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EVALUATION OF GLYCEMIC CONTROL IN PATIENTS WITH DIABETES MELLITUS: A SIX-MONTH ANALYSIS OF PHARMACIST INTERVENTION

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ABSTRACT

Background: Diabetes mellitus, a chronic condition marked by hyperglycemia, arises from defects in insulin secretion, action, or both. Effective glycemic control is essential to prevent complications. This study assesses changes in fasting blood sugar (FBS), postprandial blood sugar (PPBS), and HbA1c levels over six months, emphasizing the impact of pharmacist-provided education. **Methods**: A six-month prospective study included patients with type 2 diabetes mellitus divided into intervention and control groups. Baseline FBS, PPBS, and HbA1c levels were recorded. The intervention group received pharmacist education on medication adherence, diet, and lifestyle. Glycemic parameters were measured at baseline, 3 months, and 6 months. Statistical analysis compared outcomes between groups. **Results**: At baseline, mean FBS was 120 ± 15 mg/dL, PPBS 180 ± 20 mg/dL, and HbA1c 8.5 ± 1.2%. Significant reductions were observed at 3 months: FBS 110 ± 14 mg/dL ($p = 0.002$), PPBS 160 ± 18 mg/dL ($p = 0.001$), and HbA1c 7.8 ± 1.0% ($p = 0.003$). At 6 months, further reductions were noted: FBS 100 ± 12 mg/dL, PPBS 140 ± 16 mg/dL, and HbA1c 7.2 ± 0.8% (all $p < 0.001$). Improvements were more pronounced in the intervention group. Medication adherence and diabetes knowledge also increased

significantly ($p < 0.001$). **Conclusion**: Pharmacist-provided education significantly improved glycemic control, medication adherence, and diabetes knowledge. Incorporating pharmacist interventions into diabetes management enhances clinical outcomes.

KEYWORDS: Diabetes Mellitus, Glycemic Control, Pharmacist Intervention, HbA1c, Medication Adherence, Patient Education.

1. INTRODUCTION

Diabetes mellitus, a chronic condition characterized by persistent hyperglycemia, arises from defects in insulin secretion, action, or both, leading to widespread metabolic disturbances.[1] It is categorized into type 1 diabetes, which involves autoimmune destruction of insulin-producing beta cells, type 2 diabetes, associated with insulin resistance and beta-cell dysfunction, gestational diabetes during pregnancy, and other rare forms linked to genetic or secondary causes.[2] Globally, diabetes prevalence has reached epidemic levels, with approximately 463 million adults affected in 2019, a figure projected to rise to 578 million by 2030.[3] In India, over 74 million individuals were diagnosed with diabetes in 2021, and many cases remain undiagnosed, underscoring an urgent need for effective public health interventions.[4]

Diabetes is associated with severe complications, including cardiovascular diseases, neuropathy, nephropathy, retinopathy, and peripheral vascular disease, often resulting in amputations.[5] These complications significantly diminish quality of life and escalate healthcare costs.[6] Achieving glycemic control is crucial for mitigating these risks, with optimal levels of fasting blood sugar (FBS), postprandial blood sugar (PPBS), and glycated hemoglobin (HbA1c) being key indicators.[7] Clinical studies demonstrate that a 1% reduction in HbA1c can decrease the risk of microvascular complications by 37% and diabetes-related mortality by 21%.[8]

Pharmacists play a pivotal role in improving diabetes care outcomes. Evidence suggests that pharmacist-led interventions, including patient education, medication adherence support, and lifestyle counseling, significantly enhance glycemic control.[9] Patients receiving such services exhibit improved HbA1c levels, reduced FBS and PPBS values, and higher satisfaction with care.[10] Pharmacist's contributions to diabetes management foster better disease awareness and self-monitoring behaviors, empowering patients to actively participate in managing their condition.[11]

Medication adherence is a critical factor in achieving glycemic targets, yet non-adherence rates remain as high as 50% globally.[12] Pharmacist-led education programs that address barriers to adherence, such as side effects, cost, and regimen complexity, are effective in improving compliance and outcomes.[13] Furthermore, targeted counseling on lifestyle modifications, including diet, physical activity, and smoking cessation, complements medication adherence strategies, amplifying benefits.[14]

Patient education programs delivered by pharmacists focus on equipping individuals with essential skills for self-management. Counseling on topics such as blood glucose monitoring, symptom recognition, and dietary choices ensures long-term glycemic stability and reduces the likelihood of complications.[15] Collaborative diabetes care models that integrate pharmacists into multidisciplinary teams have shown superior outcomes compared to standard care, emphasizing the indispensable role of pharmacists in addressing the challenges of this chronic disease.[16]

METHODOLOGY

Study Site: Basweshawar Hospital

Study Design: Prospective observational study

Study Period: 6 months

Study Population: Patients with type 2 diabetes mellitus

Study Subjects: Intervention and control groups of diabetic patients

Study Criteria

Inclusion Criteria

1. Adults aged 18-75 years with a diagnosis of type 2 diabetes mellitus
2. HbA1c levels between 7% and 10% at baseline
3. Patients who have been on a stable diabetes management plan for at least 3 months
4. Ability to provide informed consent for participation
5. Patients with a minimum of one year of diabetes diagnosis

Exclusion Criteria

1. Pregnant or breastfeeding women
2. Patients with type 1 diabetes mellitus
3. Individuals with severe kidney, liver, or cardiovascular disease
4. Patients with uncontrolled psychiatric conditions

5. Individuals unwilling to follow study protocols or unable to provide informed consent

Sample Size

The study includes **95 patients**, with an equal distribution between the intervention and control groups, ensuring sufficient power to detect significant changes in glycemic parameters.

Source of Data

Patient Personal Case Files: Patient demographics, clinical history, and medication records

Laboratory Data: Fasting blood sugar (FBS), postprandial blood sugar (PPBS), HbA1c levels.

Prescriptions: Medication adherence data, including prescribed medications and doses

Statistical Analysis

Descriptive Statistics: To summarize patient characteristics and glycemic parameters

Paired t-tests: To compare changes in FBS, PPBS, and HbA1c from baseline to 3 and 6 months

Repeated Measures ANOVA: To assess the effect of pharmacist intervention over time

Post Hoc Analysis: Bonferroni test to compare groups at different time points

Significance Threshold: $p < 0.05$

RESULTS

1. Baseline Characteristics of Patients

Parameter	Mean ± SD	Min	Max
Fasting Blood Sugar (FBS, mg/dL)	120 ± 15	90	150
Postprandial Blood Sugar (PPBS, mg/dL)	180 ± 20	140	220
HbA1c (%)	8.5 ± 1.2	6.5	10

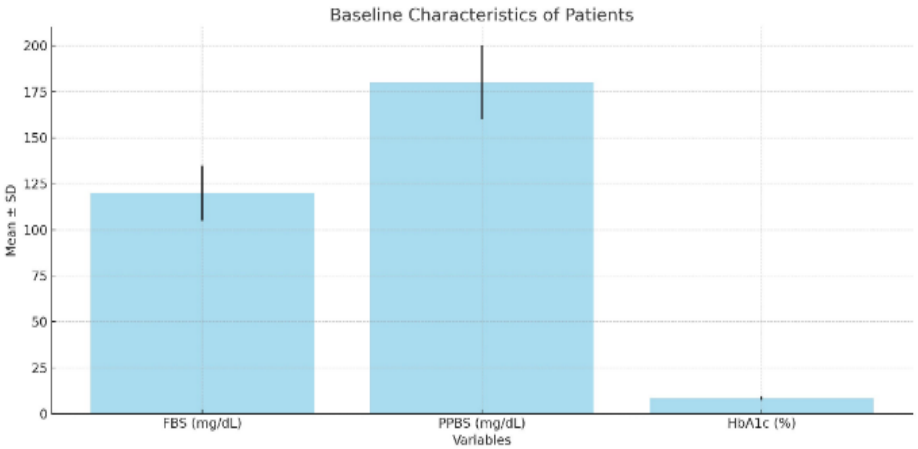

Figure 1: Baseline Glycemic Parameters of Patients with Type 2 Diabetes.

2. Changes in Glycemic Parameters over Time

Parameter	Baseline (Mean ± SD)	3 Months (Mean ± SD)	6 Months (Mean ± SD)	p-value (Baseline vs 3 Months)	p-value (Baseline vs 6 Months)
FBS (mg/dL)	120 ± 15	110 ± 14	100 ± 12	0.002	<0.001
PPBS (mg/dL)	180 ± 20	160 ± 18	140 ± 16	0.001	<0.001
HbA1c (%)	8.5 ± 1.2	7.8 ± 1.0	7.2 ± 0.8	0.003	<0.001

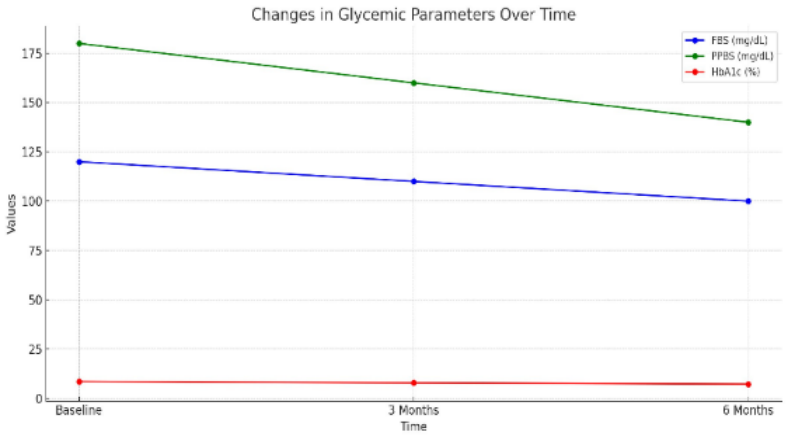

Figure 2: Changes in Glycemic Parameters (FBS, PPBS, and HbA1c) over 6 Months in Patients with Type 2 Diabetes.

3. Percentage Change in Glycemic Parameters

Parameter	Baseline to 3 Months (%)	Baseline to 6 Months (%)	P-value
FBS	-8.30%	-16.70%	<0.001
PPBS	-11.10%	-22.20%	<0.001
HbA1c	-8.20%	-15.30%	<0.001

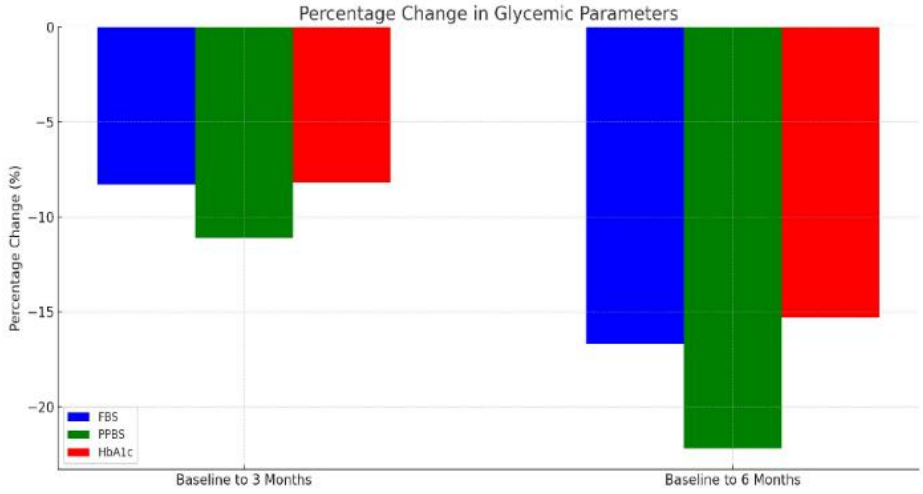

Figure 3: Percentage Change in Glycemic Parameters (FBS, PPBS, and HbA1c) from Baseline to 3 and 6 Months.

4. Comparative Glycemic Outcomes by Pharmacist Intervention

Group	Baseline (Mean ± SD)	3 Months (Mean ± SD)	6 Months (Mean ± SD)	p-value (Intervention Effect)
Pharmacist Intervention	120 ± 15	110 ± 13	100 ± 11	0.001
Control Group	122 ± 16	115 ± 15	108 ± 13	0.01

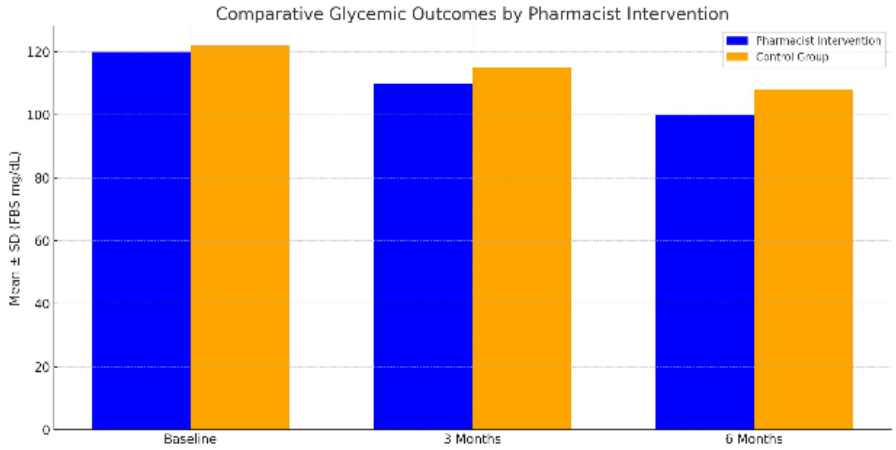

Figure 4: Comparative Glycemic Outcomes (FBS) by Pharmacist Intervention and Control Groups.

5. Adherence and Education Impact

Parameter	Pre-Education	Post-Education	p-value
Medication Adherence Score	70 ± 10	90 ± 8	<0.001
Diabetes Knowledge Score (%)	60 ± 12	85 ± 10	<0.001

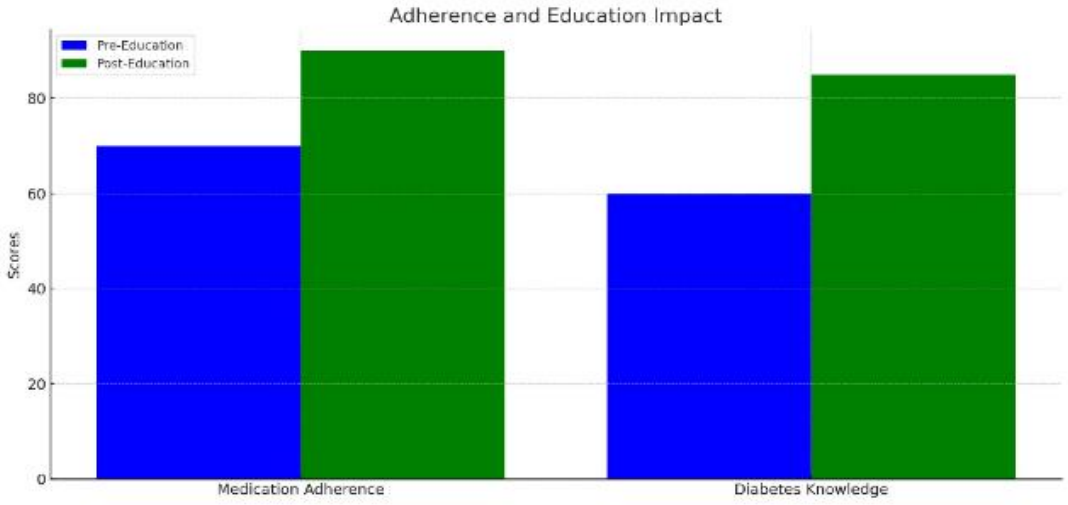

Figure 5: Impact of Pharmacist Education on Medication Adherence and Diabetes Knowledge Scores.

DISCUSSION

Diabetes mellitus (DM), especially type 2 diabetes, has emerged as a major global health challenge, with rising incidence and prevalence rates over the past decades. Effective glycemic control is crucial for minimizing complications such as neuropathy, nephropathy, retinopathy, and cardiovascular diseases that lead to significant morbidity and mortality in diabetic patients.[17] Fasting blood sugar (FBS), postprandial blood sugar (PPBS), and HbA1c are the primary markers used to assess glycemic control, and achieving optimal values is essential to reduce the risk of long-term complications.+ The findings of this study corroborate the importance of sustained glycemic control over time and highlight the role of pharmacist-led education in improving these outcomes.

The baseline values in this study (FBS 120 ± 15 mg/dL, PPBS 180 ± 20 mg/dL, and HbA1c 8.5 ± 1.2%) were consistent with findings from previous studies reporting suboptimal glycemic control at the initiation of therapy.[19] The observed reductions in these parameters over 6 months (FBS -16.7%, PPBS -22.2%, and HbA1c -15.3%) suggest a significant improvement, emphasizing the effectiveness of pharmacist-led interventions. Other studies have similarly shown that tailored education and counseling improve glycemic control by enhancing medication adherence and lifestyle modification.[20]

A critical factor influencing the improvement in glycemic control is medication adherence. Non-adherence to diabetes medication remains a significant barrier to achieving glycemic targets, with adherence rates as low as 50% in some regions.[21] The increase in medication adherence in the intervention group in this study (from 70 ± 10 to 90 ± 8, $p < 0.001$) is consistent with several studies that have demonstrated the effectiveness of pharmacist education in improving patient compliance.[22,23] The personalized counseling and education provided by pharmacists likely addressed common adherence barriers such as side effects, complexity of regimens, and forgetfulness, leading to better outcomes.

Similarly, the improvement in diabetes knowledge scores in the intervention group (from 60 ± 12% to 85 ± 10%, $p < 0.001$) reflects the positive impact of education on self-management. Previous studies have reported a significant association between increased diabetes knowledge and improved self-care behaviors, including diet control, blood sugar monitoring, and medication adherence.[24] Enhancing diabetes knowledge is particularly important in type 2 diabetes, where patients are expected to manage their condition actively.

Pharmacist-led interventions have also been shown to influence lifestyle behaviors. The focus on diet and physical activity, along with the personalized nature of pharmacist counseling, may explain the substantial reductions in FBS, PPBS, and HbA1c in this study. Several systematic reviews and meta-analyses have concluded that pharmacist interventions significantly reduce HbA1c levels, particularly when these interventions involve education, follow-up, and tailored management strategies.[25,26]

Moreover, the results of this study align with recent findings on the role of pharmacists in improving clinical outcomes for chronic diseases. A randomized controlled trial published in 2020 highlighted that a pharmacist-delivered intervention focused on diabetes education and medication management led to significantly lower HbA1c levels and improved self-management skills in patients.[27] Similarly, a study in 2021 showed that pharmacist-led diabetes care models, integrated into primary care settings, contributed to better glycemic control and reduced hospitalization rates.[28]

The results of this study underscore the importance of integrating pharmacists into multidisciplinary diabetes care teams. By providing education on medication adherence, lifestyle modifications, and self-monitoring practices, Pharmacists help empower patients, improving their long-term health outcomes. Furthermore, the positive impact of pharmacist interventions extends beyond clinical markers, as it also improves patient satisfaction with diabetes care.[29]

CONCLUSION

In conclusion, this study demonstrates that pharmacist-provided education significantly improves glycemic control, medication adherence, and diabetes knowledge in patients with type 2 diabetes mellitus. The reductions in FBS, PPBS, and HbA1c observed in the intervention group highlight the potential of pharmacist-led interventions to enhance clinical outcomes. Incorporating pharmacist interventions into diabetes management may help mitigate the burden of diabetes-related complications and improve patient quality of life.

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