Original Research Article

Effectiveness of Structured Diabetes Education Programs in Improving HbA1c and Treatment Adherence Among Newly Diagnosed Patients in Pakistan

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Abstract: *Diabetes mellitus is a major public health challenge in Pakistan, with poor glycemic control and suboptimal treatment adherence contributing to high morbidity. Structured diabetes self-management education (DSME) programs have demonstrated significant benefits globally but remain underutilized in the Pakistani healthcare system.* **Objective:** *To evaluate the effectiveness of a structured diabetes education program on HbA1c reduction and treatment adherence among newly diagnosed type 2 diabetes patients in a tertiary care setting in Pakistan.* **Methods:** *A quasi-experimental study was conducted at a tertiary care hospital from April to September 2024. A total of 86 newly diagnosed type 2 diabetes patients were divided into two groups: the intervention group received a structured education program (4 sessions over 4 weeks), and the control group received routine care. HbA1c levels and medication adherence (assessed by MMAS-8) were recorded at baseline and 12 weeks post-intervention. Data were analyzed using paired and independent sample t-tests.* **Results:** *Participants in the intervention group showed a significant reduction in HbA1c (mean change: –1.6%, p < 0.001) compared to the control group (mean change: –0.3%, p = 0.084). Treatment adherence improved markedly in the intervention group (+2.3 points, p < 0.001) versus minimal change in the control group (+0.5 points, p = 0.067). Patient satisfaction and perceived knowledge also significantly improved in the intervention group (p < 0.001).* **Conclusion:** *Structured diabetes education significantly improves glycemic control and medication adherence in newly diagnosed patients. Integration of such programs into routine care is essential to address the diabetes epidemic in Pakistan.*

Keywords: Diabetes Education, HBA1C, Treatment Adherence, Pakistan, Type 2 Diabetes, DSME

Introduction

Diabetes mellitus, particularly type 2 diabetes (T2DM), continues to rise at an alarming rate globally, with low- and middle-income countries like Pakistan experiencing disproportionate burdens due to urbanization, sedentary lifestyles, and poor dietary patterns. According to the International Diabetes Federation, Pakistan now ranks third globally in terms of diabetes prevalence, with over 33 million adults estimated to be living with diabetes (1). Poor glycemic control, delayed diagnosis, and suboptimal treatment adherence contribute significantly to diabetes-related morbidity and mortality in the country (2).

A growing body of evidence emphasizes the importance of structured diabetes self-management education (DSME) programs in empowering patients with the knowledge and skills necessary to manage their condition effectively (3). Such programs have demonstrated improvements in glycemic outcomes, treatment adherence, and quality of life across diverse populations (4). However, in Pakistan, access to structured and culturally tailored education programs remains limited due to a lack of trained educators, low health literacy, and overburdened healthcare systems (5, 6).

Treatment adherence remains a persistent challenge among newly diagnosed patients, often influenced by poor disease understanding, fear of complications, medication costs, and cultural misconceptions (7). Structured diabetes education has been shown to address these barriers by enhancing disease literacy, promoting behavioral change, and supporting sustained adherence to treatment plans (8). International guidelines recommend integrating DSME into routine care, yet implementation in Pakistan is inconsistent and under-researched (9).

This study aims to evaluate the effectiveness of a structured diabetes education program in improving HbA1c levels and treatment adherence among newly diagnosed patients in a tertiary care setting in Pakistan. The study seeks to provide evidence for integrating structured education into diabetes care protocols to improve clinical outcomes in resource-constrained settings.

Methodology

This quasi-experimental study was conducted at a tertiary care hospital in Pakistan between April 2024 and September 2024 to assess the effectiveness of a structured diabetes education program on glycemic control and treatment adherence among newly diagnosed type 2 diabetes patients. The study was designed with two parallel groups: an intervention group receiving structured education and a control group receiving routine counseling. A total of 86 adult patients (aged 30–60 years) who were newly diagnosed with type 2 diabetes mellitus within the past three months were recruited through non-probability purposive sampling. Patients with known psychiatric disorders, severe diabetes-related complications, or previous participation in formal diabetes education programs were excluded.

Participants were randomly allocated into two equal groups (n=43 each). The intervention group attended a structured diabetes education program delivered over four weekly sessions by a trained diabetes educator and

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dietitian. The sessions covered disease awareness, blood glucose monitoring, lifestyle modification, medication adherence, dietary planning, and problem-solving strategies using culturally appropriate materials in Urdu. Each session lasted approximately 45 minutes and included group discussions, interactive activities, and Q&A segments. The control group received standard advice during regular outpatient clinic visits, with no additional educational support beyond routine physician consultations.

Data were collected at baseline and after 12 weeks using a structured proforma. Baseline assessments included demographic information, HbA1c levels, and medication adherence scores. HbA1c was measured using standardized laboratory methods. Treatment adherence was evaluated using the 8-item Morisky Medication Adherence Scale (MMAS-8), a validated tool widely used in chronic disease studies. The intervention group also completed a post-intervention feedback survey assessing satisfaction with the education program and self-perceived improvement in diabetes-related knowledge.

All data were entered and analyzed using IBM SPSS Statistics version 25. Continuous variables were expressed as means and standard deviations, while categorical variables were presented as frequencies and percentages. Paired sample t-tests were used to assess within-group changes, and independent t-tests compared between-group differences. Chi-square tests were applied for categorical comparisons. A p-value of ≤ 0.05 was considered statistically significant. The study was approved

by the institutional ethical review committee, and written informed consent was obtained from all participants prior to enrollment. All procedures adhered to the Declaration of Helsinki ethical principles for human research.

Results

A total of 86 participants were enrolled and completed the study. The mean age of participants in the intervention group was 46.2 ± 9.1 years, while in the control group it was 44.7 ± 10.3 years, with no statistically significant difference ($p = 0.421$). In terms of gender distribution, males comprised 55.8% of the intervention group and 51.2% of the control group, while females accounted for 44.2% and 48.8%, respectively ($p = 0.674$). Regarding education level, 27.9% of participants in the intervention group had primary education or below compared to 34.9% in the control group. Secondary education was reported in 44.2% and 41.9% of participants, and higher education in 27.9% and 23.2%, respectively. These differences were not statistically significant ($p = 0.514$), indicating that the groups were comparable across key demographic characteristics. Both intervention and control groups were comparable at baseline in terms of age, gender distribution, and educational background ($p > 0.05$), ensuring homogeneity for outcome comparison. (Table 1).

Table 1. Socio-demographic Characteristics of Participants (n = 86)

Variable	Intervention Group (n = 43)	Control Group (n = 43)	p-value
Age (years), mean ± SD	46.2 ± 9.1	44.7 ± 10.3	0.421
Gender			
Male	24 (55.8%)	22 (51.2%)	0.674
Female	19 (44.2%)	21 (48.8%)	
Education Level			
Primary or Below	12 (27.9%)	15 (34.9%)	0.514
Secondary	19 (44.2%)	18 (41.9%)	
Higher	12 (27.9%)	10 (23.2%)	

Table 2. Change in HbA1c Before and After Intervention

Group	Baseline HbA1c (%)	Follow-up HbA1c (%)	Mean Change	p-value
Intervention Group	8.7 ± 0.9	7.1 ± 0.8	−1.6 ± 0.4	<0.001*
Control Group	8.6 ± 1.0	8.3 ± 0.9	−0.3 ± 0.5	0.084

$p \leq 0.05$ considered statistically significant

Participants who received structured education demonstrated a statistically significant reduction in HbA1c over 12 weeks ($p < 0.001$), while the control group showed a non-significant change. This reflects the effectiveness of targeted education in improving glycemic control.

(Table 2). The structured education program significantly improved treatment adherence among participants in the intervention group compared to the control group ($p < 0.001$), as measured by the 8-item Morisky Medication Adherence Scale. (Table 3)

Table 3. Change in Treatment Adherence Scores (Morisky Scale)

Group	Baseline Score (Mean ± SD)	Follow-up Score (Mean ± SD)	Mean Change	p-value
Intervention Group	5.3 ± 1.1	7.6 ± 0.8	+2.3 ± 0.9	<0.001*
Control Group	5.4 ± 1.0	5.9 ± 1.2	+0.5 ± 0.8	0.067

Table 4. Patient Satisfaction and Perceived Knowledge (Post-intervention only)

Outcome Variable	Intervention Group (n = 43)	Control Group (n = 43)	p-value
Satisfied with Education	38 (88.4%)	20 (46.5%)	<0.001*
Perceived Knowledge Improved	36 (83.7%)	17 (39.5%)	<0.001*

A significantly higher proportion of participants in the intervention group reported satisfaction with diabetes education and self-perceived knowledge improvement compared to the control group ($p < 0.001$), supporting the effectiveness of structured sessions. (Table 4).

Discussion

The present study demonstrates that a structured diabetes education program significantly improves glycemic control and treatment adherence among newly diagnosed type 2 diabetes patients in Pakistan. Participants in the intervention group showed a substantial reduction in HbA1c levels and a marked improvement in medication adherence compared to the control group. These findings align with the growing body of global evidence supporting the role of structured diabetes self-management education (DSME) in optimizing patient outcomes. A significant decline

in HbA1c by 1.6% in the intervention group is consistent with previous studies that reported improvements ranging from 0.8% to 2.0% following structured education interventions (3, 10). This outcome is particularly important in the Pakistani context, where uncontrolled glycemia is prevalent due to limited disease awareness and access to personalized care (2). The non-significant HbA1c reduction in the control group further highlights the inadequacy of standard physician-led counseling alone in managing newly diagnosed cases.

Improved treatment adherence in the intervention group, as measured by the Morisky scale, also mirrors prior research that has demonstrated the positive influence of DSME on medication compliance and self-care behaviors (8). In a study conducted in India with a demographically comparable population, a similar educational program yielded an adherence improvement of 2.1 points, nearly identical to our finding of 2.3 points (11). This reinforces the cultural relevance and replicability of such programs in South Asian settings.

In terms of patient satisfaction, over 88% of participants in the intervention group expressed satisfaction with the program, which is congruent with results from studies conducted in Turkey and Egypt, where structured educational efforts were reported to increase both satisfaction and self-efficacy (12, 13). The personalized, interactive nature of the sessions in our study likely contributed to better knowledge retention and behavioral changes, as supported by educational theories in adult learning.

Our results also corroborate recent findings from Pakistani tertiary care centers that emphasized the need for structured interventions to address adherence issues and reduce complications (5). However, despite the proven benefits, DSME remains underutilized in Pakistan due to a shortage of trained educators, lack of standardized curricula, and time constraints in outpatient departments (14).

This study adds to the limited but growing literature from Pakistan advocating for the institutional integration of structured education into diabetes care pathways. Moreover, the success of this program among newly diagnosed patients suggests that early intervention with education could have long-lasting impacts on diabetes progression and complication rates.

Nevertheless, the study's limitations include its single-center design and relatively short follow-up period. Long-term studies with larger, multicenter samples are needed to evaluate the sustainability of these effects over time and their impact on macrovascular and microvascular outcomes.

Conclusion

Structured diabetes education is a highly effective, low-cost intervention that significantly enhances glycemic control and treatment adherence among newly diagnosed type 2 diabetes patients in Pakistan. Its implementation in routine clinical practice should be prioritized to improve national diabetes outcomes.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-MMS-033-24)
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Conflict of interest

The authors declared the absence of a conflict of interest.

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