management of each participant was included in the analyses. Shapiro-Wilk's and normality tests were applied to assess the data distribution. continuous data were analyzed using non-parametric tests, specifically Mann-Whitney U and Wilcoxon signed-rank tests, due to their non-normal distribution. The Mann-Whitney U test was used to identify differences between groups, while the Wilcoxon signed-rank test was used to examine within-group differences.

In addition, a difference-in-differences (DID) regression analysis on HgbA1C level, diabetes distress, and self-efficacy before and after the implementation of the MI intervention was done to assess its effectiveness (average treatment effect). DID is an effective method for estimating causal effects when individual-level randomization is not feasible. DID is a quasi-experimental design that utilizes longitudinal data from treatment and control groups to generate a suitable counterfactual to estimate a causal effect.[49] By leveraging the inherent variations in intervention exposure over time, DID provides a potent method for assessing intervention effectiveness. All assumptions except parallel trend were fulfilled. Parallel trends assumption between groups could not be tested due to lack of multiple pre-intervention time points. The analysis was done using Stata version 17 for windows and A p-value of <0.05 was considered as statistically significant. Results were reported as medians (min, max), U value, Z-scores, and effect sizes (r) in nonparametric tests and estimated treatment effect (coefficient) and standard error in difference in deference analysis with statistical significance set at a 95% CI and a p-value of <0.05.

Ethical consideration: Ethical clearance was obtained from the Mekelle University-College of Health Science Institution Review Board (IRB) (MU-IRB 2044/2023). In addition, a support letter from the Tigray regional Health Bureau and permission from medical directors of the hospitals were secured. The study was conducted in accordance with the Declaration of Helsinki. Participants were recruited voluntarily after being fully informed about the study and providing written consent. They were also informed of their rights to withdraw from the study at any time. All data were kept anonymously and stored in a pseudonymized way to maintain confidentiality, and beneficence was ensured throughout the study. Only the researchers had access to the data.

3. Results

Recruitment: The study included 160 adult people diagnosed with type 2 diabetes, selected from two public hospitals and divided into two groups: an intervention group (n=80) and a control group (n=80). The retention rates were 96.2% (n=77) for the intervention group and 97.5% (n=78) for the control group (Figure1).

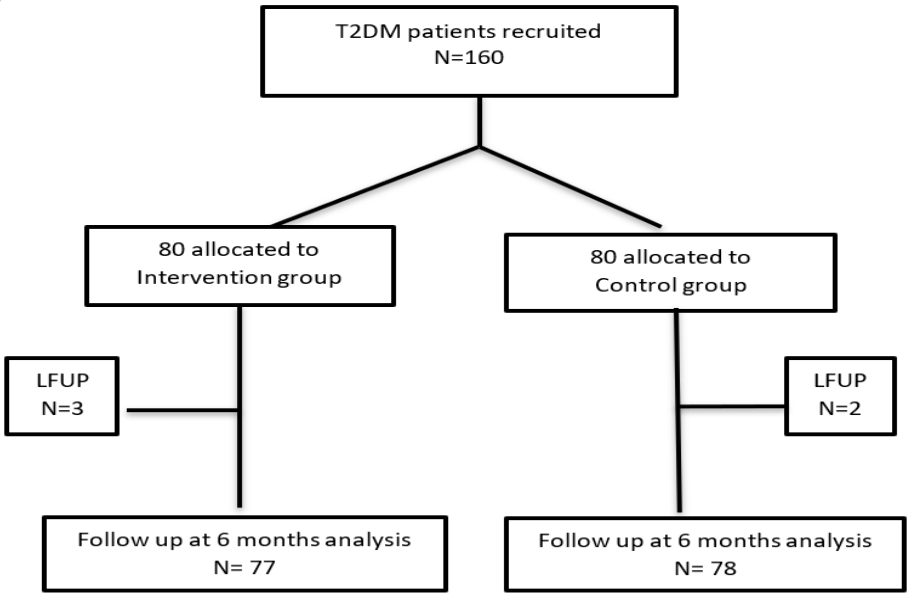

Fig.1 Flow diagram on recruitment and participation in this study (n = 160)

Sample Description

Demographic characteristics: There were no significant differences between the two groups in baseline characteristics except for marital status, diabetes treatment regimen, and FBS levels. At baseline, 80% of participants were aged 51-70 years, with similar distributions across groups. Regarding marital status, the control group had more single participants (13.8% vs. 1.2%), while the intervention group had more widowed participants (15.0% vs. 2.4%, P < 0.001). The percentage of illiterate participants was slightly higher in the control group (20.0% vs. 16.3%). Furthermore, more participants in the intervention group were unemployed (31.3% vs. 28.8%), and the majority of participants lived with their families (91.2% vs. 83%). (Table 1).

Table 1: Demographic characteristics of participants, Ethiopia 2023/24 (n=160)

Variable	Category	Control (n=80)	Intervention (n=80)	Total (n=160)	Statistical comparison
Age in year (n, %)	1.30-40	3(3.8)	4(5.0)	7(4.4)	X2 =0.894 df=3, P=0.827
	2.41-50	13(16.2)	13(16.3)	26(16.2)	
	3.51-60	39(48.8)	43(53.7)	82(51.2)	
	4.61-70	25(31.2)	20(25.0	45(28.2)	
Sex (n, %)	1 Male	40(50.0)	42(52.5)	82(51.3)	X^2 =0.100 df=1,P=0.752
	2 Female	40(50.0)	38(47.5)	78(48.7)	
Marital Status (n, %)	1.Single	11(13.8)	1(1.2)	12(7.5)	X^2 =18.268 df=3 P<0.001
	2.Married.	66(82.4)	62(77.6)	128(80.0)	
	3.Divorced	1(1.2)	5(6.2)	6(3.8)	
	4.Widowed	2(2.4)	12(15.0)	14(8.8)	
Education Level (n, %)	1. Illiterate	16(20.0)	14(17.6)	30(18.8)	X^2 =5.621 df=3 P=0.132
	2. Primary school	26(32.4)	18(22.4)	44(27.5)	
	3. Secondary school	17(21.2)	13(16.2)	30(18.8)	
	4.College/University	21(26.2)	35(43.8)	56(35.0)	
Occupation (n, %)	1. Gov't employee	28(35.0)	24(30.0)	52(32.5)	X^2 =0.780 df=3
	2. Private work	11(13.8)	14(17.5)	25(15.6)	

	3. Retired	18(22.4)	17(21.2)	35(21.9)	P=0.854
	4. Unemployed	23(28.8)	25(31.3)	48(30.0)	
Living arrangements (n, %)	1. Living with family	67(83.8)	73(91.2)	140(87.5)	X2 =2.057 df=1, P=0.151
	2. Living alone	13(16.2)	7(8.8)	20(12.5)	

Clinical characteristics: At baseline, a higher proportion of participants in the intervention group were treated with both insulin and oral hypoglycemic agents (26.3% vs 1.3%, P<0.01). Similarly, the intervention group had slightly higher median values for BMI (23.6 vs 22.8), diabetes duration (10.0 vs 8.0 years), FBS (160.0 mg/dL vs 136.0 mg/dL), and systolic blood pressure (SBP) (128.5 mmHg vs 120.0 mmHg) compared to the control group. However, the median diastolic blood pressure (DBP) was slightly lower in the intervention group (77.5 mmHg vs. 80.0 mmHg) compared to the control group. (Table2).

Table 2: Participant clinical characteristics (pre-intervention), Ethiopia 2023/24 (n=160)

Variable	**Category**	**Control (n=80)**	**Intervention (n=80)**		**Total (n=160)**	**Statistical comparison**
Diabetes treatment regimen	1.Insulin only	20(25.0)	18(22.4)		38(23.8)	X2 =21.527
	2.Insulin & OHA*	1(1.3)	21(26.3)		22(13.8)	df=2
	3.OHA*	59(73.8)	41(51.3)		100(62.4)	P<0.01
Domain	**Control**	**Intervention**	**Mann-Whitney Test**		**Effect size (r)**	**p-value**
	median (min, max)	**median (min, max)**	**U-test**	**Z**		
BMI* ((kg/m 2)	22.8(15,29)	23.6(14,35)	2692.5	-1.732	0.137	0.083
Duration of diabetes (years)	8.0(1,32)	10-.0(1,30)	2914.5	-0.980	0.077	0.327
FBG* (mg/gl)	136.0(75,434)	160.0(74,392)	2364.0	-2.854	0.225	0.004
SBP* (mmHg)	120.0(106,217)	128.5(82,214)	2897.0	-1.062	0.083	0.288
DBP* (mmHg)	80.0(66,104)	77.5(57,120)	2689.5	-1.830	0.144	0.067

*OHA: Oral Hypoglycemic Agent, SBP: Systolic blood Pressure, DBP: Diastolic blood pressure, FBG: Fasting Blood glucose, SD=standard deviation. HbA1c, glycated hemoglobin; BMI: Body Mass Index, Md: Median

Primary and secondary outcome measures

Serum HbA1C level: A Wilcoxon signed-rank test revealed that HgbA1C level was significantly reduced in the treatment group after the intervention [Md: Median=8.0 (6, 15)] compared to baseline [Md=8.0 (5, 12); Z=-4.099, P<0.001, with a medium effect size, r=0.32]. However, in the control group the HbA1C level was significantly increased at the end line [Md=7.0 (5, 12)] compared to baseline [Md=9.0 (6, 14); Z=-4.995, P<0.001, with a medium effect size, r=0.39]. (Table 3). A Mann-Whitney U test indicated there was a statistically significant difference found between the two groups at baseline (U=2557, Z=-2.216, P=0.027) and end line (U=2244, Z=-3.328, P=0.001), with a small effect size (r=0.17) and (r=0.26), respectively. (Table 4).

Table 3: Within Group Comparison of HgbA1C, Diabetes Distress and self-efficacy Scale scores before and after the intervention, Ethiopia 2023/24 (n=160)

Domain	Time	Control				Intervention			
		median (min, max)	Wilcoxon signed-rank test			median (min, max)	Wilcoxon signed-rank test		
			Z	Effect size(r)	P-Value		Z	Effect size(r)	P-Value
HgbA1C	Baseline	7.0(5,12)	-4.995	0.394	< 0.001	8.0(6,15)	-4.089	0.323	<0.001
	Follow-up	9.0(6,14)				8.0(5,12)			
Diabetes distress	Baseline	7.0(5,19)	-0.074	0.006	0.941	9.0(4,20)	-4.900	0.387	<0.001
	Follow-up	7.0(5,15)				5.5(0,17)			
DMSE*	Baseline	25.0(21,35)	-0.279	0.022	0.780	25.0(16,29)	-5.400	0.426	<0.001
	Follow-up	25.0(21,36)				28.0(16,31)			

*DMSE: Diabetes management Self-efficacy

Diabetes distress: A Wilcoxon signed-rank test revealed that a statistically significant decrease was observed in PAID scores in the intervention group, decreasing from [Md=9.0 (4, 20) to Md=5.5 (0, 17); Z = -4.900, P < 0.001)] after follow-up, with a medium effect size (r = 0.38). In contrast, there was no change in the control group, as PAID scores remained consistent at [Md=7.0 (5, 19) compared to 7.0 (5, 15)] (Table 3). This suggests that the intervention was effective in reducing diabetes-related distress. A Mann-Whitney U test indicated that there was a significant difference in baseline and end-line HbA1c levels between the two groups (U=2604, P=0.041, r=0.16) and (U=2422, P=0.008, r=0.21), respectively, with a small effect size (Table 4).

Self-efficacy for diabetes management: A Wilcoxon signed-rank test showed that the median perceived self-efficacy score in the intervention group increased significantly from [Md=25.0(16,29) at baseline to Md=28.0(16,31) after intervention (MI); Z =-5.400, P<0.01)], with medium effect size (r=0.42). In contrast, the median score in the control group remained unchanged from baseline to the end of the intervention [Md=25.0(21, 35) Vs Md=25.0(21,36) (Z =-0.279, P=0.780)]. This indicates that participants in the intervention group demonstrated better diabetes management self-efficacy than those in the control group (Table 3). At six months' follow-up a Mann-Whitney U test revealed that no difference in baseline HbA1c levels was observed between the two groups (U=2768, P=0.138). However, a statistically significant difference was found between the intervention and control groups at follow-up (U=1589, P<0.001), with a medium effect size (r= 0.43). (Table 4)

Table 4: Between Group Comparison of HgbA1C, diabetes distress, Self-efficacy Scale scores before and after the intervention, Ethiopia 2023/2024 (n=160)

Domain	Time	Control	Intervention	Mann-Whitney U test			
		median (min, max)	median (min, max)	U	Z	Effect size (r)	P-Value
HgbA1C	Baseline	7.0(5,12)	8.0(6,15)	2557	-2.216	-0.17	0.027
	Follow-up	9.0(6,14)	8.0(5,12)	2244	-3.328	-0.26	0.001
Diabetes distress	Baseline	7.0(5,19)	9.0(4,20)	2604	-2.048	-0.16	0.041
	Follow-up	7.0(5,15)	5.5(0,17)	2422	-2.666	-0.21	0.008
DMSE*	Baseline	25.0(21,35)	25.0(16,29)	2768	-1.484	-0.11	0.138
	Follow-up	25.0(21,36)	28.0(16,31)	1589	-5.527	-0.43	0.000

*DMSE: Diabetes management Self-efficacy

Difference in Difference (DID) analysis: The average effects of the MI intervention on HbA1C levels, diabetes distress, and Self-efficacy for diabetes management were also assessed using the DID regression analysis model. The analysis results showed that MI intervention significantly decreased HbA1c level, with a coefficient of -1.51 (standard error 0.012, p-value = 0.005). This indicates that the intervention led to a 1.5 % reduction in the HbA1C level in the intervention group compared to the control group. Similarly, the DID analysis showed a statistically significant negative treatment effect on diabetes distress, with a coefficient of -3.32 (standard

error 0.001, p-value < 0.01). This suggests that the intervention significantly reduced the PAID score by 3.41 units compared to the control group. Moreover, the DID analysis revealed a statistically significant positive treatment effect on diabetes management self-efficacy, with a coefficient of 3.41 (standard error: 0.044, p-value: 0.008). This shows that the intervention group experienced a 3.41-unit increase in diabetes management self-efficacy scores compared to the control group following the intervention. (Table 5).

Table 5: DID regression analysis for the HgbA1C level, Diabetes distress and diabetes management Self-efficacy among people diagnosed with type 2 diabetes, Ethiopia 2023/24 (n = 160)

ATET (Intervention vs. Control)	Coefficient	Robust Std. err	t	P-value	95 % CI
HgbA1C	-1.51	0.012	-116.39	0.005*	(-1.67, -1.34)
Diabetes Distress	-3.32	0.001	-3215.54	0.000*	(-3.33, -3.30)
Diabetes care Self-efficacy	3.41	0.044	76.99	0.008*	(2.85, 3.98)

Note ATET estimate adjusted for covariates (Age, Gender, Marital status. Diabetes treatment regimen, diabetes duration and Fasting blood sugar), group effects, and time effects * statistically significant at the 0.05 level of significance, ATET: Average Treatment Effect for treated

4. Discussion

The aim of this study was to analyze the effect of motivational interviewing (MI) on glycemic control, diabetes distress, and diabetes management self-efficacy among individuals with type 2 diabetes. Baseline characteristics were generally comparable between intervention and control groups, with the exception of differences in marital status, diabetes treatment regimens, and FBS levels.

The Wilcoxon signed-rank test and the difference-in-differences (DID) regression analysis results of this study revealed that the HgbA1C level was significantly reduced in the intervention group after MI implementation. This is consistent with results from previous studies. For example, a study by Welch et al. reported there was a 2.1% reduction of HbA1c in the intervention group. [50] and meta-analysis by Bilgin A, et and Berhe et al found a statistically significant reduction in glycated hemoglobin following MI (Berhe et al., 2020; Kıral & Cansu, 2022). Furthermore, studies by Mehmet et al, Chen et al and Ayse Dogru et al revealed that significant reduction of HbA1clevel was observed in MI group post-intervention(Chen et al., 2012; Racic et al., 2015; Dogru et al., 2019). Similarly, studies by Racic M, Chen S-M et al, S.M. Chen et al and Momtazi S et al found that there was meaningful decreases in HgbA1C in intervention group with no significant changes in control group (Chen, 2008; Rosenbek Minet et al., 2011; Momtazi et al., 2018; Ismail et al., 2018).

However, this result is contradicts with a study done by Garry Welch, et a., where HbA1c levels increased in the control group but no significant changes were occurred in the intervention group (Bilgin et al., 2022). Similarly, Ismail K. et al. also reported that MI did not significantly impact HbA1c levels in intervention group (Rosenbek Minet et al., 2011). and findings from a Danish study that found no difference in HbA1c reduction between MI and control groups at one-year follow up (Li et al., 2014). Moreover, Meng Li et al found reductions in both groups with no significant difference between them (Channon et al., 2007). Furthermore, in this study there was significant difference in median HgbA1C levels between the two groups at follow up. This is in line with findings from Racic M et al and Sue j. channon et al who also reported between-group differences in HbA1c at follow up (Momtazi et al., 2018; Li et al., 2020).

In this study Wilcoxon signed-rank test found that MI significantly improved participants' diabetes distress level compared to usual diabetes health education. Similarly, the DID analysis further supported this finding, showing that MI led to a statistically significant reduction in PAID scores compared to the control group. This suggests that the MI may be more effective in addressing patients' perceived problem areas related to diabetes. These findings are consistent with Li et al., who reported significant improvement in PAID scores in intervention group at follow up .[62] Our results also align with those Knight et al and Bilgin A et al., their meta-analyses findings confirmed the positive effect of MI on emotional distress reduction in individuals with diabetes(Hemmati Maslakpak et al., 2021; Kıral & Cansu, 2022).

A statistically significant improvement in self-efficacy for diabetes self-management was observed in the intervention group compared to the control group after MI. Similarly, DID analysis also showed that there was statistically significant increase in diabetes management self-efficacy scores in the intervention group compared to the control. This suggests that MI effectively enhances patients' confidence in managing their condition. Our findings are congruent with studies by Hemmati et al., who reported improved self-efficacy after MI.[64] and studies by Chen S-M, Shu Ming Chen et al and Siska Puji Lestari et al. found significant improvements in self-efficacy among MI participants from baseline to follow-up(Ismail et al., 2018; Dogru et al., 2019).

The following limitations should be considered when interpreting these results; In the first place, the sample sizes of both groups were relatively small that may limit the generalizability of the findings. A large sample size would enhance statistical power to allow more robust conclusions. Furthermore, various external factors such as treatment and care experiences, level of medical staff education and training, equipment levels, and treatment acceptance levels of patients could have influenced the results because of data were collected from two different hospitals with different levels of care and locations. Although we assume that regular care and consultations are comparable in both clinics. The other aspect is, despite efforts to minimize contact, participants from both groups may have shared information during social interactions, potentially influencing results inaddition, responses related to behavioral factors might be influenced by the desire to provide socially acceptable answers. Finally, the DID analysis assumes parallel trends between groups, but this could not be tested due to lack of multiple pre-intervention time points.

5. Conclusion

This study found that Motivational Interviewing (MI) was associated with a reduction in HbA1c levels, decreased diabetes-related distress, and improved diabetes management self-efficacy among individuals in the intervention group compared to the control group. Such studies could provide important evidence regarding the positive effect of motivational interviewing, which may be a compelling reason to implement it more widely in routine hospital and similar health care settings.

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