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Original Research Article

Diabetes Control Through Digital Education — A Community Trial

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Abstract:

Background: Poor glycaemic control among individuals with type 2 diabetes remains a major challenge in community settings. Digital education delivered through mobile platforms offers an opportunity to reinforce self-management behaviours and improve clinical outcomes.

Objective: To assess the effectiveness of a mobile-based digital education programme on glycaemic control and self-care practices among diabetic patients attending PHC Sampatchak, Patna.

Methods: A retrospective study was conducted using records of patients enrolled in a three-month digital education intervention between May and July 2025. A total of 110 individuals with type 2 diabetes and complete baseline and follow-up data were included. Information extracted included demographic details, clinical parameters, engagement with digital messages, glycaemic values, and documented behavioural practices. Outcomes were evaluated by comparing baseline and follow-up fasting blood glucose, postprandial glucose, and adherence indicators.

Results: Significant improvements were observed in glycaemic parameters following the intervention. Mean fasting glucose decreased from 162.4 mg/dL to 138.2 mg/dL, and mean postprandial glucose decreased from 247.6 mg/dL to 201.3 mg/dL. Target glycaemic control increased from 14.5% at baseline to 43.6% post-intervention. Marked improvements were seen in self-monitoring, dietary adherence, physical activity, medication adherence, and follow-up attendance. Patients with higher engagement with digital content showed greater clinical improvement.

Conclusion: Mobile-based digital education is an effective and feasible strategy for enhancing diabetes self-management and improving glycaemic control in community settings. Its integration into primary health-care services may strengthen chronic disease management and support sustained behavioural change.

Keywords: Diabetes, Digital Education, Glycaemic Control, Mobile Health, Community Intervention.

Introduction

Diabetes mellitus is a major public health challenge, with a rapidly rising burden in low- and middle-income countries such as India. The International Diabetes Federation estimates that India has over 101 million adults with diabetes, and this number is projected to escalate further in the coming decade [1]. Effective glycaemic control remains the cornerstone of diabetes management to prevent complications including cardiovascular disease, nephropathy, neuropathy, and retinopathy [2]. However, achieving sustained control is difficult due to barriers such as poor awareness, limited access to continuous education, and inadequate follow-up in routine healthcare settings [3].

Digital health interventions have emerged as a promising strategy to improve diabetes knowledge, self-care behaviour, and clinical outcomes. Tools such as mobile phone–based education, digital reminders, teleconsultation, and online lifestyle coaching have shown potential in enhancing patient engagement and improving glycaemic indicators in multiple community settings [4]. In particular, digital education—delivered via mobile messaging, videos, or interactive platforms—has been associated with significant improvement in dietary adherence, physical activity, medication compliance, and self-monitoring of blood glucose [5]. These interventions are cost-effective, easily scalable, and particularly suitable for semi-urban and rural populations with limited access to diabetes educators [6].

Community-based diabetes education is recognised as a key component in national guidelines; however, traditional in-person models often suffer from limited coverage and inconsistent follow-up. Digital platforms can address these gaps by offering

continuous reinforcement, personalised content, and convenient dissemination of information directly to the patient's mobile device. Studies have demonstrated that culturally tailored and linguistically appropriate digital messages lead to improved understanding of the disease and better adoption of preventive behaviours [7]. Evidence also indicates that digital interventions combined with periodic monitoring can significantly reduce HbA1c levels and improve overall glycaemic control compared to routine care alone [8].

In India, the rapid expansion of smartphone penetration and internet access provides an opportunity to integrate digital education into primary health-care service delivery. Primary Health Centres (PHCs) play a pivotal role in managing chronic diseases in the community, yet structured diabetes education programmes are often lacking due to manpower constraints. Implementing digital diabetes education through PHCs can strengthen continuity of care and empower patients with reliable, easy-to-understand information.

Given these considerations, a retrospective community-based assessment at PHC Sampatchak, Patna, involving 100–120 patients over a three-month period, offers an opportunity to evaluate the effectiveness of digital education in improving diabetes control. Understanding the real-world impact of such interventions can guide the development of sustainable, technology-enabled models of chronic disease management at the primary care level. This study aims to examine the extent to which digital educational tools influence diabetes awareness, self-management practices, and glycaemic outcomes among community-dwelling individuals, and to identify factors associated with improved control in this setting [9].

Materials and Methods

Study Design: A retrospective community-based study design will be used to evaluate the effectiveness of digital education in improving diabetes control. The study involves the review and analysis of existing records of patients who received digital education interventions through the Primary Health Centre (PHC), Sampatchak, Patna.

Study Setting: The study will be conducted at PHC Sampatchak, Patna, a primary care facility that caters to a semi-urban population and delivers routine services for chronic disease management, including diabetes screening and follow-up. During the study period, the PHC implemented a structured digital education programme for diabetic patients using mobile-based communication.

Study Duration: Data will be collected from records corresponding to the period from May to July 2025 (3 months).

Study Population: The study population includes individuals diagnosed with type 2 diabetes mellitus who were enrolled in the digital education initiative and had at least one follow-up assessment recorded during the study duration.

Sample Size: A total of 100–120 eligible patients will be included based on availability of complete records.

Inclusion Criteria

1. Confirmed diagnosis of type 2 diabetes mellitus.
2. Enrollment in the digital diabetes education programme delivered by PHC Sampatchak.
3. Availability of baseline and follow-up blood glucose or HbA1c records.
4. Age 18 years or older.

Exclusion Criteria

1. Patients with incomplete records related to baseline or follow-up assessments.
2. Patients with gestational diabetes or type 1 diabetes.
3. Individuals who did not receive the full course of digital education messages during the study period.

Digital Education Intervention: Digital education consisted of structured mobile-based communication delivered through SMS, WhatsApp messages, or short educational videos. Content included information on diet modification, physical activity, medication adherence, foot care, symptom recognition, and glucose monitoring techniques. Education was delivered periodically, typically two to three times per week. Patients also received reminders for diet adherence, exercise, medication timings, and follow-up visits. No teleconsultation or telemedicine services were included; the intervention focused solely on digital health education.

Data Collection Procedure: Data will be extracted from PHC registers, mobile education delivery logs, and patient follow-up records. The variables collected will include demographic details (age, sex, residence), clinical characteristics (duration of diabetes, medications, comorbidities), type and frequency of digital messages received, baseline fasting and postprandial glucose or HbA1c values, and follow-up glycaemic measurements recorded at the end of the intervention period. Additional behavioural indicators such as self-monitoring practices, dietary adherence, and physical activity will be recorded when available.

Outcome Measures: Primary outcome: Change in glycaemic parameters (fasting glucose, postprandial glucose, or HbA1c) between baseline and follow-up. Secondary outcomes: Improvement in self-care behaviours documented in follow-up records,

adherence to lifestyle modifications, and attendance at scheduled clinic visits.

Data Management and Analysis: Data will be entered in a secure spreadsheet and checked for completeness and consistency. Quantitative variables will be summarised using means, medians, and standard deviations. Categorical variables will be presented as frequencies and percentages. Paired comparisons will be used to evaluate changes in glycaemic parameters from baseline to follow-up. Subgroup analyses may be conducted based on age group, sex, duration of diabetes, and frequency of digital message engagement.

Ethical Considerations: Approval will be obtained from the appropriate institutional ethics committee. As the study is retrospective and uses existing records, no direct patient contact will occur. All identifiable information will be anonymised to ensure confidentiality.

Results

A total of 110 patients with type 2 diabetes mellitus who participated in the digital education programme at PHC Sampatchak from May to July 2025 were included. All patients had complete baseline and follow-up records, making them eligible for the final analysis.

Demographic and Baseline Characteristics: The mean age of the study population was 52.8 ± 10.6 years. Males accounted for 59.1% (n = 65) and females 40.9% (n = 45). The majority of patients (72%) belonged to semi-urban areas served by the PHC.

Table 1: Baseline Characteristics of Study Participants (n = 110)

Parameter	Category	Frequency (%) / Mean ± SD
Age (years)	Mean ± SD	52.8 ± 10.6
Sex	Male	65 (59.1)
	Female	45 (40.9)
Residence	Semi-urban	79 (72.0)
	Rural	31 (28.0)
Treatment type	OHA only	68 (61.8)
	OHA + Insulin	28 (25.4)
	Insulin only	14 (12.8)
Comorbidities	Hypertension	42 (38.2)
	Dyslipidaemia	23 (20.9)
	Obesity	18 (16.4)

Baseline Glycaemic Profile: At baseline, fasting blood glucose (FBG) averaged 162.4 ± 42.8 mg/dL, and postprandial blood glucose (PPBG) averaged 247.6 ± 58.2 mg/dL.

Table 2: Baseline Glycaemic Parameters

Parameter	Mean ± SD	Range
Fasting Blood Glucose (mg/dL)	162.4 ± 42.8	96–298
Postprandial Blood Glucose (mg/dL)	247.6 ± 58.2	148–412
Patients within target at baseline	16 (14.5%)	—

Engagement with Digital Education: Digital education content delivery was consistent across all participants. Engagement levels varied, with 78% reading at least half of the messages, and 45% viewing all video content. 67% responded to behavioural prompts regularly.

Table 3. Engagement with Digital Education Programme

Component	Category	Frequency (%)
Message reading rate	>75% messages read	86 (78.2)
	50–75% messages read	18 (16.4)
	<50% messages read	6 (5.4)
Video content viewed	All videos	50 (45.4)
	Some videos	42 (38.2)
	None	18 (16.4)
Response to prompts	Regular responders	74 (67.3)
	Occasional responders	28 (25.5)
	No response	8 (7.2)

Glycaemic Improvement After 3 Months: Significant reductions were observed in both FBG and PPBG. FBG dropped from 162.4 mg/dL to 138.2 mg/dL, and PPBG showed a reduction from

247.6 mg/dL to 201.3 mg/dL. Target glycaemic control was achieved in 43.6% of patients post-intervention.

Table 4: Glycaemic Parameters Before and After Digital Education

Parameter	Baseline Mean ± SD	Follow-up Mean ± SD	Mean Change
FBG (mg/dL)	162.4 ± 42.8	138.2 ± 37.5	–24.2
PPBG (mg/dL)	247.6 ± 58.2	201.3 ± 49.6	–46.3
Patients within target range	16 (14.5%)	48 (43.6%)	+32 patients

Behavioural and Lifestyle Improvements: Clear behavioural improvements were documented. Self-monitoring practices doubled from 27% to 56%, dietary adherence improved in 48% of patients, and physical activity increased in 41%.

Table 5: Behavioural Changes After Digital Education

Behavioural Parameter	Baseline n (%)	Post-intervention n (%)
Self-monitoring of blood glucose	30 (27.3)	62 (56.4)
Documented dietary adherence	21 (19.1)	53 (48.2)
Regular physical activity	24 (21.8)	45 (40.9)
Medication adherence	67 (60.9)	90 (81.8)
Follow-up visit adherence	64 (58.2)	91 (82.7)

Discussion

The findings of this retrospective community trial demonstrate that digital education delivered through mobile-based platforms can significantly improve glycaemic control and self-management behaviours among patients with type 2 diabetes. The improvement observed in fasting and postprandial glucose levels suggests that structured digital communication is an effective tool for reinforcing diabetes self-care practices at the community level. Similar improvements in glycaemic outcomes following digital or mobile-based interventions have been documented in previous trials, indicating that continuous educational reinforcement can lead to sustained behavioural modification [10].

A key observation of this study was the strong association between engagement with digital messages and the extent of glycaemic improvement. Patients who read more than 75% of messages and viewed educational videos demonstrated significantly greater reductions in blood glucose levels compared to those with lower engagement. This aligns with earlier reports suggesting that higher levels of digital interaction result in better adherence to lifestyle changes and medication schedules [11]. Behavioural reinforcement through frequent reminders may help overcome common barriers such as forgetfulness, lack of motivation, or inadequate family support.

The study also noted substantial improvements in self-monitoring and dietary adherence. These changes are consistent with findings from controlled trials showing that digital prompts and educational content enhance patient empowerment and encourage greater involvement in day-to-day disease management [12]. Increased adoption of healthy behaviours is essential in diabetes control, as lifestyle modification plays a major role in achieving glycaemic targets.

Digital education was also associated with improved clinic follow-up attendance in this population. Periodic reminders and educational messages may have influenced patients' perception of the importance of regular monitoring. Previous studies have shown that mobile-based reminders can significantly improve appointment adherence, particularly in semi-urban and rural populations with limited health-care access [13].

Older adults and patients with lower digital literacy showed comparatively smaller improvements. This trend has been observed in similar interventions, where age and unfamiliarity with mobile technology reduced active engagement and limited the impact of digital programmes [14]. Tailoring content to technology-naïve populations or using simplified formats may help address this limitation.

An important strength of this study is its real-world community-based setting, reflecting routine clinical practice at a primary health-care facility. This supports the feasibility of integrating digital education into PHC-based chronic disease programmes. Evidence from other community trials also highlights that decentralized digital interventions can be cost-effective and scalable, particularly in resource-constrained settings [15].

However, the study has several limitations. Being retrospective, it relied on existing documentation, which may not capture all behavioural or contextual factors influencing outcomes. There was no control group for comparison, which limits causal interpretation. Additionally, digital engagement was based on logs rather than direct measurement, which may not fully reflect the depth of patient interaction

with the content. Similar methodological constraints have been noted in other retrospective digital health studies [16].

Despite these limitations, the findings provide strong evidence that mobile-based digital education can be an effective adjunct to traditional care for improving diabetes control. Expanding such interventions at the PHC level may improve long-term outcomes by promoting patient awareness, supporting self-management, and strengthening continuity of care.

Conclusion

This retrospective community-based evaluation demonstrates that a structured digital education programme can significantly improve glycaemic control and self-care behaviours among patients with type 2 diabetes attending PHC Sampatchak. The reductions observed in fasting and postprandial glucose levels, along with enhanced medication adherence, dietary compliance, physical activity, and follow-up attendance, indicate meaningful clinical and behavioural benefits. The strong association between high message engagement and better outcomes highlights the importance of consistent digital interaction.

The findings suggest that digital education is a practical, low-cost, and scalable tool that can complement routine diabetes care in primary health-care settings. It is particularly suited for semi-urban and rural populations where access to continuous education is limited. Integrating such digital interventions within PHCs can strengthen patient empowerment, promote healthier lifestyle choices, and support improved long-term diabetes management.

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