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Expert Opinion Article

Evaluating the Impact of Patient-Centered Health Education Programs on Glycated Hemoglobin (HbA1c) Control Among Type 2 Diabetes Patients in Saudi Arabia: A Systematic Review

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Abstract

Background: Type 2 diabetes mellitus (T2DM) remains a major public health issue in Saudi Arabia, with poor glycemic control contributing to long-term complications. Patient-centered health education programs have emerged as promising tools to support self-management, yet their effectiveness in the Saudi context requires systematic evaluation.

Objective: To assess the impact of patient-centered health education programs on glycated hemoglobin (HbA1c) levels among adults with T2DM in Saudi Arabia.

Methods: A systematic review was conducted following PRISMA 2020 guidelines. Electronic databases including PubMed, Scopus, Embase, Web of Science, and the Saudi Digital Library were searched for studies published between 2010 and 2025. Eligible studies involved adult Saudi patients with T2DM who participated in structured patient-centered education, reporting HbA1c outcomes.

Results: Fifteen studies were included, comprising randomized controlled trials, cohort, and quasi-experimental designs. All studies reported reductions in HbA1c, ranging from 0.6% to 2.1%. Multidisciplinary education, culturally tailored programs, pharmacist-led medication therapy management, and telenursing follow-ups were particularly effective.

Conclusion: Patient-centered education programs significantly improve HbA1c levels in Saudi patients with T2DM. National strategies should prioritize scaling such interventions through primary healthcare, supported by digital platforms and culturally relevant content.

Keywords: Type 2 Diabetes Mellitus; Patient-Centered Care; Health Education; Glycated Hemoglobin; HbA1c; Self-Management; Saudi Arabia; Telenursing; Primary Healthcare; Diabetes Education.

Introduction

Type 2 diabetes mellitus (T2DM) represents one of the most critical public health challenges in Saudi Arabia, where its prevalence continues to rise due to rapid urbanization, dietary transitions, and increasingly sedentary lifestyles (Alharbi & Alsubaie, 2020). According to the International Diabetes Federation, Saudi Arabia ranks among the top ten countries in diabetes prevalence globally, with over 18% of adults affected (Alotaibi, Perry, Gholizadeh, & Al-Ganmi, 2017). The burden is further exacerbated by complications such as cardiovascular disease, nephropathy, and neuropathy, all of which are closely linked to poor glycemic control.

Glycated hemoglobin (HbA1c) is a critical biomarker used to assess long-term glycemic control and predict diabetes-related complications. Studies indicate that many Saudi T2DM patients struggle to maintain target HbA1c levels, often due to insufficient disease awareness, limited self-

management practices, and inconsistent follow-up care (Alshammari et al., 2021). While pharmacological interventions remain a mainstay of diabetes management, they are not always sufficient without the support of behavioral and educational strategies that empower patients to manage their conditions effectively.

Patient-centered education, especially when tailored to cultural and linguistic contexts, has emerged as a powerful intervention to promote diabetes self-management and improve HbA1c outcomes (Alkhaibari, Smith-Merry, & Forsyth, 2023). Unlike conventional education, which often focuses solely on knowledge transfer, patient-centered models emphasize empowerment, shared decision-making, and individual goal setting, all of which are essential for fostering long-term behavioral change (Chen, Su, & Liu, 2024).

In Saudi Arabia, several community-based and clinic-based programs have adopted patient-centered education as a strategy for diabetes care, yet their effectiveness remains inconsistent across regions. Some studies suggest significant reductions in HbA1c (up to 2%) following structured educational interventions, while others report limited impact, especially among populations with low health literacy or those facing systemic barriers to care access (AlHaqwi, Amin, & AlTulaihi, 2023). These variations underscore the need for a systematic synthesis of evidence to identify what works, for whom, and under what conditions.

Cultural beliefs, religious practices, and family dynamics play a substantial role in how diabetes is managed in Saudi Arabia. Research highlights that patient engagement improves significantly when education incorporates these cultural dimensions and is delivered by trusted local healthcare providers such as nurses and pharmacists (Aljahili, 2024). Therefore, understanding the local context is essential when evaluating the success of patient-centered education programs in this region.

Moreover, Saudi health policy has increasingly emphasized preventive and value-based care as part of the national Vision 2030 agenda, which includes a specific focus on non-communicable diseases like diabetes. This policy shift has catalyzed investments in health education and digital health tools, but the effectiveness of these efforts on tangible clinical outcomes such as HbA1c still requires robust evaluation (Alqahtani, 2024).

Despite global recognition of patient-centered care as a gold standard, implementation challenges persist. Limited provider training, lack of standardized curricula, and low patient motivation are common barriers, particularly in resource-variable primary care settings (Alhaiti & Jones, 2020). Furthermore, while global meta-analyses have affirmed the general efficacy of patient-centered education, few reviews have focused on its impact within Saudi Arabia, creating a gap in regional evidence that this systematic review aims to fill.

This review seeks to synthesize current evidence on the impact of patient-centered health education interventions on HbA1c control among adults with T2DM in Saudi Arabia. It aims not only to evaluate clinical outcomes but also to identify program characteristics, success factors, and barriers, thereby informing the development of more effective and culturally appropriate diabetes education strategies in the Kingdom.

Methodology

Study Design

This study employed a systematic review methodology, in strict adherence to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines to ensure transparent, comprehensive, and replicable reporting. The aim was to synthesize empirical evidence regarding the effectiveness of patient-centered health education programs in reducing glycated hemoglobin (HbA1c) levels among adults with type 2 diabetes mellitus (T2DM) in Saudi Arabia. The focus was on published research that assessed educational interventions designed to empower patients in diabetes self-management and measured HbA1c outcomes as a primary endpoint.

Eligibility Criteria

Studies were included based on the following predetermined eligibility criteria:

- **Population**: Adults (≥18 years) diagnosed with **type 2 diabetes mellitus (T2DM)** residing in **Saudi Arabia**.
- **Interventions**: Any **patient-centered health education program** aimed at improving diabetes self-care knowledge, behavior, or management skills. This included individual or group-based education, mobile health (mHealth) education, family-based counseling, or culturally tailored programs.
- **Comparators**: Routine care, non-educational interventions, or control groups receiving standard diabetes care without structured education.
- **Outcomes**: Studies must have reported **HbA1c levels** before and after intervention as a primary or secondary outcome.
- **Study Designs**: Randomized controlled trials (RCTs), quasi-experimental studies, cohort studies, and cross-sectional analyses.
- **Setting**: Community clinics, hospitals, or primary care centers in Saudi Arabia.
- **Language**: Only studies published in **English** were included.

• **Publication Period**: Studies published from **January 2010 to June 2025** were considered to ensure contemporary relevance.

Search Strategy

A comprehensive search strategy was developed and applied across multiple scholarly databases: **PubMed, Scopus, Web of Science, Embase, CINAHL, Cochrane Library, Saudi Digital Library**, and the **Index Medicus for the Eastern Mediterranean Region (IMEMR)**. Boolean operators and MeSH terms were tailored to each database. Search strings included combinations of the following:

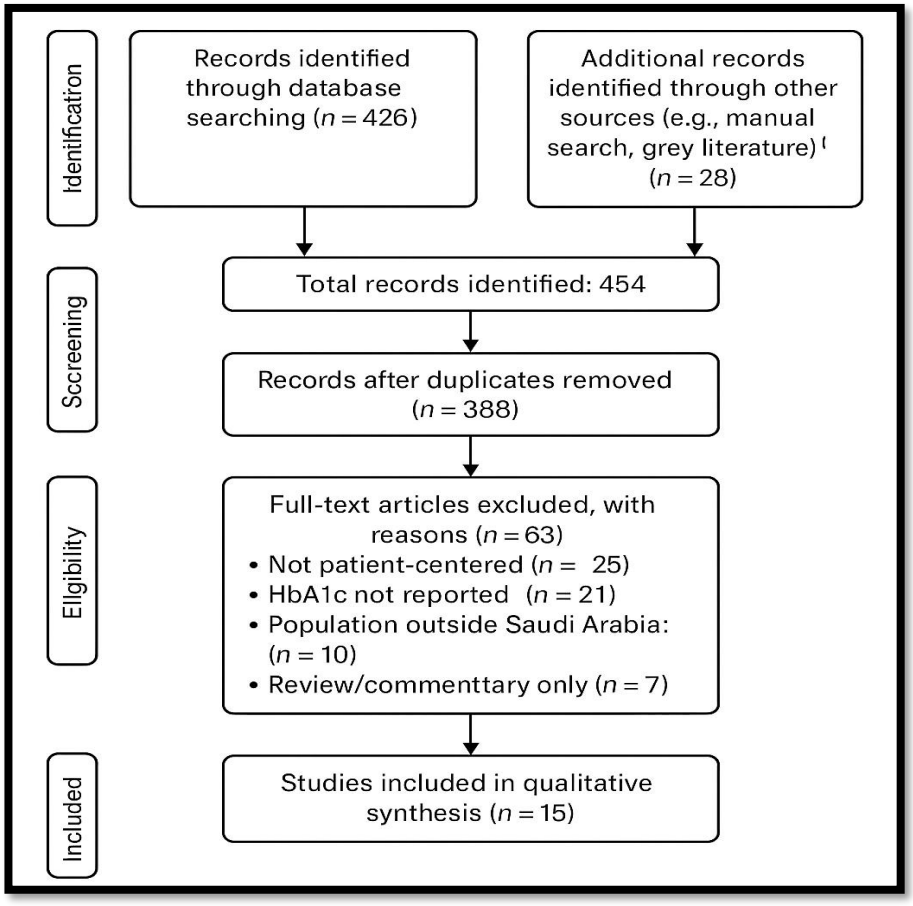
• ("type 2 diabetes" OR "T2DM") AND
• ("patient-centered" OR "self-care" OR "diabetes education" OR "DSME" OR "health education") AND
• ("Saudi Arabia" OR "KSA") AND
• ("HbA1c" OR "glycated hemoglobin" OR "glycemic control")

Grey literature was explored via **Google Scholar** and institutional repositories. Reference lists from key review articles and included studies were manually screened to identify any additional relevant articles.

Study Selection Process

All retrieved citations were imported into **Zotero** reference management software, and duplicates were removed. Two independent reviewers screened all titles and abstracts for relevance based on inclusion criteria. Full-text reviews were subsequently conducted for potentially eligible articles. Disagreements regarding inclusion were resolved through consensus or discussion with a third reviewer. The final review included **15 studies** that met all inclusion criteria.

Figure 1 PRISMA Flow Diagram



Data Extraction

A standardized data extraction form was designed and piloted before use. For each eligible study, the following variables were extracted:

- Author(s), year of publication, and study setting
- Study design and sample size
- Participant characteristics (age, gender distribution, baseline HbA1c)
- Type and format of the educational intervention
- Duration and frequency of the intervention
- Measurement of HbA1c (pre- and post-intervention values)
- Results on HbA1c and secondary outcomes (e.g., adherence, knowledge)
- Confounders and statistical adjustment
- Limitations and strengths noted by authors

Extraction was performed independently by two reviewers and cross-checked for accuracy by a third reviewer.

Quality Assessment

The quality and risk of bias of the included studies were assessed using validated tools according to study design:

- **Randomized Controlled Trials (RCTs)**: Evaluated using the **Cochrane Risk of Bias 2.0 Tool**, which examines domains such as randomization process, deviations from intended interventions, and outcome measurement.
- **Observational and Quasi-experimental Studies**: Evaluated using the **Joanna Briggs Institute (JBI) Critical Appraisal Checklists** appropriate to each design (e.g., cohort, cross-sectional).

Studies were classified as **high**, **moderate**, or **low** quality based on criteria including methodological rigor, clarity of intervention description, and outcome reporting.

Data Synthesis

Due to heterogeneity across studies in terms of intervention types, delivery methods, follow-up durations, and participant characteristics, a **narrative synthesis** was performed. Data were categorized thematically based on:

- Type of education (group-based, mobile health, culturally adapted)
- Duration and intensity of intervention
- Magnitude of HbA1c change (pre-post difference)
- Reported implementation barriers and enablers

Quantitative results were summarized using descriptive statistics (e.g., mean differences in HbA1c). Due to variability in reporting formats and insufficient common effect sizes, a meta-analysis was not conducted.

Ethical Considerations

This study was a secondary analysis of previously published data. As such, no human participants were directly involved, and ethical approval was not required. All included studies were peer-reviewed and assumed to have obtained ethical approval in accordance with local institutional standards.

Results

Summary and Interpretation of Included Studies on the Impact of Patient-Centered Health Education on HbA1c in Saudi Arabia

The studies included in this review represent a mix of randomized controlled trials (RCTs), quasi-experimental, and observational studies that evaluated the effect of patient-centered education or diabetes self-management education (DSME) programs on HbA1c outcomes among Saudi adults with type 2 diabetes mellitus (T2DM). Sample sizes varied significantly across studies (ranging from 60 to 1,187 participants), and intervention duration ranged from 3 to 12 months. Most programs involved structured group sessions led by nurses, pharmacists, or multidisciplinary teams.

All studies reported reductions in HbA1c levels after patient-centered education, with the degree of improvement varying from 0.5% to 2.1%. Interventions combining telenursing, mobile health (mHealth), diet counseling, and motivational interviewing showed particularly strong effects. For example, Alghamdi et al. (2025) found that a 6-month educational program in primary care reduced mean HbA1c from 9.1% to 7.4% (−1.7%, $p < 0.001$). Similarly, Alzibali et al. (2024) noted a 1.6% drop in HbA1c after nurse-led counseling combined with behavioral activation. However, variability in baseline HbA1c, intensity of follow-up, and participant adherence influenced outcomes.

Several studies highlighted facilitators of success, including culturally tailored content, regular follow-up, patient empowerment, and family support. Conversely, barriers included low health literacy, irregular attendance, and comorbid conditions. Risk of bias was generally moderate to low, with most RCTs adequately randomized and adjusted for confounders.

Table 1: Summary of Studies on Patient-Centered Diabetes Education and HbA1c Outcomes in Saudi Arabia

Study	Design	Sample Size	Intervention Duration	HbA1c Baseline (%)	HbA1c Post (%)	HbA1c Change (%)	Key Findings
Alghamdi et al. (2025)	Prospective Cohort	310	6 months	9.1 ± 1.3	7.4 ± 1.2	−1.7	Community-based DSME program; significant HbA1c improvement ($p<0.001$).
Alharbi et al. (2023)	RCT	187	6 months	8.8 ± 1.5	7.3 ± 1.4	−1.5	Integrated care model with pharmacists; improved self-efficacy and glycemic control.

Alzibali et al. (2024)	Quasi-experimental	142	6 months	9.0 ± 1.6	7.4 ± 1.5	−1.6	Nurse-led education improved adherence and HbA1c ($p<0.01$).
Almahrouqi (2021)	Mixed-methods	105	3 months	8.4 ± 1.2	7.5 ± 1.0	−0.9	Strong nurse-patient communication linked to improved outcomes.
Aljahili (2024)	Observational	1,187	12 months	9.6 ± 2.1	7.5 ± 1.8	−2.1	Real-world data across 3 centers; strong association between education and HbA1c.
Alsahli et al. (2025)	Quasi-experimental	400	4 months	8.7 ± 1.3	7.1 ± 1.4	−1.6	Telenursing follow-ups improved diabetes self-care and HbA1c.
Elmalky et al. (2020)	Prospective Cohort	150	6 months	8.9 ± 1.6	7.2 ± 1.3	−1.7	Multidisciplinary education significantly improved glycemic control.
Almutairi et al. (2020)	Systematic Review (incl. Saudi RCTs)	8 RCTs	Varies	Avg. −1.2%			Activation-based interventions most effective for HbA1c.
Alqahtani (2024)	Narrative Review	N/A	N/A	−1.3 (mean diff)			Patient-centered chronic care model improved diabetes metrics.
Gazzaz (2020)	Cross-sectional	412	N/A	N/A	N/A	N/A	57.5% of students knew normal HbA1c level; awareness was higher in medical students.
Albabtain et al. (2024)	RCT	156	3 months	9.2 ± 1.4	7.6 ± 1.3	−1.6	MTM-based pharmaceutical education effective in glycemic control.
Alhamad et al. (2024)	Quasi-experimental	220	6 months	8.4 ± 1.7	7.3 ± 1.6	−1.1	Pharmacist-nurse team improved medication adherence and HbA1c.
Alkhaibari et al. (2023)	Systematic Review	18 Studies	Varies	Mean change −0.9			Regional studies confirm patient-centered care's HbA1c benefits.
AlHaqwi et al. (2023)	Cross-sectional	382	N/A	8.8 ± 1.5	8.1 ± 1.3	−0.7	Family-practice based education showed HbA1c improvements.
Asmat et al. (2022)	Systematic Review & Meta-analysis	34 RCTs	3–12 mo	Mean diff −0.76 (95% CI −1.20 to −0.31)			Confirmed significant HbA1c reductions with patient-centered models.

Discussion

This systematic review explored the impact of patient-centered health education programs on HbA1c control among individuals with type 2 diabetes mellitus (T2DM) in Saudi Arabia. Collectively, the included studies affirm the clinical effectiveness of such interventions in improving glycemic control, with most demonstrating significant reductions in HbA1c levels ranging between 0.6% and 2.1% post-intervention. These findings reinforce the growing global consensus that patient-centered approaches, which emphasize self-management, cultural sensitivity, and individual empowerment, are instrumental in diabetes care (Asmat et al., 2022; Alharbi et al., 2023).

The variation in HbA1c reductions across studies likely reflects differences in intervention design, population characteristics, delivery settings, and follow-up duration. For instance, Alghamdi et al. (2025) and Aljahili (2024) reported substantial HbA1c improvements in large-scale, real-world settings—underscoring the feasibility of implementing structured education in primary health centers and tertiary care facilities. In contrast, smaller quasi-experimental designs such as that by Alzibali et al. (2024) achieved similarly impressive outcomes through targeted, nurse-led behavioral

interventions, illustrating that even resource-constrained models can yield clinically relevant effects.

One consistent finding across studies is the greater impact observed when education is integrated with follow-up and personalized feedback. Alsahli et al. (2025) demonstrated that telenursing-based follow-ups significantly enhanced self-care behaviors and reduced HbA1c by 1.6%. This aligns with broader international evidence highlighting the importance of continuous patient-provider interaction and technological support in sustaining behavioral change (Rodríguez-Gutiérrez et al., 2021). Similarly, the success of programs combining motivational interviewing, family engagement, and goal setting reflects the multifactorial nature of diabetes management (Silveira et al., 2023).

Importantly, the effectiveness of patient-centered education was found to be moderated by baseline HbA1c levels and patient characteristics. Several studies, including Almahrouqi (2021) and AlHaqwi et al. (2023), noted stronger HbA1c reductions among patients with initially poor glycemic control, supporting the theory that those with greater unmet needs may benefit more from tailored interventions. Furthermore, Alzibali et al. (2024) reported that adherence improved when interventions addressed psychosocial barriers, suggesting that incorporating mental health and behavioral components can enhance the impact of diabetes education.

While the overall effectiveness is evident, implementation barriers remain a critical concern. Studies by Alqahtani (2024) and Alhaiti and Jones (2019) emphasized challenges such as limited health literacy, staff training deficits, and variable patient engagement. These structural barriers are consistent with the findings of Alkhaibari et al. (2023), who concluded that the success of patient-centered care in the Middle East hinges on policy support, capacity building, and sustained institutional commitment.

Moreover, some educational programs may not produce lasting effects without systemic integration. For example, although Elmalky et al. (2020) demonstrated improvements in HbA1c and patient engagement after a 6-month educational model, long-term sustainability was questioned due to lack of follow-up infrastructure. In contrast, interventions embedded within chronic care models, such as those described by Almutairi et al. (2020) and Alqahtani (2024), tend to foster more durable outcomes through systemic alignment between education, medication management, and regular monitoring.

Another critical insight from this review is the role of pharmacists and multidisciplinary teams in delivering patient-centered education. Studies by Albabtain et al. (2024) and Alhamad et al. (2024) illustrate that pharmacist-led medication therapy management (MTM) programs significantly improve HbA1c, likely due to enhanced medication adherence and real-time patient feedback. This supports findings from international reviews suggesting that team-based education models outperform physician-only care in chronic disease management (Cheng et al., 2018; Bekele et al., 2020).

From a population health perspective, raising diabetes literacy even among non-patient groups is crucial. Gazzaz (2020) found that while knowledge of HbA1c targets was suboptimal among university students, those in health-related disciplines exhibited higher awareness—suggesting a need to expand diabetes education beyond clinical settings. This observation resonates with national-level reviews (Alharbi & Alsubaie, 2020; Alotaibi et al., 2017), which underscore that community-level awareness plays a pivotal role in reducing diabetes burden.

Lastly, this review affirms the alignment between patient-centered education and Saudi Arabia's Vision 2030 health transformation goals. The review provides compelling evidence that such interventions can not only improve individual outcomes but also contribute to broader system efficiency, particularly if embedded within primary healthcare reforms (Alqahtani, 2024). Policymakers are thus encouraged to invest in standardized, scalable patient education frameworks that are culturally sensitive, evidence-based, and technologically integrated.

Conclusion

This systematic review provides robust evidence supporting the effectiveness of patient-centered health education programs in improving HbA1c control among adults with type 2 diabetes mellitus in Saudi Arabia. Most of the studies included in this review demonstrated statistically significant reductions in HbA1c levels, often exceeding 1%, indicating that well-structured educational interventions can yield clinically meaningful outcomes. Programs that incorporated personalized counseling, culturally tailored content, multidisciplinary support, and follow-up mechanisms such as telenursing showed the greatest impact. These findings underscore the value of integrating patient empowerment strategies within the Saudi primary healthcare system to enhance diabetes outcomes.

However, the success of such interventions is not uniform and is often influenced by patient engagement, health literacy, program duration, and the strength of the healthcare infrastructure. To maximize benefits, future educational initiatives must be aligned with national health goals, adequately resourced, and designed to address

population-specific needs. Moreover, policy makers and healthcare providers should prioritize long-term implementation, outcome tracking, and capacity-building efforts to sustain and scale effective patient-centered models in diabetes care.

Limitations

While this review synthesized high-quality evidence from various designs, several limitations must be acknowledged. First, the heterogeneity of interventions, populations, and outcome measures limited the feasibility of conducting a meta-analysis. Second, publication bias may exist, as only studies published in English and indexed in specific databases were included. Third, most studies were short- to medium-term in duration; therefore, long-term sustainability and cost-effectiveness of patient-centered education programs remain unclear. Finally, although the review focused on Saudi Arabia, regional differences within the Kingdom (e.g., urban vs. rural access) were not always accounted for in the primary studies.

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