

Impact of Diabetes Educator on Medication Adherence, HbA1c, and Health-Related Quality of Life in Type 2 Diabetes Mellitus

Basit Ramzan¹, Sabariah Noor Harun¹, Fatima Zahid Butt², Rahma Zahid Butt³, Furqan Hashmi⁴, Shahnawaz Gardezi⁵, Iltaf Hussain⁶, Muhammad Fawad Rasool^{6*}

¹School of Pharmaceutical Sciences, University Sains Malaysia, Penang, Malaysia.

²Lahore General Hospital, Lahore, Pakistan.

³M. Islam Medical and dental college, Lahore, Pakistan.

⁴University College of Pharmacy, University of Punjab, Allama Iqbal Campus, Lahore Pakistan.

⁵City hospital, Multan, Pakistan. ⁶Department of Pharmacy Practice, Bahauddin Zakariya University, Multan, Pakistan.

*E-mail ✉ fawadrasool@bzu.edu.pk

Abstract

This study aimed to evaluate the effectiveness of diabetes educator-assisted management in improving diabetes care in Pakistan, particularly among low and middle-income populations. A randomized controlled trial was conducted with 150 participants, who received care from an endocrinologist. Diabetes educators used a structured approach, which involved identifying patient care priorities, assessing specific educational needs, designing personalized diet plans, emphasizing the importance of self-monitoring blood glucose, and addressing concerns related to diabetes medication, foot care, and hypoglycemia. In the intervention group, patients were trained by the diabetes educator over 6 months, which included both follow-up visits and phone consultations. The primary measure for success was the improvement in HbA1c levels, while secondary outcomes involved assessing medication adherence, blood glucose levels, quality of life, blood pressure, and lipid profiles. Participants were predominantly male (53.3%) and aged 40-60 years (57.3%). Results showed significant improvements in HbA1c, blood glucose, blood pressure, and lipid profiles in the intervention group ($P < 0.0001$). In addition, the group showed greater medication adherence and health-related quality of life. This study emphasizes the need for continued education to improve glycemic control in type 2 diabetes patients and aims to strengthen the self-management of those with poorly controlled diabetes, who are at a higher risk of complications.

Keywords: Health-related quality of life, Medication adherence, HbA1c, Diabetes educator, Type 2 diabetes mellitus

Introduction

Diabetes is a persistent metabolic condition that continues to rise at an alarming rate, responsible for nearly 5 million deaths globally in the last year [1]. In 2021, it was estimated that 536.6 million individuals between the ages of 20 and 79 years were living with

diabetes across 215 nations and regions. Projections indicate that by 2045, this number will escalate to 783.2 million [2]. A large percentage of the global diabetic population (80.6%, or 432.7 million) resides in low- and middle-income nations. Pakistan holds the top spot with a diabetes prevalence rate of 30.8%, expected to increase to 33.6% by 2045. Furthermore, it ranks third globally, with 33 million people diagnosed with diabetes in 2021, a figure anticipated to rise to 62.2 million by 2045, following China and India [3].

Both the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD) advocate for starting treatment with non-pharmacological strategies, such as lifestyle modifications including weight loss and physical

Access this article online

<https://smerpub.com/>

Received: 04 December 2021; Accepted: 07 February 2022

Copyright CC BY-NC-SA 4.0

How to cite this article: Ramzan B, Noor Harun S, Zahid Butt F, Zahid Butt R, Hashmi F, Gardezi S, et al. Impact of Diabetes Educator on Medication Adherence, HbA1c, and Health-Related Quality of Life in Type 2 Diabetes Mellitus. Ann Pharm Educ Saf Public Health Advocacy Spec. 2022;2:7-15. <https://doi.org/10.51847/HM2EYHinlp>

activity. However, long-term success with lifestyle changes alone is limited, often necessitating the inclusion of medication to achieve or maintain an A1C level below 7% [4]. Metformin is widely regarded as the first-line treatment. For patients who do not achieve sufficient control with metformin alone, sulfonylureas are considered a second-line treatment due to their established efficacy, long history of use, and affordability. The guidelines also suggest injectable insulin as a second-line therapy for patients not sufficiently managed with metformin alone or as a third-line option for those still not meeting their A1C target with oral combination therapies. Other treatment options for type 2 diabetes include DPP-4 inhibitors, meglitinides, thiazolidinediones, and incretin mimetics [5].

To promote better self-management and support individuals with diabetes, pharmacists have increasingly taken on expanded roles in delivering education and care to these patients [6-8]. A prime example of this can be seen in the American Diabetes Association, which has formally recognized and authorized pharmacists to provide diabetes-related education and care [9]. Pharmacists are vital in guiding patients on how to manage their condition effectively on their own [10, 11]. By offering this education, pharmacists help improve patients' adherence to treatment plans and encourage healthier lifestyle changes, which leads to a significant enhancement in their overall quality of life (QoL) [8, 12-14]. Therefore, the current research aims to explore the pharmacist's contribution as a diabetes educator, focusing on their role in assisting patients with self-care, promoting treatment adherence, and offering dietary support. Additionally, the study intends to evaluate the impact of diabetes educator interventions on improving treatment adherence, clinical outcomes, and health-related quality of life.

Materials and Methods

Research Design and Sampling

For this study, a quantitative randomized controlled trial design was employed. Initially, the sample size was determined to be 150 participants. To account for potential dropouts, an additional 10% was added to the total, leading to a final sample size of 165 participants. The sample size was calculated by using the following formula [15].

$$n = Z^2 \times p (1-p) / d^2 \quad (1)$$

where n = sample size, Z^2 = confidence interval, p = prevalence of type 2 diabetes mellitus, d^2 = margin of error.

Participants were selected through a simple random sampling technique. To eliminate confounding variables, the inclusion criteria were carefully followed. The specific requirements for participation were:

- Diagnosis of type 2 diabetes
- Use of oral hypoglycemic agents in conjunction with insulin
- An A1C level higher than 7% in the month before the study
- Ability to independently use a blood glucose monitoring device.

Trial Design and Data Collection

This research employed a randomized controlled trial to evaluate the effectiveness of diabetes education delivered by pharmacists in managing diabetes. Participants were assigned to two distinct groups: the intervention group (A) and the control group (B). The intervention group (A) received comprehensive education from diabetes educators, while the control group (B) underwent an assessment of their existing knowledge about diabetes, sugar level management, and quality of life (QoL) but did not receive any educational intervention. The control group continued with conventional care, including routine medical evaluations, diagnosis reviews, and prescriptions without receiving any further education about their diabetes or treatments.

The intervention group (A) followed a structured protocol that included identifying individual care needs, evaluating educational gaps, creating customized dietary plans, teaching blood glucose self-monitoring techniques, addressing issues like hypoglycemia, foot care, and treatment-related concerns, and demonstrating insulin administration devices when applicable. The education sessions typically consisted of a single 30-minute in-person meeting, followed by weekly phone consultations until the next visit to the physician.

Data collection occurred between March and December 2020 at City Hospital Multan, a facility with a focus on endocrinology and diabetes care. After collecting baseline information, the pharmacist-led intervention was implemented following international guidelines for managing type 2 diabetes [16]. Follow-up data were

recorded at various intervals, with further details provided in **Figure 1** and **Table 1**.

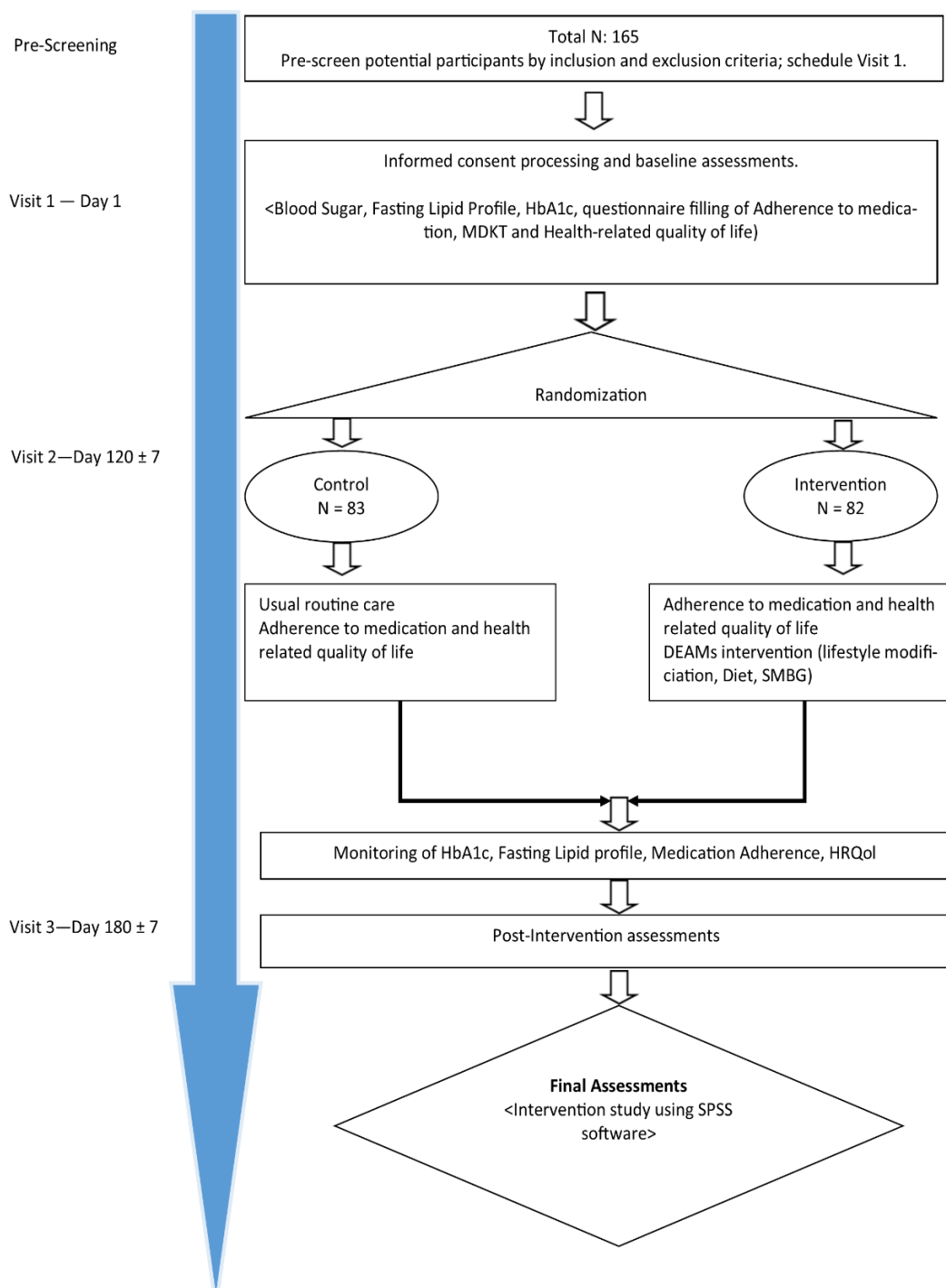


Figure 1. Patient recruitment and follow-up procedure

Table 1. Summary of the outcomes from the control and interventional study

Control group			Intervention group		
0 month	3 months	6 months	0 month	3 months	6 months

Demography data	✓		✓	
HbA1c	✓	✓	✓	✓
Lipid profile	✓	✓	✓	✓
Medication adherence (DAI-10)	✓	✓	✓	✓
Quality of life (EQ5D)	✓	✓	✓	✓
Review of patients' knowledge about diabetes (MDKT)	✓		✓	
DEAMS intervention			✓	✓

Research Instruments

To evaluate the diabetes knowledge of participants, the Michigan Diabetes Knowledge Test (MDKT) was employed, consisting of 14 questions covering both medical and socio-cultural aspects of diabetes [17]. Medication adherence was measured using the drug adherence inventory (DAI-10) scale [18], while the EQ-5D-3L instrument was utilized to assess quality of life [19].

Ethical Considerations

The study obtained approval from the Department of Pharmacy Practice at Bahauddin Zakariya University, Multan (Reference No: 173-A/Pharmacy Practice 02/20), and adhered to the principles outlined in the Declaration of Helsinki. Before enrollment, informed consent was obtained from all participants, ensuring their confidentiality throughout the research.

Data Analysis

Statistical analyses were carried out using SPSS version 26. Categorical variables were presented as frequencies and percentages, while continuous variables were shown as means with standard deviations. A paired sample t-test was used to assess differences between pre- and post-intervention measurements, with statistical significance set at a P-value ≤ 0.05 .

Results and Discussion

The final analysis included 150 participants. The majority of participants (57.3%) were aged between 40-60 years, and 53.3% were male. Most participants had primary education (38.0%), and a large proportion (62.7%) worked in office environments. A detailed breakdown of demographic characteristics is provided in **Table 2**.

Table 2. Demographic characteristics of the participants

		Overall		Group			
				Control		Intervention	
		N	%	N	%	N	%
Age (years)	20-40	36	24.0	18	23.1	18	25.0
	41-60	86	57.3	42	53.8	44	61.1
	61-80	28	18.7	18	23.1	10	13.9
Gender	Male	80	53.3	46	59.0	34	47.2
	Female	70	46.7	32	41.0	38	52.8
Marital status	Single	5	3.3	3	3.8	2	2.8
	Married	145	96.7	75	96.2	70	97.2
Education	Primary	57	38.0	32	41.0	25	34.7
	Secondary	40	26.7	17	21.8	23	31.9
	Graduation	36	24.0	21	26.9	15	20.8
	Masters	16	10.7	8	10.3	8	11.1
	Illiterate	1	0.7	0	0.0	1	1.4
Smoking status	Yes	35	23.3	18	23.1	17	23.6
	No	115	76.7	60	76.9	55	76.4
Living status	Urban	123	82.0	65	83.3	58	80.6
	Rural	27	18.0	13	16.7	14	19.4
Occupation	Public sector	27	18.0	13	16.7	14	19.4
	Private sector	39	26.0	22	28.2	17	23.6
	Business/self-employed	48	32.0	26	33.3	22	30.6
	Housewife	24	16.0	10	12.8	14	19.4
Job nature	Unemployed	12	8.0	7	9.0	5	6.9
	Office job	94	62.7	46	59.0	48	66.7

Monthly income (PKR)	Field + office job	11	7.3	8	10.3	3	4.2
	Physical labour	5	3.3	3	3.8	2	2.8
	Household	39	26.0	20	25.6	19	26.4
	N/A	34	22.7	19	24.4	15	20.8
	20,000-60,000	84	56.0	42	53.8	42	58.3
	60,001-100,000	32	21.3	17	21.8	15	20.8
Family history	> 100,000	0	0.0	0	0.0	0	0.0
	Yes	150	100.0	78	100.0	72	100.0
Family members	No	0	0.0	0	0.0	0	0.0
	Parents	119	79.3	58	74.4	61	84.7
	Siblings	31	20.7	20	25.6	11	15.3
	N/A	0	0.0	0	0.0	0	0.0
Concomitant disease	Hypertension/cardiac problems	124	82.7	63	80.8	61	84.7
	Dyslipidaemia	12	8.0	8	10.3	4	5.6
	N/A	14	9.3	7	9.0	7	9.7
Duration of diabetes (years)	1 to 5	63	42.0	31	39.7	32	44.4
	5 to 10	71	47.3	37	47.4	34	47.2
	> 10	15	10.0	9	11.5	6	8.3
	11.00	1	0.7	1	1.3	0	0.0

The findings of this study revealed that the involvement of a diabetes educator led to marked improvements in several clinical indicators. Notably, there were statistically significant reductions in HbA1c levels ($P <$

0.0001), blood glucose concentrations ($P < 0.0001$), blood pressure readings ($P < 0.0001$), and lipid profile values ($P < 0.0001$) following the intervention. Comprehensive results are presented in **Table 3**.

Table 3. Comparison of lab parameters before and after pharmacist intervention

Lab parameters	Values	Pre	Post
HbA1c	< 6.6	3 (2)	12 (8)
	6.6-8.0	24 (16)	39 (26)
	8.1-9.0	33 (22)	43 (28.7)
	9.1-11.0	63 (42)	33 (22)
	> 11.0	27 (18)	23 (15.3)
Blood glucose	< 100	6 (4)	14 (9.3)
	100-200	52 (34.7)	65 (43.3)
	201-300	59 (39.3)	47 (31.3)
	> 300	33 (22)	24 (16)
Diastolic blood pressure	< 80	60 (40)	57 (38)
	80-89	79 (52.7)	61 (40.7)
	90-99	10 (6.7)	23 (15.3)
	> 100	1 (0.7)	9 (6)
Systolic blood pressure	< 120	60 (40)	56 (37.3)
	120-139	79 (52.7)	62 (41.3)
	140-159	10 (6.7)	23 (15.3)
	> 160	1 (0.7)	9 (6)
Cholesterol	< 200	91 (60.7)	60 (40)
	200-239	53 (35.3)	72 (48)
	> 240	6 (4)	18 (12)
Triglycerides	< 150	74 (49.3)	63 (42)
	150-199	60 (40)	54 (36)
	200-499	16 (10.7)	24 (16)
	> 500	0 (0)	9 (6)
Low-density lipoproteins	60-130	102 (68)	57 (38)
	131-159	21 (14)	59 (39.3)
	160-189	24 (16)	21 (14)
	> 190	3 (2)	13 (8.7)
High-density lipoproteins	< 35	29 (19.3)	32 (21.3)

	35-60	108 (72)	70 (46.7)
	> 60	13 (8.7)	48 (32)

A notable enhancement in quality of life was identified following the intervention by the diabetes educator, with the specifics illustrated in **Table 4**.

Table 4. Comparison of QoL of the participants before and after pharmacist intervention

		Mean	Standard deviation	P-value
QoL	Pre	7.77	1.37	< 0.0001
	Post	8.30	2.52	
EQVAS	Pre	59.68	12.19	< 0.0001
	Post	59.13	14.95	

Following the educational sessions conducted by the diabetes educator, patients exhibited a marked increase in their adherence to prescribed treatments. Comprehensive data supporting this outcome is presented in **Table 5**.

Table 5. Comparison of drug adherence before and after pharmacist intervention

		N	%	P-value
AdherencePre	Adherent	55	36.7%	0.028
	Non-adherent	95	63.3%	
AdherencePost	Adherent	89	59.3%	
	Non-adherent	61	40.7%	

In terms of diabetes-related knowledge, 41.3% of the participants identified the importance of a healthy diet for individuals with diabetes. Additionally, a considerable portion of respondents (36%) correctly recognized conditions unrelated to diabetes complications, while 30.7% were able to identify appropriate carbohydrate sources. A full breakdown of these findings is available in **Table 6**.

Table 6. Participant knowledge concerning diabetes

Diabetes knowledge question (answer)	N	%
The appropriate diet for someone with diabetes is: (A balanced diet suitable for most people)	True	62
Which of the following contains the most carbohydrates? (Baked potato)	True	46
Which of the following contains the most fat? (Low-fat milk)	True	51
Which of the following qualifies as free food? (Any food with fewer than 20 calories per serving)	True	56
Glycosylated hemoglobin (Hemoglobin A1) measures your average blood glucose level over the past: (6-10 weeks)	True	46
What is the most reliable method for testing blood glucose? (Blood test)	True	44
How does unsweetened fruit juice affect blood glucose levels? (It increases it)	True	53
Which should not be used to treat low blood glucose levels? (1 cup of diet soft drink)	True	49
For a person with well-controlled diabetes, what effect does exercise have on blood glucose? (It increases it)	True	46
What is likely to occur during an infection? (A decrease in blood glucose)	True	51
What is the best way to care for your feet? (Examine and wash them daily)	True	45
Eating foods lower in fat reduces your risk of: (Heart disease)	True	48
Numbness and tingling could be signs of: (Nerve disease)	True	52
Which of the following is typically not related to diabetes? (Lung problem)	True	54

Living with diabetes has widespread implications on both physical and mental well-being. It imposes a substantial burden that extends beyond physical symptoms, profoundly affecting psychological health. This investigation aimed to determine how structured counseling and targeted intervention strategies influence

patients' overall health status and life quality. In the context of the Pakistani population, it was noted that routine monitoring of blood glucose was not among the dominant contributors to poor quality of life. However, physical activity emerged as a crucial determinant. Additional physiological variables, such as LDL and

HDL cholesterol, were associated with heightened fat accumulation, further diminishing life quality.

This study framework was designed to explore the effectiveness of innovative educational strategies integrated into routine diabetic self-management support systems. It also aimed to assess the scalability of such educational interventions for broader implementation. Patients receiving the intervention were anticipated to show notable improvements in HbA1c, knowledge about their condition, and engagement in self-care activities, compared to those in the control group. If a six-month educational approach significantly reduces HbA1c levels, it is reasonable to infer that this would yield favorable long-term outcomes for the patients.

Few existing investigations employing proxy measures have explicitly addressed how such self-management programs influence individual skill sets in diabetes care. However, meta-analytical findings demonstrate that pharmacist-led interventions significantly improve clinical parameters such as HbA1c, body mass index (BMI), blood pressure, and patients' capacity for self-management. Additionally, these interventions contribute to enhanced medication adherence, improved understanding of the disease, and better quality of life.

A considerable impact on HbA1c levels was found in studies where pharmacists guided the interventions. The reduction in HbA1c—approximately 0.71% [0.91; 0.51]—is not only statistically relevant but also clinically meaningful due to its association with reduced microvascular complications [20]. This aligns with findings from previous research reporting an average pooled decrease of $-1.00 \pm 0.28\%$ in HbA1c levels [21], although that analysis included a broad spectrum of pharmacist-led strategies. Systematic reviews suggest that such pharmacist-led models are almost three times more effective than those conducted by nurses, physicians, or certified diabetes educators [22].

Moreover, one study indicated a relative risk value of 1.83 [1.44; 2.33] [23] favoring pharmacist-led disease management for diabetes, underlining their value in achieving clinical goals. Prior reviews have also pointed to the heterogeneous nature of the intervention designs included in their assessments [21, 23, 24].

An additional variable influencing the pharmacist's role as a diabetes educator is patients' socioeconomic status. Demographic data revealed that over half (55%) of the participants had monthly incomes below 60,000 PKR, which often correlates with limited access to quality healthcare and educational resources. The highest level

of education for many participants was at the primary or secondary school level, reinforcing this limitation. In such underserved settings, pharmacists frequently become the primary—and sometimes sole—reliable source of scientific information, offering vital education on diabetes, cardiovascular health, and other comorbidities.

Conclusion

This research aimed to assess the influence of pharmacists, specifically diabetes educators, in enhancing the baseline knowledge of individuals with diabetes and, consequently, improving their quality of life. To achieve this, the study implemented randomized controlled trials, evaluating participants' understanding of essential medical concepts related to type 2 diabetes through DAI scoring, MDKT assessments, and EQ-VAS. The resulting data were analyzed using SPSS, with demographic details reviewed initially, followed by paired statistical tests applied to the sample. The findings of the study highlighted that factors contributing to a reduced quality of life among Pakistani diabetes patients include insufficient physical activity and lack of self-care motivation, both of which, when combined with their underlying health conditions, are crucial for overall well-being. Additionally, the role of pharmacists in improving mental health was evident, as the anxiety levels, measured through the paired t-test, showed a notable impact. In conclusion, the study suggests that diabetes educators significantly contribute to enhancing patient management by fostering self-care practices and promoting both physical and psychological well-being.

Strengths and Limitations

A major strength of this study lies in the execution of scientifically controlled randomized trials to examine the impact of pharmacists serving as diabetes educators on participants' quality of life and knowledge. Additionally, the use of primary data collection allowed for a direct review of medical information. However, a limitation of the study was the absence of follow-up sessions during the data collection phase due to time constraints, which prevented the possibility of conducting yearly or even monthly reviews. Another limitation is the lack of inclusion of participants' perspectives, whether qualitatively or quantitatively. Incorporating feedback on their experiences, changes, and shifts in self-efficacy

could have provided deeper insights into the study's topic.

Future Implications

Given the study's limitations, there are several implications for future research. One potential improvement is addressing the lack of follow-up data by incorporating long-term study designs, involving weekly, monthly, or yearly reviews to evaluate the lasting effects of pharmacist-led education on diabetes management and patients' quality of life. Another suggestion for future studies is the inclusion of patient perspectives, which could be gathered through interviews or surveys, providing a more comprehensive understanding of the impact of such interventions. Additionally, the variables chosen for the randomized controlled trials in this study could be further refined, offering a platform for deeper discussions and reviews of the scientific concepts explored.

Acknowledgments: I would like to express my deepest gratitude to Prof. Dr. Fahad Saleem for his unwavering support throughout this project.

Conflict of Interest: None

Financial Support: None

Ethics Statement: This study was approved by the Department of Pharmacy Practice, Faculty of Pharmacy, BZU Multan (Reference No: 173-A/Pharmacy Practice 02/20).

References

1. Kabir N, Ibrahim SI, Aujara IA, Isah SY. Prevalence of Prediabetes and Its Associated Risk Factors among Staff and Students of Federal University Dutse. *BJMLS*. 2020;5(1):1-9.
2. Prajapati VB, Blake R, Acharya LD, Seshadri S. Assessment of quality of life in type II diabetic patients using the modified diabetes quality of life (MDQoL)-17 questionnaire. *Braz J Pharm Sci*. 2018;53.
3. Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, Duncan BB, et al. IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diabetes Res Clin Pract*. 2022;183:109119.
4. Lee SK, Shin DH, Kim YH, Lee KS. Effect of diabetes education through pattern management on self-care and self-efficacy in patients with type 2 diabetes. *Int J Environ Res Public Health*. 2019;16(18):3323.
5. Bukhsh A, Tan XY, Chan KG, Lee LH, Goh BH, Khan TM. Effectiveness of pharmacist-led educational interventions on self-care activities and glycemic control of type 2 diabetes patients: a systematic review and meta-analysis. *Patient Prefer Adherence*. 2018;12:2457.
6. Zubioli A, Silva MA, Tasca RS, Curi R, Bazotte RB. Pharmaceutical consultation as a tool to improve health outcomes for patients with type 2 diabetes. *Braz J Pharm Sci*. 2013;49(1):85-94.
7. Ghoreishi MS, Vahedian-Shahroodi M, Jafari A, Tehranid H. Self-care behaviors in patients with type 2 diabetes: Education intervention base on social cognitive theory. *Diabetes Metab Syndr*. 2019;13(3):2049-56.
8. Tesfaye T, Shikur B, Shimels T, Firdu N. Prevalence and factors associated with diabetes mellitus and impaired fasting glucose level among members of federal police commission residing in Addis Ababa, Ethiopia. *BMC Endocr Disord*. 2016;16(1):1-9.
9. Hanif S, Ali SN, Hassanein M, Khunti K, Hanif W. Managing People with Diabetes Fasting for Ramadan During the COVID-19 Pandemic: A South Asian Health Foundation Update. *Diabetic Med*. 2020;37(7):1094-102.
10. Gagliardino JJ, Chantelot JM, Domenger C, Ramachandran A, Kaddaha G, Mbanya JC, et al. Impact of diabetes education and self-management on the quality of care for people with type 1 diabetes mellitus in the Middle East (the International Diabetes Mellitus Practices Study, IDMPs). *Diabetes Res Clin Pract*. 2019;147:29-36.
11. Surucu HA, Kizilci S, Ergor G. The impacts of diabetes education on self care agency, self-care activities and hbA1c levels of patients with type 2 diabetes: A randomized controlled study. *Int J Caring Sci*. 2017;10(1):479.
12. Bardan AS, Thaker R, Diab RA, Maurino V, Liu C. Challenging Cases. In *cataract Surgery 2021* (pp. 143-171). Springer, Cham.
13. Silva WH, Dantas DS, Nóbrega BS, Queiroz MD, Alves HD. Evaluation of adherence to pharmacological treatment. *Braz J Pharm Sci*. 2019;55.

14. Aditama L, Athiyah U, Utami W, Qomaruddin MB. Effect of comprehensive medication management on patient empowerment 'type II diabetes mellitus patients in primary care'. *J Adv Pharm Educ Res*. 2021;11(3):43.
15. Pourhoseingholi MA, Vahedi M, Rahimzadeh M. Sample size calculation in medical studies. *Gastroenterol Hepatol Bed Bench*. 2013;6(1):14.
16. Aschner Montoya P, Beck Nielsen H, Bennett P, Boulton A, Colagiuri R, Colagiuri S, et al. Global guideline for type 2 diabetes. *Diabetes Res Clin Pract*. 2014;104(1):1-52.
17. Johnston MP. Secondary data analysis: A method of which the time has come. *Qualitative and quantitative methods in libraries*. 2017;3(3):619-26.
18. Iqbal Q, Bashir S, Bashaar M. Profile and predictors of health related quality of life among type II diabetes mellitus patients in Quetta city, Pakistan. *Health Qual Life Outcomes*. 2017;15(1):1-9.
19. Rehman IU, Chia DW, Ahmed R, Khan NA, Rahman AU, Munib S, et al. A randomized controlled trial for effectiveness of zolpidem versus acupuncture on sleep in hemodialysis patients having chronic kidney disease-associated pruritus. *Medicine*. 2018;97(31):e10764.
20. Stratton IM, Adler AI, Neil HA, Matthews DR, Manley SE, Cull CA, et al. Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. *Bmj*. 2000;321(7258):405-12.
21. Machado M, Bajcar J, Guzzo GC, Einarson TR. Sensitivity of patient outcomes to pharmacist interventions. Part I: systematic review and meta-analysis in diabetes management. *Ann Pharmacother*. 2007;41(10):1569-82.
22. Sherifali D, Bai JW, Kenny M, Warren R, Ali MU. Diabetes self-management programmes in older adults: a systematic review and meta-analysis. *Diabetic Med*. 2015;32(11):1404-14.
23. Greer N, Bolduc J, Geurkink E, Rector T, Olson K, Koeller E, et al. Pharmacist-led chronic disease management: a systematic review of effectiveness and harms compared with usual care. *Ann Intern Med*. 2016;165(1):30-40.
24. Pousinho S, Morgado M, Falcão A, Alves G. Pharmacist interventions in the management of type 2 diabetes mellitus: a systematic review of randomized controlled trials. *J Manag Care Spec Pharm*. 2016;22(5):493-515.