

Original Article

Diabetes educator-led education intervention to improve the medication adherence and quality of life in type 2 diabetes patients: a pre-and post-analysis

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Abstract

The current study aims to assess the effectiveness of diabetes educator-led education intervention in improving medication and overall quality of life in patients with Type 2 diabetes (T2DM). Pakistan ranked third globally, with a diabetes prevalence of 33 million in 2021, highlighting the significance of this health issue, which can be further exacerbated by medication non-adherence to diabetes medication—the current study utilized pre- and post-intervention design. The study participants were diabetes patients. Diabetes educators, who play a crucial role in diabetes management, delivered educational interventions to patients with diabetes during one-to-one consultations. The intervention focused on educating the patients regarding the importance of medication adherence, understanding diabetes medication, and techniques to take medication (pill organizer), as well as dietary and lifestyle modifications to support medication efficacy. Adherence was assessed using the DAI-10 scale, while quality of life was assessed using the EQ-5D-3L scale. The Wilcoxon signed-rank test was used to assess the effect of the intervention. A total of 300 patients participated, amongst which most of the patients were 41–60 years old (57.3%) and were male (52.7%). In the post-intervention, compared to the pre-intervention group, the adherence level was significantly increased ($p < 0.001$). Being male, having employment, and smoking were significantly associated with medication adherence in the post-intervention group. In addition, patients who have co-morbidities were 2.07 times more likely to be associated with medication adherence. The education intervention significantly improved the adherence to diabetes medication and overall QoL of the diabetes patients.

Keywords: type 2 diabetes, education, adherence, quality of life

Introduction

Type 2 diabetes (T2DM) is a chronic condition that requires lifelong management to prevent complications. As of 2021, the International Diabetes Federation (IDF) estimated that approximately 536 million adults lived with diabetes worldwide. These numbers can be projected to be 783 million if current trends persist [1]. It has been linked to the deaths of nearly 5 million individuals worldwide in the past year [2]. Pakistan ranked third globally, with a diabetes prevalence of 33 mil-

lion in 2021. This number is expected to rise to around 62 million by 2045 [1].

Medication adherence, which refers to the extent to which patients take medications as prescribed by their healthcare providers, is crucial in controlling blood sugar levels and reducing the risk of long-term complications in individuals with T2DM [3]. Poor medication adherence among T2DM patients can lead to uncontrolled blood glucose levels, increased healthcare costs, higher rates of hospitalization, and a more significant burden on the healthcare system [4–6]. Despite



the availability of effective medications for managing T2DM, studies have consistently shown that medication non-adherence is a common problem among patients with this condition [5]. Factors contributing to poor medication adherence in type 2 diabetes patients include forgetfulness, lack of understanding about the importance of medication compliance, concerns about side effects, complex treatment regimens, financial constraints, and psychological barriers [4].

Education plays a significant role in the management of diabetes. It helps patients understand their disease, improves their self-management skills, makes informed decisions about their health, and thus prevents complications [7–9]. However, to promote self-care and assist diabetes patients, pharmacists have expanded their roles as diabetes educators in assisting and providing diabetes education and care [10]. An example is the American Diabetes Association, which has registered and recognized pharmacists who deliver diabetes education and care [11].

However, in developing countries like Pakistan, diabetes management is still a significant public health issue [12, 13]. Therefore, providing localized evidence on effective diabetes management strategies is crucial due to potential differences in healthcare infrastructure, cultural factors influencing health behaviors, and accessibility to healthcare services. In addition, it is well established that diabetes education plays a sig-

nificant role in diabetes management; however, their application and effectiveness can vary across different cultural contexts [10, 14–16]. Furthermore, we are incorporating a diabetes educator certified in diabetes education, which can improve diabetes management due to its specific role. Therefore, the current study aimed to assess the effectiveness of diabetes educator-led education intervention in improving medication adherence and quality of life (Figure 1).

Material and methods

Study design, setting, and participants

A pre- and post-intervention design was utilized for the current study. The study was conducted at Hayatabad Medical Complex, Peshawar, Pakistan. The study was conducted between September 2023 and March 2024. The study population was physician-diagnosed type 2 diabetes mellitus patients. The inclusion criteria were patients’ age equal to or greater than 18 years, who visited the outpatient department, ability to understand and follow study instructions, and willingness to participate in the current study. The patients with type 1 diabetes, in-patients, pregnant women, and the presence of cognitive impairment or mental health conditions that may hinder participation

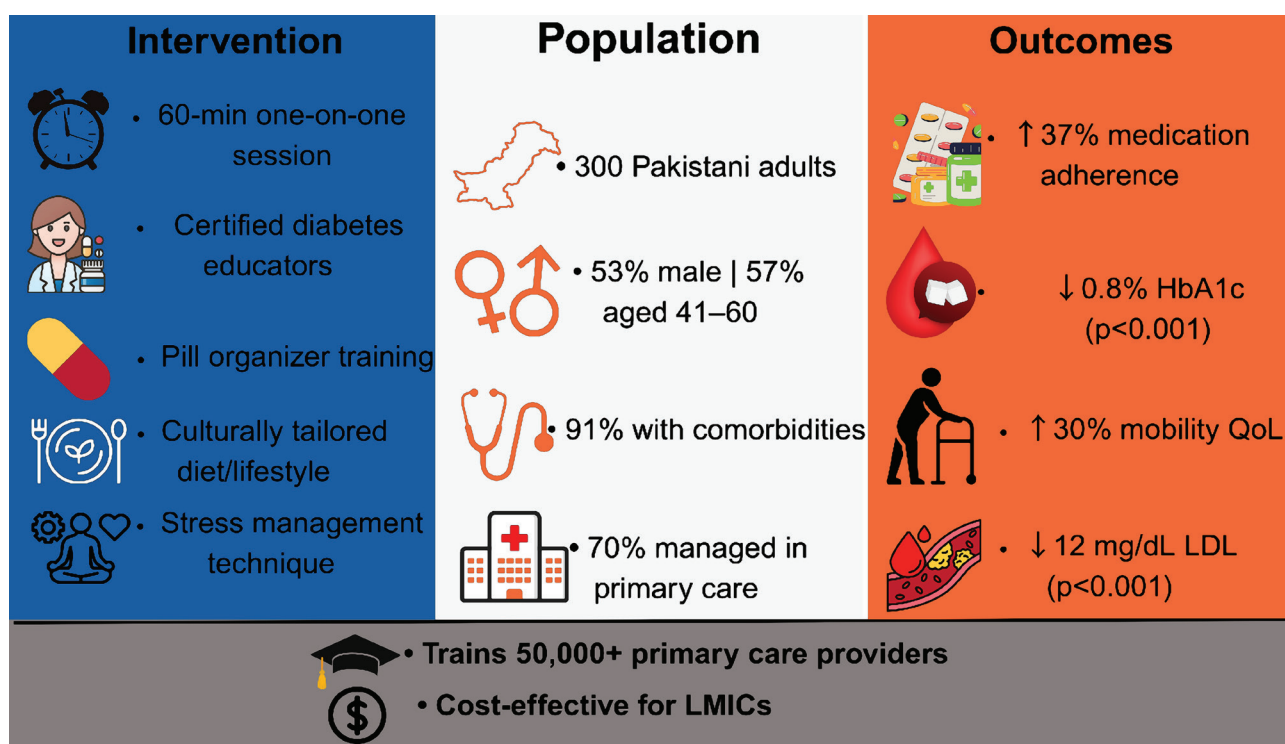


Figure 1: Summary on the key aspects of the study.

were excluded. A total of 640 patients were assessed for eligibility. Among 640, 335 patients were eligible, and 300 patients willingly accepted participation in the study. The details are given in Figure 2.

Intervention

We designed the education intervention based on the IDF's previous recommendation for medication adherence [17–19]. We focused on educating the patients regarding the importance of medication adherence, understanding diabetes medication, and techniques to take medication (pill organizer), as well as dietary and lifestyle modifications to support medication efficacy. In addition, we also focused on the perceived seriousness of diabetes and its vulnerability to complications. Moreover, we also added coping strategies for controlling stress, as psychological problems have been reported to affect treatment adherence adversely [20]. The intervention was given to the patient by a diabetes educator during a one-to-one consultation in OPD.

Sampling and data collection

The sample size was calculated by assuming that 21% and 35% of the pairs were positive at the first and second observations; the correlation between paired observations was 20%. Thus, the calculated sample size is 280 to achieve a power of 80% and a two-sided significance of 5% for detecting a difference of 0.14 between marginal proportions. A 5% dropout was added to the sample size; the final sample size was 294. The patients were recruited to study through simple random sampling from the outpatient department. The demographic characteristics were collected from the included patients. The clinical and lab data were collected at pre- and post-intervention.

The medication adherence data was collected using the Drug Adherence Inventory (DAI-10) [21]. Each correct response was given +1 point, whereas the incorrect response was given -1 point. The overall positive score

indicates adherence, while the negative score indicates non-adherence. The EQ-5D-3L instrument was used to assess quality of life [22].

The outcome of the study

The study's primary outcome was the improvement in the adherence level to the diabetes medication. The secondary outcome was improvement in 1) clinical-lab parameters and 2) quality of life.

Statistical analysis

The statistical package for social science (IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.) was used for the data analysis. The categorical variables were presented as frequency and percentage, whereas the continuous data was tabulated as mean and standard deviation. The Wilcoxon signed-rank test was used to assess the effect of the intervention on medication adherence, clinical lab parameters, and quality of life. Univariate and multivariate logistic regression analysis was also performed to assess the association of socio-demographic characteristics with medication adherence in the post-intervention group. The p-value was deemed significant at 0.05 level throughout the analysis.

Results

A total of 300 patients participated in the current study. Most of the patients were 41–60 years (57.3%). More than half of the patients were male (52.7%), had married marital status (96.7%), and had primary education (34.3%). Most of the patients were non-smokers (76.7%), had a family history of diabetes (89.7%), and used oral antidiabetic medication (53.3%). Detailed information is given in Table 1 and Supplementary Figure S1.

The lab parameters including A1c (Z-value: -6.35, $p < 0.001$), fasting plasma glucose level (Z-value: -3.95,

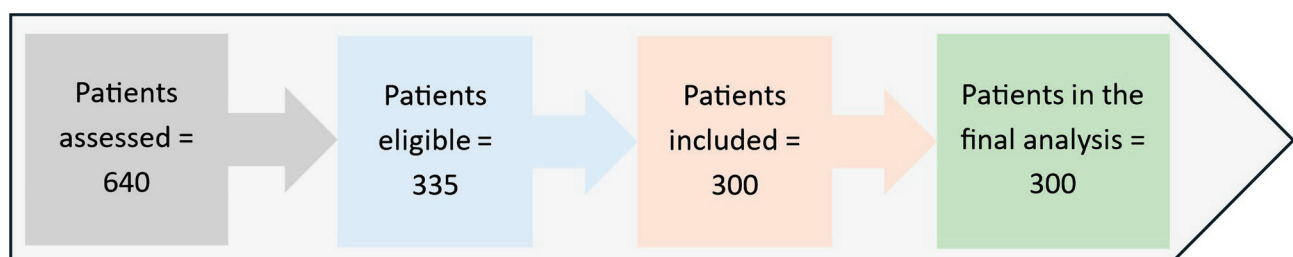


Figure 2: Flow chart of the patient selection.

Table 1: Demographic characteristics of the study population.

	N (%)	
Age	18–40	72 (24.0)
	41–60	172 (57.3)
	>60	56 (18.7)
Gender	Male	158 (52.7)
	Female	142 (47.3)
Marital status	Single	10 (3.3)
	Married	290 (96.7)
Education	No formal education	26 (8.7)
	Primary	103 (34.3)
	Secondary or high secondary	70 (23.3)
	Undergraduate and above	101 (33.7)
Residency	Rural	54 (18.0)
	Urban	246 (82.0)
Employment	Yes	202 (67.3)
	No	98 (32.7)
Monthly income	<20,000	70 (23.3)
	21,000–40,000	60 (20.0)
	41,000–60,000	106 (35.3)
	>60,000	50 (21.4)
Smoking	Yes	70 (23.3)
	No	230 (76.7)
Medication	Oral	160 (53.3)
	Oral + Insulin	140 (46.7)
Family history	Yes	269 (89.7)
	No	31 (10.3)
Co-morbidities	Yes	272 (90.7)
	No	28 (9.3)
Duration of diabetes (years)	1–5	128 (42.7)
	5–10	142 (47.3)
	>10	30 (10.0)

$p < 0.001$), cholesterol (Z-value: -6.52, $p < 0.001$), triglycerides (Z-value: -3.87, $p < 0.001$), LDL (Z-value: -4.29, $p < 0.001$), and HDL (Z-value: -3.57, $p < 0.001$) has been significantly improved in the post-intervention group. The details can be seen in Table 2. The quality of life in the post-intervention group was significantly improved, as shown in Table 3.

The intervention significantly impacts the adherence to medication in diabetes patients. In the post-in-

tervention, compared to the pre-intervention group, the adherence level was significantly increased ($p < 0.001$), as shown in Figure 3. The multivariate regression analysis showed that being male, having employment, and smoking were significantly associated with medication adherence in the post-intervention group. In addition, patients who have co-morbidities were 2.07 times more likely to be associated with medication adherence. The details are given in supplementary Tables S1 and S2.

Table 2: Impact of the intervention on the lab and clinical parameters.

			N (%)	Z-value	P-value
HbA1c	Pre	<6.5	6 (2.0)	-6.35	<0.001
		6.5–8	112 (37.3)		
		>8	182 (60.7)		
	Post	<6.5	24 (8.0)		
		6.5–8	164 (54.7)		
		>8	112 (37.3)		
BPG	Pre	<100	18 (6.0)	-3.95	<0.001
		100–200	96 (32.0)		
		200–300	118 (39.3)		
	Post	>300	68 (22.7)		
		<100	26 (8.7)		
		100–200	132 (44.0)		
DBP	Pre	200–300	94 (31.3)	-3.75	<0.001
		>300	48 (16.0)		
		<70–80	120 (40.0)		
	Post	81–90	158 (52.7)		
		>90	22 (7.3)		
		<70–80	114 (38.0)		
SBP	Pre	81–90	122 (40.7)	-4.42	<0.001
		>90	64 (21.3)		
		<120–140	112 (37.3)		
	Post	141–160	124 (41.3)		
		>160	18 (6.0)		
		4.00	46 (15.3)		
Cholesterol	Pre	<120–140	120 (40.0)	-6.52	<0.001
		141–160	158 (52.7)		
		>160	2 (0.7)		
	Post	4.00	20 (6.7)		
		<200	180 (60.0)		
		201–300	108 (36.0)		
TG	Pre	>300	12 (4.0)	-3.87	<0.001
		<200	122 (40.7)		
		201–300	142 (47.3)		
	Post	>300	36 (12.0)		
		<140	128 (42.7)		
		141–200	106 (35.3)		
Post	>200	66 (22.0)			
	<140	146 (48.7)			
	141–200	122 (40.7)			
		>200	32 (10.7)		

Table 2: Continued.

			N (%)	Z-value	P-value
HDL	Pre	<35	64 (21.3)	-3.57	<0.001
		35–60	94 (31.3)		
		>60	142 (47.3)		
	Post	<35	60 (20.0)		
		35–60	26 (8.7)		
		>60	214 (71.3)		
LDL	Pre	<100	42 (14.0)	-4.29	<0.001
		100–160	252 (84.0)		
		>160	6 (2.0)		
	Post	<100	116 (38.7)		
		100–160	158 (52.7)		
		>160	26 (8.7)		

Note: HbA1C – Hemoglobin A1C, %; FPG – Fasting Plasma Glucose level, mg/dL; DPB – Diastolic Blood Pressure, mmHg; SBP – Systolic Blood Pressure, mmHg); Cholesterol level – mg/dL; TG – Triglycerides, mg/dL; LDL – Low-Density lipoprotein, mg/dL; HDL – High-density lipoprotein, mg/dL.

Discussion

The current study highlighted that education intervention significantly impacts medication adherence in diabetes patients. The blood glucose and cholesterol levels were significantly improved in the post-intervention group. The significant predictors of adherence to diabetes medication in the post-intervention group were males, smokers, and employed patients.

Interventions in education are important for improving adherence to medicine among patients with chronic diseases. Chronic diseases like diabetes, hypertension, asthma, and others need long-term medication to prevent complications and improve health outcomes [23, 24]. Consistently in the current study, adherence to diabetes medication was improved in the post-intervention group. However, many patients suffering from chronic diseases do not follow their prescribed treatments; this may worsen their condition, thereby raising costs in healthcare while decreasing the quality of life [25, 26]. Education intervention deals with barriers to drug adherence by giving patients ideas on managing their drugs through skills development and knowledge improvement and offering support [27]. The current study shows that educational intervention is associated with improved outcomes in diabetes patients.

In the current study, being male, having employment, and being a smoker were significant predictors

of adherence to diabetes medication. The adherence of the male gender could be associated with differences in health beliefs, social support systems, and health-care-seeking behavior [28, 29]. In addition, the employed patient's adherence may be attributed to their structured routine, access to healthcare benefits, and financial stability [30]. Moreover, smoking is a well-known risk factor for diseases, including diabetes [31, 32]. Individuals who smoke may be more aware of their health risks and, therefore, more motivated to adhere to their prescribed medications after receiving education on the importance of managing their condition effectively [28].

Pharmacists can play an essential role in diabetes education, as evidenced by the current study. In developing countries like Pakistan, where the healthcare system faces a constrained economic situation, a limited number of physicians, and a burden of patients, clinical or hospital pharmacists can play a role in educating patients with chronic diseases like diabetes [33]. It has been evidenced from previous reports that pharmacists, including clinical pharmacists and community pharmacists, play a vital role in diabetes management by counseling and educating patients [34, 35]. However, to provide effective diabetes management, pharmacists need to be certified in diabetes education, as offered in developed countries. Therefore, on an individual level, the pharmacist should specialize in diabetes education and care. On a policy level, the related

Table 3: Impact of the intervention on the quality of life.

				Z-value	P-value
Walking	Pre	No problem	150 (50.0)	-8.30	<0.001
		Moderate problem	108 (36.0)		
		Severe problem	42 (14.0)		
	Post	No problem	240 (80.0)		
		Moderate problem	58 (19.3)		
		Severe problem	2 (0.7)		
Self-care	Pre	No problem	146 (48.7)	-5.28	<0.001
		Moderate problem	118 (39.3)		
		Severe problem	36 (12.0)		
	Post	No problem	176 (58.7)		
		Moderate problem	114 (36.3)		
		Severe problem	10 (5.0)		
Usual activities	Pre	No problem	160 (53.3)	-6.62	<0.001
		Moderate problem	100 (33.3)		
		Severe problem	40 (13.3)		
	Post	No problem	218 (72.7)		
		Moderate problem	78 (26.0)		
		Severe problem	4 (1.3)		
Pain/discomfort	Pre	No problem	128 (42.7)	-5.24	<0.001
		Moderate problem	134 (44.7)		
		Severe problem	38 (12.7)		
	Post	No problem	178 (59.3)		
		Moderate problem	112 (37.3)		
		Severe problem	10 (3.3)		
Anxiety/depression	Pre	No problem	146 (48.7)	-8.36	<0.001
		Moderate problem	98 (32.7)		
		Severe problem	56 (18.7)		
	Post	No problem	240 (80.0)		
		Moderate problem	56 (18.7)		
		Severe problem	4 (1.3)		
EQ-VAS, median (IQR)	Pre	59.61 (30–100)		-8.78	<0.001
	Post	68.40 (45–100)			

Note: VAS – Visual analog scale; EQ – EuroQol.

bodies should design and implement policies in the healthcare system where diabetes educators play their role in the effective management of diabetes.

The current study has various limitations. The pre- and post-design lack the comparator group; therefore,

external factors like getting an education from other sources can act as a confounding variable. In addition, the Hawthorne effect can modify behavior or responses due to awareness of being part of an educational program. Randomized control studies can address this limitation.

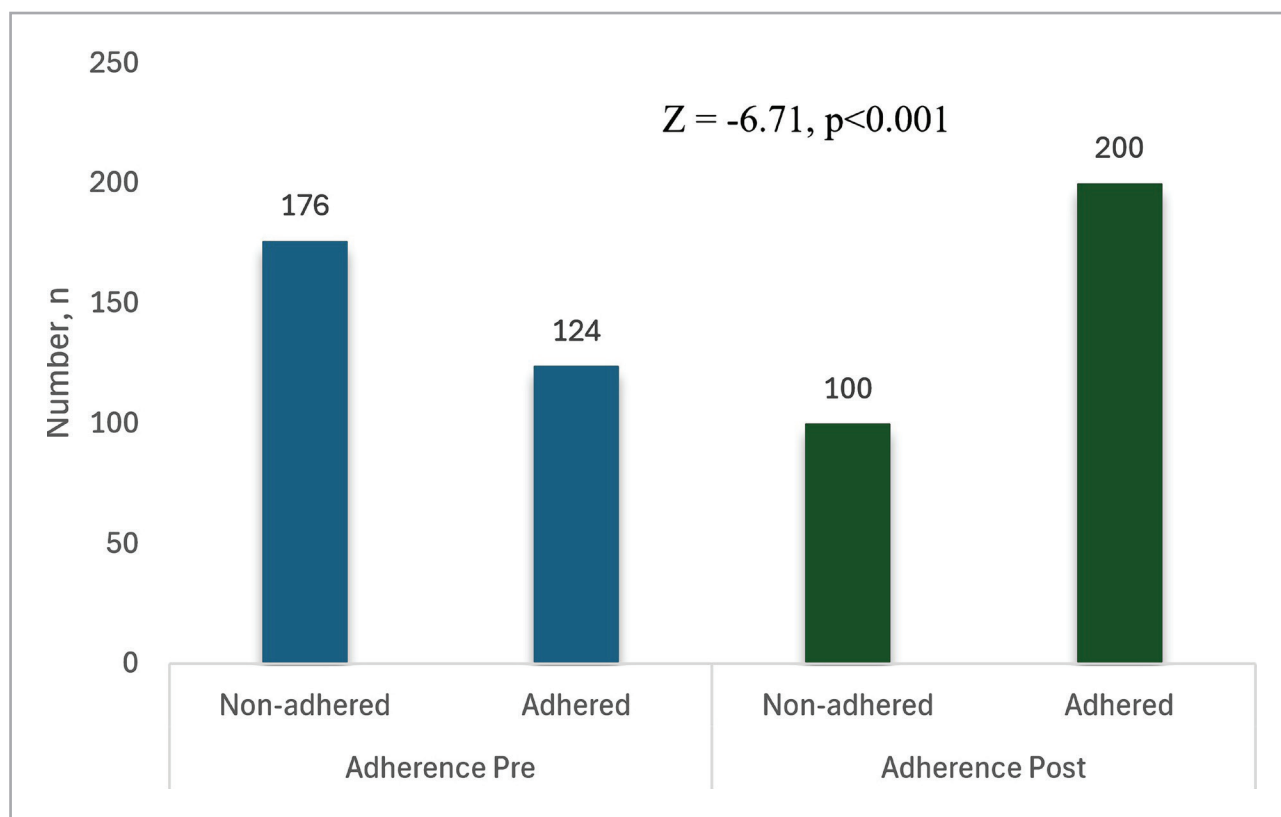


Figure 3: Impact of the intervention on medication adherence.

Conclusion

The current study highlighted that education intervention is significantly associated with favorable outcomes in diabetes patients. The education intervention significantly improved the adherence to diabetes medication and overall QoL of the diabetes patients.

Acknowledgments

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Conflict of interest

The authors declare no conflict of interest.

Ethics approval and consent to participate

The study received ethical approval from Hayatabad Medical Complex and the Research Ethics Committee. All research activities were conducted in accordance with the principles outlined in the Declaration of Helsinki, ensuring the highest standards of ethical conduct. Participant confidentiality was rigorously maintained throughout the study, safeguarding personal information and data. Informed consent was obtained from each participant prior to their involvement, ensuring that they were fully aware of the study’s purpose, procedures, and their rights. This commitment to ethical standards underscores our dedication to conducting responsible and respectful research.

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