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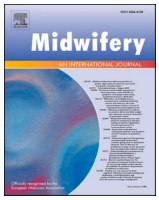

Review Article

Gestational diabetes education management interventions implemented across Arabic-speaking countries: A systematic scoping review

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ABSTRACT

Background The prevalence of Gestational Diabetes Mellitus (GDM) in Arabic-speaking countries varies from 1.2 % (Jordan) to almost 40 % (Saudi Arabia). Untreated GDM increases the risk of poor maternal and neonatal health outcomes.

Objective This systematic scoping review aims to examine the current literature to determine the effectiveness of interventions designed to manage and prevent GDM across Arabic-speaking countries.

Design Systematic scoping review.

Methods Employing the PRISMA-ScR and the AND-EAL for study quality and bias assessment, a comprehensive review of the literature was conducted using 12 databases and search terms relevant to GDM interventions conducted across the League of Arab states. The search period includes intervention studies published up to and including August 31st, 2024.

Findings Eight studies met the inclusion criteria. Interventions conducted included those modeled on the Health Behavior Change model, Theory of Reasoned Action and the PRECEDE model, constructs of Social Cognitive Theory including self-efficacy, GDM self-management, lifestyle management and BASNEF model-based empowerment. The intervention studies had positive effect on GDM knowledge, self-efficacy, A1C levels, quality of life, maternal and neonatal outcomes.

Conclusion Prevention and management of GDM is important in addressing maternal and neonatal health outcomes. Interventions designed with a theoretical framework and those that are culturally tailored are more likely to elicit behavior change.

Introduction

Gestational Diabetes Mellitus (GDM) can have a considerable influence on maternal and neonatal health, leading to numerous complications. The prevalence of GDM in Arabic-speaking countries varies widely ranging from 1.2 % to 39.4 % where the lowest in Yemen and the highest in Saudi Arabia (Al-Rubeaan et al., 2014; Alfadhli et al., 2015; Ali et al., 2016; Chamlal et al., 2020; Chitme et al., 2017; Karasneh et al., 2021; Rayis et al., 2021). This variation in prevalence could be attributed to factors such as accurate recording of rates, disparate diagnostic criteria, variations in healthcare systems, and other factors, including genetic predispositions and lifestyle habits (Al-Rubeaan et al., 2014; Alfadhli et al., 2015; Ali et al., 2016; Chamlal et al., 2020; Chitme et al., 2017; Karasneh et al., 2021; Rayis et al., 2021).

The lifestyle interventions were designed for individuals with GDM that are based on an educational or framework model (Facchinetti et al., 2014; Helm et al., 2022; Lamminpää et al., 2018; Mierzyński et al., 2021; Zugravu et al., 2023). Although most research on lifestyle

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modifications for GDM has been studied in the Western societies, there is limited emphasis on the importance of lifestyle modifications in controlling GDM among women in Arab nations (Al-Hashmi et al., 2018; Chahed et al., 2022; Elnour et al., 2008; Rahmani and Afandi, 2015; Sadiya et al., 2022; Utz et al., 2018). In Arab societies, cultural customs and social norms can pose significant challenges to achieving effective glycemic control—for example, the frequent serving of high-calorie dishes when entertaining guests (Sheffer-Hilel et al., 2024). To effectively address GDM outcomes, it is crucial to develop interventions that take into account these cultural and social norms. Al-Hamdan et al. (2021) developed a diabetes prevention program for Saudi women with prediabetes, incorporating cultural considerations, and found positive outcomes in improving HbA1c levels (Al-Hamdan et al., 2021; Sheffer-Hilel et al., 2024). Conventional GDM intervention programs may be less effective in Arab populations if they do not employ culturally sensitive approaches.

Numerous cultural and structural barriers persist in the adoption of effective lifestyle interventions across Arab populations. Misconceptions regarding the safety of physical activity during pregnancy and socioeconomic limitations can restrict both participation and adherence to recommended lifestyle changes (Aljehani et al., 2021). Furthermore, the implementation of large-scale nutritional interventions remains challenging in the region (Hjelm et al., 2021). Factors such as socioeconomic disparities, limited food availability, cultural beliefs surrounding dietary practices during pregnancy, and inadequate healthcare infrastructure can significantly impede the success of lifestyle intervention programs (May et al., 2024; Raju et al., 2024).

Given the significant impact of GDM on both maternal and neonatal health, the development of effective GDM prevention and management strategies is crucial in ensuring the health of pregnant persons at risk for GDM and their neonates. Interventions have shown promise in reducing GDM-associated risks and complications. However, their effectiveness requires further exploration. Studies have highlighted the importance of effective screening and management strategies, particularly early detection and treatment, which have been associated with improved maternal and neonatal health outcomes. Based on these findings, this systematic scoping review aims to comprehensively examine the current literature to further determine the effectiveness of interventions designed to manage and prevent GDM across Arabic-speaking countries.

Methods

Literature search

This review utilized the PRISMA Extension for Scoping Reviews (Tricco et al., 2018). The Population, Intervention, Comparison, and Outcomes (PICO) design guidelines (Higgins et al., 2019) were incorporated to develop the research question: In pregnant persons living in Arabic-speaking countries with or at risk of GDM (P) do interventions designed to manage and prevent GDM (I) compared to those who do not receive interventions designed to manage and prevent GDM (C) improve health outcomes (O)"and a subsequent inclusion and exclusion criteria was included (see Table 1). An extensive search of the literature was performed across twelve databases recognized for their focus on medical and biomedical research, using a variety of search terms related to GDM interventions in the League of Arab states (See Table 2).

The 22 member countries of the Arab League States (Blair et al., 2014) were considered as the Arabic-speaking countries for this review. The articles obtained were evaluated based on set eligibility criteria (Table 1) to ensure their pertinence to the goals of this systematic scoping review. Furthermore, the bibliographies of the articles sourced were manually examined to uncover any additional studies of relevance. Approval by an institutional or human subjects review board was not sought as the review relied on previously published literature and required no human subject participation.

Table 1
PICOS Criteria for inclusion and exclusion of studies.

Parameter	Inclusion Criteria	Exclusion Criteria
Population	• Pregnant women diagnosed with gestational diabetes living in Arab countries	• Arab pregnant women resident outside Arab countries • Arab patients with other types diabetes (type 1 or type 2) or pre-diabetic) • Arab pregnant women not diagnosed with gestational diabetes
Intervention type	Any type of education intervention that promotes the control of gestational diabetes, including: • Educational interventions. • Training intervention • Multi-componential interventions.	• Interventions that are not delivered in Arab countries • Interventions that do not address gestational diabetes related outcomes.
Comparators	Pre-intervention, baseline of gestational diabetes and its related variables (self-care behavior, birth outcome, pregnancy outcome, glucose level, knowledge, attitudes, practice related to gestational diabetes) of studied groups who were: • Control: received no intervention. • Intervention: receive intervention • Post- intervention	• N/A
Outcomes of interest	• Changes in self-care behavior • Changes mean fasting glucose • Changes in HbA1c • Improvement in birth outcome • Improvement in pregnancy outcome • Changes in knowledge related to gestational diabetes	• Non-Gestational diabetes related outcomes
Study Type:	• Experimental intervention studies with quantitative outcomes • Peer-reviewed original research articles • Original research conference publications	Non-numeric/categorical assessments or qualitative studies Non-Peer-reviewed articles Commentaires Narratives Communications Non-intervention based studies White papers Similar article types Grey literature Qualitative studies
Language	English, Arabic, or French	All other languages

Eligibility criteria

The search focused on research papers published in English, French, and Arabic within peer-reviewed journals. This search took place in September 2024, and it encompasses works made available up to and including August 31st, 2024. Only intervention-focused articles that involved addressing GDM maternal and/or neonatal health outcomes as either the primary intervention or as a component of a multi-behavioral intervention were included. Protocol studies were also included. The review excluded studies on Arabic-speaking communities or migrants of Arab origin residing outside the League of Arab states. It also excluded publications in any language other than English, French, and Arabic, along with brief communications, grey literature, qualitative studies, and interventions not presented in traditional peer-reviewed journals.

Table 2
Electronic databases used with relevant search period and terms.

Databases	Search Period	keywords, search terms, and phrases
ArticleFirst; Biomed Central; CINAHL; EBSCOHost; PubMed; SAGE Reference Online; Index Medicus for the Eastern Mediterranean Region; ScienceDirect; Scopus; SpringerLink; Taylor & Francis; and Wiley Online	Up to and including August 31st, 2024	"Gestational diabetes [All Fields];" OR "Maternal diabetes [All Fields];" AND "education [All Fields];" OR "management [All Fields];" OR "promotion [All Fields];" OR "intervention [All Fields];" OR "Program [All Fields]" AND "Algeria"; "Egypt"; "Bahrain"; "Comoros"; "Djibouti"; "Iraq"; "Jordan"; "Saudi Arabia"; "Kuwait"; Lebanon"; "Libya"; "Mauritania"; "Morocco"; "Oman"; "Palestinian Territories"; "Qatar"; "Yemen"; "Somalia"; "Sudan"; "Syria"; "Tunisia"; "United Arab Emirates."

Study selection and data extraction

Two authors independently conducted the literature search and chose studies for the systematic scoping review. Any differences were resolved through discussion until consensus was reached. In instances where consensus could not be achieved, two separate authors intervened to arbitrate discrepancies. Two authors were responsible for data extraction and organization, while two separate authors independently verified this process. The search strategy was tailored to fit the indexing systems of each database used. To facilitate the screening and selection of studies, Rayyan QCRI software was employed (Ouzzani et al., 2016). The titles and abstracts underwent an initial screening for relevance, and those appeared potentially relevant were further assessed by four authors for their suitability for inclusion based on relevance, quality, and specific criteria for inclusion or exclusion. All articles chosen for potential inclusion were reviewed with the lead author before making a final inclusion decision (Fig. 1). After finalizing the list of studies, the authors extracted and cross verified data for each study's author, publication date, target demographic, country, study type, sample size, intervention details, measured parameters, primary findings, and key recommendations (see Table 3).

Quality assessment of studies

Quality and bias assessment was scored by the authors using the Evidence Analysis Manual of the Academy of Nutrition and Dietetics (Academy of Nutrition and Dietetics., 2022).

Results

The characteristics of the studies

From 2006 to 2022, eight studies were selected to investigate various aspects of gestational diabetes mellitus (GDM). Various interventions were employed across the studies to address gestational diabetes. The reviewed studies ranged in duration from 4 weeks (Al-Hashmi et al., 2018) to 18 months. (Elnour et al., 2008) Seven of the eight studies (Al-Hashmi et al., 2018; Batta et al., 2018; Chahed et al., 2022; Elnour et al., 2008; Lamadah et al., 2022; Sadiya et al., 2022; Utz et al., 2018) included in this systematic scoping review had a positive score based on evaluation using the Evidence Analysis Manual of the Academy of Nutrition and Dietetics Quality Criteria Checklists.(Academy of Nutrition and Dietetics., 2022) One article (Rahmani and Afandi, 2015) was scored neutral based on the relevance questions in the quality criteria checklist. The totality of the evidence from the studies included in this review was graded as II, or fair, (Academy of Nutrition and Dietetics., 2022) with limitations noted based on the small number of articles available.

Interventions

Several studies (Al-Hashmi et al., 2018; Batta et al., 2018; Chahed et al., 2022; Elnour et al., 2008; Lamadah et al., 2022) emphasize the importance of educational interventions in managing gestational

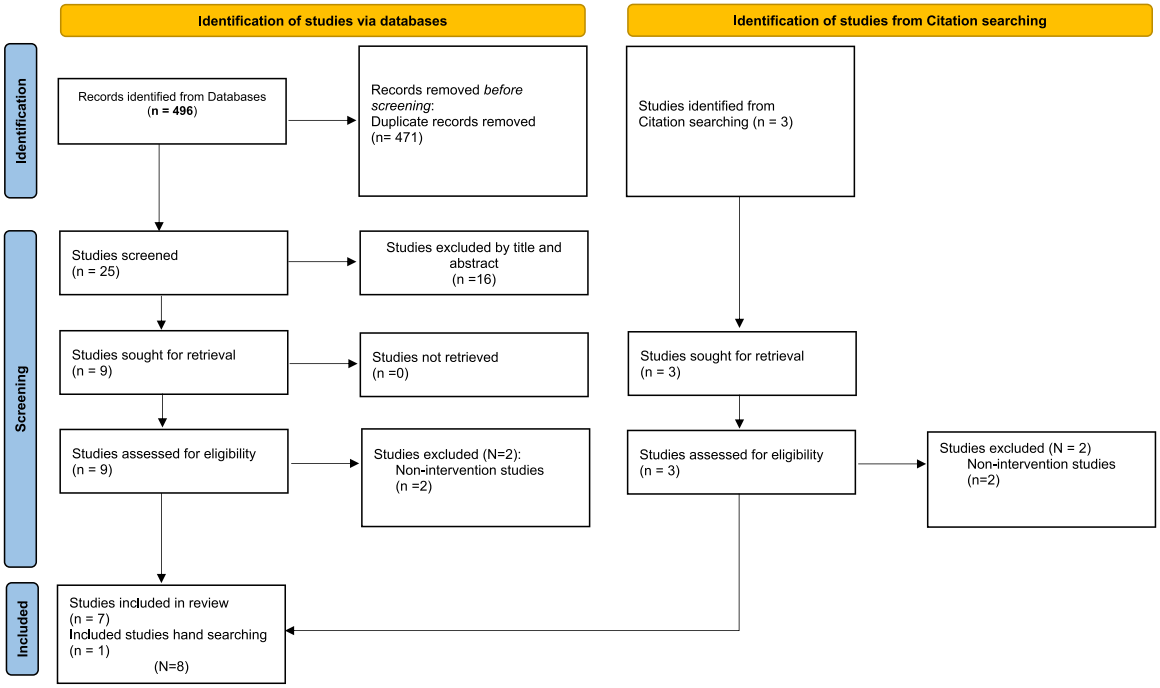

Fig. 1. Flow diagram.

Table 3
Summary of literature search ($n = 8$).

Authors (Year)	Quality Rating (-, 0, +)	Target Population/ Country	Type of Study	Sample Size	Intervention Type and Theoretical Model/Framework	Measured Parameters	Main Results	Main Recommendations
Al-Hashmi et al., 2018	+	Omani women with singleton pregnancies at <33 gestational weeks and diagnosed with GDM Oman	Comparative pre-post study (4 weeks)	90 (45 intervention, 45 control)	Individualized health education intervention using "self-efficacy-enhancing" intervention using constructs of Social Cognitive Theory and Health Behavior Change (motivational messages, role modelling, setting goals, mastery experience)	Self-efficacy and adherence to healthy behaviors (diet, physical activity, blood glucose level)	Intervention group has improved pre-post change in self efficacy scores (9.9 ± 19.6, $p < 0.05$) and healthy behaviours scores (diet (1.1 ± 1.2, $p < 0.05$), physical activity (2.5 ± 2.3, $p < 0.01$), blood glucose level (1.2 ± 0.3, $p < 0.05$)	The "self-efficacy-enhancing" intervention improved self-efficacy and adherence to healthy behaviors
Elnour et al., 2008	+	Patients diagnosed with GDM United Arab Emirates	Randomized, controlled trails (18 months)	165 patients (99 intervention, 66 control)	Education of self-management by interdisciplinary care team using Health Behavior Change constructs, diet, exercise, self-monitoring of plasma glucose. Assessment: baseline, 1 month, 6–7 months and 8–9 months after baseline, and at 3 and 6 months postpartum	DM knowledge HRQOL Insulin use and plasma glucose monitoring, HbA1c, blood pressure, maternal, and neonatal outcomes	Intervention group has improved in knowledge of diabetes, different domains of HRQOL and A1c ($p < 0.05$) in the 2nd,3rd, 4th and 5th assessment compared to the control group. Intervention group has lower maternal complications (Hydramnios (5.1% vs. 15.1 %, $p = 0.027$), episodes of severe hyperglycaemia (3.0% vs. 19.7 %, $p = 0.001$), re-eclampsia toxicity (5.1 % vs. 16.7 %, $p = 0.014$), premature labour (4.0% vs. 13.6 %, $p = 0$ 0.025), eclampsia toxicity (1.0 % vs. 7.6 %, $p = 0$ 0.027), obstructed labour (1.0 % vs. 9.1 %, $p = 0$ 0.012), deficiency in lactation (1.0 % vs. 7.6 %, $p = 0$ 0.027), need for Caesarean section (7.1 % vs. 18.2 %, $p = 0.028$), and frequent urinary tract infection(45.1 % vs. 21.2 %, $p = 0$ 0.002), Intervention group has lower neonatal complications (incidence of neonatal hypoglycaemia (2.0 % vs. 10.6 %, $p = 0$ 0.031), respiratory distress at birth (4.0 % vs. 15.2 %, $p = 0$ 0.020), hyperbilirubinaemia (1.0 % vs. 12.1 %, $p = 0$ 0.003), macrosomia (11.1 % vs. 24.2 %, $p = 0$ 0.032), and large for gestational age (9.0 % vs. 22.7 % $p = 0$ 0.023)	Self-management program improves A1c, HRQOL, and reduce maternal and neonatal complications
Utz et al., 2018	+	Pregnant women attending antenatal care and newly diagnosed	Cluster randomized controlled trial (12 months)	210 (118 intervention, 92 control)	Intervention group: Nutritional counselling for 2 weeks by trained nurse (who received prior training on	Primary outcome: birth weight Secondary outcomes: maternal weight gain, glucose	The number of macrosomia was lower in the intervention (3.5 %) than control group (18.4 %) ($p < 0.001$) Maternal weight gain	Participants in the intervention group had lower birthweight, macrosomia and

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Table 3 (*continued*)

Authors (Year)	Quality Rating (-, 0, +)	Target Population/ Country	Type of Study	Sample Size	Intervention Type and Theoretical Model/Framework	Measured Parameters	Main Results	Main Recommendations
		with GDM Morocco			nutrition counselling) Control group: standardized medical care (referral to MD) for further management	levels during follow-up, pregnancy related (mode of delivery), obstetric (prolonged labor, pre/ eclampsia, shoulder dystocia and) or neonatal outcomes (respiratory distress, hypoglycemia)	per week was lower in the intervention (202.0 ± 13.2 g) than control group (250.0 ± 18.5 g) ($p = 0.032$)	maternal weight gain per week.
Sadiya et al., 2022	+	Pregnant women (≤12 weeks of gestation, singleton pregnancy) and having ≥ 2 risk factors for GDM (high-risk ethnic group (Middle Eastern, Southern Asian) first-degree relative with DM 2, pre-pregnancy Body mass index ≥ 30 kg/ m^2, previous macrosomic baby weighing > 4.5 kg, history of GDM or polycystic ovarian syndrome) United Arab Emirates	Open-label randomized clinical trial (12 weeks)	63 (30 intervention, 33 control)	Lifestyle intervention with a licensed dietitian motivational interviewing, SMART (specific, measurable, attainable, relevant and time-bound) goal setting, self-monitoring (pedometer, food log), and problem-solving skills: two face-to-face individualized dietary consultations and two telephonic counseling sessions Nutrition: American Diabetes Association -Physical Activity:150 min of moderate-intensity activity/ week or to monitor a minimum of 10,000 steps/ day (1 hour 40 min daily activity).	primary outcome: incidence of GDM by OGTT at 24–28 gestation weeks Secondary outcomes: gestational weight gain, fetal birth weight, mode of delivery	Intervention group has lower incidence of GDM (33.3 % vs 57.5 %, $p = 0.05$). The risk of GDM was reduced by 74 % after adjusted for age m BMI and family history.	The lifestyle intervention program reduces the risk of GDM.
Rahmani et al., 2015	0	GDM mothers who were followed in a tertiary medical Center United Arab Emirates	Retrospective analysis	200 neonates (100 intervention 2011–12, 100 control 2005–06)	GDM program by multidisciplinary team in diabetes education and nutritional teaching, based on Health Behavior Change constructs and lifestyle intervention techniques	neonatal outcomes (NICU admissions, neonates with hypoglycemia, macrosomia, neonates without complications) and caesarian section	The intervention group (2011) were higher in percentage of caesarian section (22 % vs12 %, $p = 0.013$), and NICU (5.7 % vs 3 %, $p = 0.017$) and lower in overall neonatal complications 2011 (16 % vs 30 %,$p = 0.04$) and hypo- glycemia (3.7 % vs 16.6 %,$p = 0.006$) than 2005 (control)	The GDM Multidisciplinary intervention program has a positive influence on neonatal outcomes
Batta et al., 2018	+	Pregnant patients of gestational age 20–28 weeks with DM Jordan	Randomized controlled longitudinal study	85 (51 intervention group and 34 control)	"Clinical pharmacist-assisted program" of optimizing drug therapy and patient education materials (diabetes, medication use, diet, complications, and blood glucose monitor) for six weeks	Fasting plasma glucose, A1c, GDM knowledge, HRQOL	Intervention group has improved A1c − 0.54 ± 1.47 vs. − 0.08 ± 0.43, $p = 0.04$), GDM knowledge (39.22 ± 2.42 vs. 7.32 ± 1.95, $p < 0.001$), emotional wellbeing (87.96 ± 5 vs. 775.64 ± 10.7, $p < 0.001$), role limitation due to emotional problems (78.62 ± 40.09 vs. 50.59 ± 50.56, $p = 0.007$), general health (76.37 ± 5.11 vs. 73.93 ±	The "Clinical pharmacist-assisted program" improved A1c, knowledge about GDM, and HRQOL

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Table 3 (*continued*)

Authors (Year)	Quality Rating (-, 0, +)	Target Population/ Country	Type of Study	Sample Size	Intervention Type and Theoretical Model/Framework	Measured Parameters	Main Results	Main Recommendations
							3.19, $p = 0.006$), and social function (76.07 ± 13.06 vs. 65.65 ± 16.83, $p < 0.001$) than control group.	
Chahed, 2022	+	Pregnant women diagnosed with GDM in the first trimester Tunisia	Randomized controlled trial (7 months)	Intervention group ($n = 61$) control group ($n = 60$)	Intervention program:"Tailored self-care education" program for 6 days General education information about pathophysiology and complications of GDM Education about the technique of injecting insulin and self-monitoring Nutrition therpay based on British Diabetes Association reommendations	Number of hospitalizations blood glucose level birth term, birth mode, neonatal outcomes (foetal distress, appearance, pulse, grimace, Activity and respiration score, birth weight, hospitalization, respiratory complications, glycemia, foetal infection, birth defect, and intra-uterine foetal death).	The intervention group has lower in number of hospitalizations due to GDM (intervention 1.02± 0.12, control 2.38± 0.49, $p < 0.001$), number of hospitalizations (intervention 1.28± 0.45, control 2.67± 0.85, $p < 0.001$), fasting blood glucose level after following up (intervention 0.92± 0.09, control 1.15± 0.26, $p < 0.001$), number of hypoglycemia at follow up intervention 8. %, control 21.7 %, $p <$ 0.001),	"Tailored self-care education » reduces number of hospoitalization, improves blood glucose level, and maternal and neonatal outcomes.
Lamadah, 2022	+	Gestational diabetic women Alexandria, Egypt	Randomized controlled clinical trial (7 months)	180 (91 intervention and 89 control groups)	Gestational Diabetes Self-Care Behaviors (GD-SCB) for 2 months using personal beliefs, attitudes, subjective norms, behavioral intention, and enabling factors model (BASNEF), grounded in Theory of Reasoned Action and PRECEDE model	total GD-SCB (dietary control, physical activities, insulin regimen, antenatal follow-up, glucose monitoring, management of blood sugar), total BASNEF score (knowledge, personal beliefs, subjective norms, behavioral intention, and enabling factors)	Intervention group has improved total GD-SCB (pre:45.23 ± 4.96 vs. post: 62.82 ± 4.15, $p <$ 0.001), dietary control (pre:10.26 ± 1.29 vs. post: 14.12 ± 1.71, $p <$ 0.001), , physical activities (pre: 7.07± 1.84 vs. post: 10.49 ± 2.08, $p <$ 0.001), insulin regimen (pre:7.57 ± 1.68 vs. post: 10.15 ± 1.29, $p <$ 0.001), antenatal follow-up (pre:7.11 ± 1.14 vs. post: 9.91 ± 1.37, $p < 0.001$), glucose monitoring (pre:5.37 ± 2.01 vs. post: 7.21 ± 1.21, $p <$ 0.001), blood sugar management (pre:7.83 ± 2.88 vs. post: 10.92 ± 2.27, $p < 0.001$),total BASNEF (pre :105.53 ± 14.38 vs. post :169.74 ± 12.06, $p < 0.001$), knowledge (pre:13.79 ± 2.21 vs. post: 23.47 ± 2.43, $p < 0.05$), personal beliefs (pre :18.62± 3.9 vs. post: 26.51 ± 2.31, $p <$ 0.05), subjective norms (pre:21.39 ± 6.35 vs. post: 40.05 ± 6.29, $p <$ 0.001), attitude (pre:20.26 ± 5.1 vs. post: 34.31 ± 4.18, $p <$ 0.001), behavioral intention (pre:16.58 ± 3.99 vs. post: 25.34 ± 4.05, $p < 0.001$), and enabling factors (pre:14.87 ± 2.56 vs. post: 16.83 ± 2.29, $p <$	The intervention program (BASNEF model) improves knowledge, personal beliefs, subjective norms, behavioral intention, and enabling factors among GDM and therefore improves the GD-SCB

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Table 3 (*continued*)

Authors (Year)	Quality Rating (-, 0, +)	Target Population/ Country	Type of Study	Sample Size	Intervention Type and Theoretical Model/Framework	Measured Parameters	Main Results	Main Recommendations
							0.001), compared to post intervention	

Abbreviations:.
A1c: Glycosylated haemoglobin (HbA1c).
DM: Diabetes mellitus.
GDM: Gestational diabetes mellitus.
GD-SCB: Gestational diabetes self-care behaviors.
HRQOL: Health related quality of life.
OGTT: Oral glucose tolerance test.

diabetes, highlighting that educational programs, whether focused on self-efficacy or knowledge and self-care, can lead to improved outcomes in both maternal and neonatal health. Specifically, these interventions can enhance adherence to healthy behaviors, improve knowledge about diabetes, and reduce complications. Educational constructs from several theories and models were employed across the studies; five of the included studies (Al-Hashmi et al., 2018; Elnour et al., 2008; Lamadah et al., 2022; Rahmani and Afandi, 2015; Sadiya et al., 2022) utilized some components of educational theory to inform the intervention. Of the included articles that employed constructs to educate the participants all included components or constructs from two or more models or frameworks (Al-Hashmi et al., 2018; Elnour et al., 2008; Lamadah et al., 2022; Rahmani and Afandi, 2015; Sadiya et al., 2022). Three utilized components of the Health Behavior Change Model (Al-Hashmi et al., 2018; Elnour et al., 2008; Rahmani and Afandi, 2015), one specifically explored self-efficacy (Al-Hashmi et al., 2018), which is closely tied to Social Cognitive Theory, two incorporated lifestyle interventions (Rahmani and Afandi, 2015; Sadiya et al., 2022), and one used BASNEF (Lamadah et al., 2022), grounded in Theory of Reasoned Action and the PRECEDE model. Of the three interventions that did not use a specific theory (Batta et al., 2018; Chahed et al., 2022; Utz et al., 2018), there was, nonetheless, what would be referred to as individualized or tailored education provided to participants, and all three of these interventions were associated with moderate positive findings.

Interventions outcomes

Across the studies included in the systematic scoping review, the main outcomes included self-efficacy, healthful behaviors, physical activity, behavioral intention, blood glucose levels, HbA1c, knowledge of GDM, quality of life, maternal and neonate complications during pregnancy and delivery, and incidence of GDM. The main findings can be categorized into four primary areas-knowledge, attitudes and behavior, physical activity, clinical values, and maternal and neonate outcomes. In four studies (Chahed et al., 2022; Elnour et al., 2008; Rahmani and Afandi, 2015; Utz et al., 2018), maternal and neonate outcomes including hydramnios, premature labor, deficiency in lactation, caesarean frequency, urinary tract infection, respiratory distress at birth, macrosomia, hyperbilirubinemia, large for gestational age, maternal weight gain, NICU admittance, and overall hospitalizations were significantly and positively impacted in the intervention group. For knowledge, attitudes and behavior, there was significant improvement in self-efficacy, healthy behaviors, dietary control, behavioral intention, quality of life, emotional well-being, general health, and social function in four of the reviewed studies. Of the two studies (Al-Hashmi et al., 2018; Lamadah et al., 2022) that included physical activity as an outcome, both found significant positive changes between the intervention and control groups. Finally, in the studies that assessed biochemical or clinical values, there was significantly improved HbA1c, blood glucose, incidence of GDM, fasting blood glucose, and insulin regimens (Al-Hashmi et al., 2018; Batta et al., 2018; Chahed et al., 2022; Elnour et al., 2008; Lamadah et al., 2022; Sadiya et al., 2022).

Discussion

Although the health implications of GDM for mothers (Goldman et al., 1991; Layton et al., 2019; Pace et al., 2017; Rahnemaei et al., 2022; Shah and Sharifi, 2020; Stivalitt Esmeralda Valdez and Eréndira Leticia, 2023) and infants (Mitanchez, 2010; Shah and Sharifi, 2020; Visolyi et al., 2023) have been well documented, prevention of GDM continues to be approached in a varied manner (Egan and Dunne, 2019; Farrar et al., 2017; Lende and Rijhsinghani, 2020; Mpondo et al., 2015). Consensus exists on the frontline approach to treatment of GDM after diagnostic detection, with medical nutrition therapy, dietary and behavioral changes such as increased physical activity, and continued monitoring the primary emphasis for management of GDM (Chiefari et al., 2017; Egan and Dunne, 2019; McIntyre et al., 2019). One recent review found little difference between the type of dietary advice and the majority of GDM related outcomes, however, there were fewer primary caesarean sections in the group that adhered to the Dietary Approaches to Stop Hypertension (DASH) diet (Han et al., 2017). Other literature has found that inclusion of psychosocial support in addition to dietary management of GDM improved outcomes across both domains, suggesting that interventions that focus on more flexible rather than restrictive dietary patterns and emphasize supportive environments may provide a more holistic approach to adherence and management of GDM (Craig et al., 2020; Gilbert et al., 2019; Hernandez et al., 2018; Marchetti et al., 2017). Additional research suggests the potential for a bi-directional impact of anxiety and depression on the incidence of GDM, with GDM diagnosis also increasing the risk of depression and anxiety (OuYang et al., 2021). It is imperative to further examine this intersect, as the hormonal contributions from anxiety, depression, and GDM can all impact the health outcomes of both the mother and the infant (Feng et al., 2020; Hinkle et al., 2016; Morrison et al., 2016; OuYang et al., 2021; Schmidt et al., 2019).

Further complicating the prevention and management of GDM are the multiple potential contributing risk factors to development, including age, familial history of GDM and DM, ethnicity, overweight and obesity, and polycystic ovary syndrome (Choudhury and Devi Rajeswari, 2021; Johns et al., 2018; Plows et al., 2018). Considering the clinically relevant challenges presented in the prevention and management of GDM is important to understand how best to inform interventions aimed at decreasing the incidence and risk of this disease. However, best practice in the development of interventions intended to prevent and manage GDM is equally important. There is evidence that culturally tailoring interventions to impact health behaviors is critical to both initial participation in and continued adherence to intervention goals (Joo and Liu, 2021; McCurley, Fortmann, et al., 2017, 2017; Zilberman-Kravits et al., 2018). Additionally, appropriately designed nutrition education interventions are based on a theoretical framework and incorporate appropriate constructs that elicit behavior change (Alden et al., 2014; Joseph et al., 2017). Of the intervention studies included in this review, three (Batta et al., 2018; Chahed et al., 2022; Utz et al., 2018) do not describe a specific theoretical framework for education components, and none describe cultural tailoring of the

intervention. The moderate positive effect noted in the articles reviewed here could possibly be impacted by the use of audience appropriate theoretical frameworks and inclusion of behavior change constructs to develop the intervention, as well as cultural tailoring of the intervention.

Limitations and areas for future research

Although there is limited evidence currently available, based on this systematic scoping review, interventions designed to prevent or manage GDM across Arabic-speaking countries have a moderately positive effect on GDM management, knowledge, and neonatal health outcomes. Interventions designed with a theoretical framework and that embed behavior change constructs in the intervention and those that are culturally tailored are more likely to elicit the desired behavior change and adherence to the changes post-intervention.

Conclusion

The prevention and management of GDM across Arabic-speaking countries is critical for maternal and infant health. Additional research on interventions that incorporate culturally appropriate tailoring and are based on a theoretical framework or model should be conducted to advance prevention and GDM management strategies across Arabic-speaking countries.

CRediT authorship contribution statement

Abeer Salman Alzaben: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Investigation, Formal analysis. **Nahla Mohammed Bawazeer:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Formal analysis. **Fatmah Almoayad:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Investigation, Formal analysis. **Nada Benajiba:** Writing – review & editing, Writing – original draft, Formal analysis. **Elizabeth Dodge:** Writing – review & editing, Writing – original draft, Software, Project administration, Methodology, Investigation, Formal analysis, Data curation. **Basil H. Aboul-Enein:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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