

RESEARCH

Open Access



Self-care interventions among women with gestational diabetes mellitus in low and middle-income countries: a scoping review

Ngoc-Anh Thi Dang^{1*}, Hieu Minh Le¹, Ai Nguyen¹, Per C. Glöde², Christina A. Vinter^{2,3}, Jannie Nielsen⁴, Kien Dang Nguyen¹, Tine M. Gammeltoft⁵ and Ditte S. Linde^{2,3}

Abstract

Background Gestational diabetes mellitus (GDM) is a transitory form of diabetes occurring in pregnancy with maternal and neonatal health consequences if left untreated. GDM can, in most instances, be managed non-medically through self-care practices, such as eating healthy or engaging in physical activity. This is especially relevant in a global health context with scarce resources. There is no official definition of “GDM self-care”; hence, the content and delivery modes of such interventions may vary greatly. Therefore, this study aimed to landscape GDM self-care interventions in low- and middle-income countries according to the WHO’s three dimensions of health.

Methods PubMed, Embase, Global Health Library, and Web of Science were searched for published intervention studies that compared the effect of a self-care intervention to standard care or had no comparator. Studies that targeted women with GDM that reported maternal health and/or neonatal health outcomes (physical, mental, and social health outcomes) and were conducted in low- and middle-income countries were included in the review.

Results Twenty-nine studies (randomised controlled trials and non-randomised studies) were included in the review. No studies were conducted in low-income countries, and studies were primarily conducted in Asia. Most interventions were complex and contained several interacting elements in relation to content, delivery mode, duration, and modality. Most interventions aimed to improve the physical health dimension ($n = 28$; 96.6%), whilst the mental health ($n = 11$; 37.9%) and social health dimensions ($n = 9$; 31.0%) were addressed to a lesser extent.

Conclusions Current GDM self-care interventions in LMICs are complex, and the content of self-care interventions overlaps with lifestyle and non-pharmaceutical interventions. It is recommended that the scientific community use a standardised terminology for such interventions and that future GDM intervention studies, as a minimum, use the core outcome set for GDM when developing future studies.

Systematic review registration OSF Registries (2 December 2022) [<https://doi.org/10.17605/OSF.IO/PJZQ3>].

Keywords GDM, Self-care, Low- and middle-income countries, Intervention, Global health

*Correspondence:

Ngoc-Anh Thi Dang

cappu.dang@gmail.com

Full list of author information is available at the end of the article



© The Author(s) 2025. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

Background

Diabetes is a major contributor to the global rise in non-communicable diseases [1, 2]. Gestational diabetes mellitus (GDM) is a transitory form of diabetes that presents during pregnancy, and it is a rising global health issue. If GDM is not managed, it can have short-term health consequences for both the mother and the unborn child, such as high blood pressure, pre-eclampsia, preterm birth, caesarean section (c-section), macrosomia, still-birth, and mental health issues [3–8]. Further, it can have long-term health consequences, such as increased risk of obesity, cardiovascular disease, and type 2 diabetes (T2D) for both mother and child [9–13]. GDM can be identified through universal or risk-based screening in pregnancy, after which healthcare providers need to guide pregnant woman and their families on how to control the condition. Most often, the disease can be managed non-medically, e.g. through self-care activities such as physical exercise or diet change [14–16].

The World Health Organization (WHO) emphasises the importance of locally grounded, informal self-care interventions for global diabetes management [17]. According to the WHO, self-care is “the ability of individuals, families and communities to promote health, prevent disease, maintain health, and cope with illness and disability with or without the support of a health worker” [18], and it is a significant component of people-centred primary health care [18]. However, to the best of our knowledge, there is no official definition of what self-care among pregnant women specifically involves, and little is known about how the different elements of self-care interventions among women with GDM in low- and middle-income countries (LMICs) address the physical, mental and social health dimensions related to GDM. For future studies to develop effective self-care interventions among pregnant women with GDM in LMICs, an overview of the literature is needed.

Aim

This study aims to provide an overview of the content of self-care interventions among pregnant women with GDM in LMICs.

Methods

Protocol and registration

This protocol-driven scoping review has been registered in the OSF registries: <https://doi.org/https://doi.org/10.17605/OSF.IO/SVU7G>. The protocol was developed according to the PRISMA-SCR (Preferred Reporting Items for Systematic Reviews and Meta-Analysis-Extension for Scoping Review) checklist [19]. The manuscript is reported according to the PRISMA checklist (Additional file 1).

Information sources

Block search strings (Additional file 2) were developed in cooperation with a scientific librarian, and four scientific databases (PubMed, Embase, Global Health Library, Web of Science) were searched from inception to 25 May 2024. The following versions of the databases were searched: Embase [Classic + Embase 1947], Global Health Library [Core collection; From 1973], and Web of Science [Core collection; From 1900]. PubMed was searched using its primary database, and no alternative versions exist.

Criteria for considering studies for this review

In this review, the standard core elements of a scoping review (Population, Concept, and Context) were interpreted according to the PICO-SD criteria (Population, Intervention, Comparator, Outcome, Setting, study Design), and studies were included accordingly:

Population

We included studies with a study population of pregnant women diagnosed with GDM. We excluded studies that targeted healthcare providers and family members of pregnant women diagnosed with GDM.

Intervention

We included studies with self-care interventions or studies with a combined self-care and medical management intervention which contained elements of the three dimensions of health according to the WHO definition:

- Self-care interventions focused on improving *physical health*, i.e. pregnancy-related risk factors, such as healthy diet and physical activity.
- Self-care interventions focused on improving *mental health*, i.e. personal well-being, depression, quality of life (QoL), and anxiety.
- Self-care interventions focused on improving *social health*, i.e. social support from friends and family as well as informal access to medical staff.

We included all types of self-care interventions, including psycho-social, counselling, empowerment-based, health education, and advocacy interventions, and had no limitations to the content, format (digital, printed, interactive) or length of the intervention. Hence, the content of the self-care interventions could vary greatly depending on which type of health dimension it contained, and which specific health outcome it aimed to improve. For example, the content of self-care interventions that aimed to improve physical health could contain education or counselling for healthy diets or exercising; self-care interventions that aimed to improve mental health could entail anxiety reduction techniques or relaxation

methods, whilst self-care interventions with social health dimensions could entail social network support or informal access to healthcare personnel.

Comparator

We included studies that compared the self-care GDM intervention to standard GDM care or had no comparator.

Outcome

We included studies that reported maternal and/or neonatal health outcomes according to WHO's three dimensions of health. For example, physical health outcomes included weight, hyper and hypo-glycaemia, proteinuria, blood pressure, c-section, prolonged labour, episiotomy, use of oxytocin, birthweight, blood glucose, stillbirths, pre- and post-mature births, macrosomia; mental health outcomes included postpartum depression and stress, and social health outcomes included patient satisfaction and social support. There were no restrictions on how outcomes should be measured/assessment tools, e.g. outcomes could be self-reported questionnaires (multiple-choice, binary questions, scales), checklists, pregnancy records, birth records, daily self-monitoring blood glucose (SMBG) records, blood samples, exercise records, gestational weight gain, postpartum weight reports, etc.

Setting

We included studies that were set in LMICs according to the World Bank's definition. The World Bank assigns the world's economies into four income groups—low, lower-middle, upper-middle, and high income, and we included studies that were set in low, lower-middle, and upper-middle-income countries [20] (Additional file 3).

Design

We included all types of intervention studies, e.g. randomised controlled trials (RCT), quasi-experimental studies, and pre-post-intervention studies. We excluded reviews, protocols, editorial and conference abstracts as well as non-English articles.

Selection of studies

All citations were imported into Covidence, after which duplicates were removed. Two authors (PCG/DTNA) independently screened titles and abstracts according to the inclusion criteria. Full-text papers were sought for all citations that met the inclusion criteria after the title-abstract screening, after which two authors independently full-text screened the papers (PCG/HLM). Disagreement regarding inclusion was resolved by discussion, and if an agreement could not be reached, an

arbitrator (DSL) made the final decision. Reasons for excluding articles were recorded.

Data extraction

An Excel template was used for data extraction. Four authors conducted the data extraction (PCG/NDK/AN/DTNA). The following data was extracted: Author, journal, publication year, objective, design, inclusion/exclusion criteria, definition of self-care, study period, study population, age, intervention, comparator, length of follow-up, outcome, and trial registration when relevant.

Data synthesis

A critical appraisal of the included studies was not conducted; however, a narrative analysis of all studies was performed. In particular, the content and delivery mode of the self-care interventions were described, how different outcomes were reported, and how the interventions addressed maternal and neonatal physical, mental, or social health according to WHO's three dimensions of health.

Quality appraisal

No quality appraisal was conducted in line with the guidelines for scoping reviews [21].

Results

A total of 3237 citations were found in the scientific databases, and 3 were found through citation searching. These were imported to Covidence, where 2215 duplicates were removed. Thus, 1025 citations were title-abstract screened, and 962 were excluded, resulting in 63 citations being sought for retrieval for full-text screening. However, six could not be retrieved via the university libraries and were therefore excluded. A total of 57 articles were full-text screened, and 29 were included in the review (see Fig. 1).

Characteristics of the included studies

The characteristics of the studies are summarised in Table 1. All included studies were published from 2012 onward, with the majority of studies ($n=17$) published between 2019 and 2024. Studies were primarily (82.8%) set in Asia, specifically in China ($n=9$) [22–30], Iran ($n=8$) [31–38], and India ($n=5$) [13, 39–42]. In addition, a multi-country study was conducted in India, Sri Lanka, and Bangladesh [43], and another was conducted in Thailand [44]. Further, only 7% were set in North Africa, specifically Egypt [45] and Tunisia [46], and in Europe, specifically Turkey ($n=2$) [47, 48]. Finally, one study (3.4%) was conducted in South America, specifically Brazil [49]. There were no studies conducted in low-income countries, while 16 studies were conducted

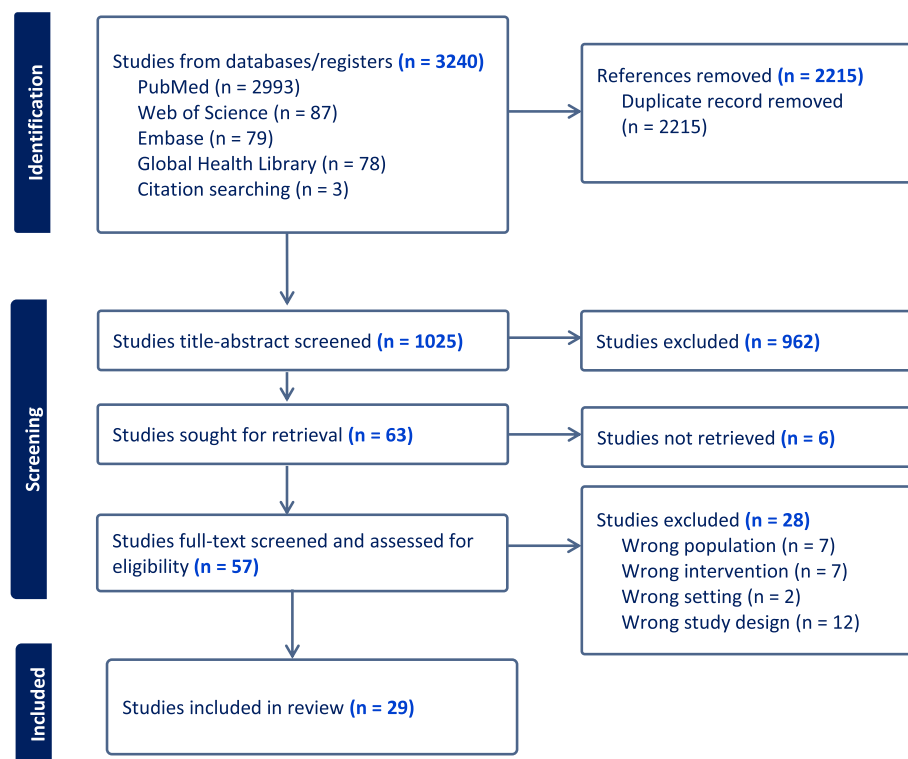


Fig. 1 PRISMA flow chart

in lower-middle-income countries, including Iran [31–38], India [13, 39–43], Egypt [45], and Tunisia [46]. The 13 remaining studies were set in upper-middle-income countries, including China [22–30], Turkey [47, 48], Thailand [44], and Brazil [49] (Table 1 and Fig. 2).

A total of 7391 pregnant women were enrolled in the studies. The mean age among the participants ranged from 26.8 to 34 years, whilst four studies reported age intervals between 20–40 years [39, 40], 20–45 years [46], and 18–45 years [48]. Further, one study did not report the age of participants [31] (Table 1).

The vast majority of studies were RCTs ($n=24$) [22–35, 37, 38, 40, 43–49], whilst five studies were non-randomised intervention studies [13, 36, 39, 41, 42], of which three were pilot intervention studies [36, 39, 41]. The majority of studies compared the intervention to standard care ($n=26$), whilst three studies had no comparator. However, the standard care encompassed varied considerably across studies (Table 1 and Additional file 4).

Characteristics of the self-care interventions

The WHO health dimensions

Table 2 shows the classification of Self-Care Interventions by WHO Health Dimensions. The majority of studies (96.6%) aimed to improve the physical health dimension—51.7% focused solely on the physical health

dimension [13, 22, 24–26, 29, 30, 32, 34, 37, 40–42, 45, 49] whilst approximately one-third of self-care interventions were designed to address two health dimensions, i.e. physical health and mental health ($n=5$) [27, 38, 39, 44, 47], physical health and social health ($n=3$) [23, 28, 46], or mental health and social health ($n=1$) [35]. Five studies addressed all three health dimensions [31, 33, 36, 43, 48].

Interventions aimed to enhance physical health through various individual self-care modifications, mainly dietary modification ($n=25$; 86.2%), physical activities—such as diaphragmatic breathing, aerobic or resistance exercises—or exercises combined ($n=22$; 75.9%), self-monitoring of blood glucose (SMBG) ($n=16$; 55.2%) or medication/insulin therapy if needed ($n=12$; 41.4%). Further, some interventions focused on weight management ($n=6$; 20.7%) or postpartum care/management ($n=5$; 17.2%), whilst two studies concerned foot care [34, 36]. Overall, most interventions were complex (23 out of 28) and integrated at least two individual self-care behaviours to improve physical health. However, three RCTs focused solely on nutrition supplements [26, 37, 49], and two focused on yoga or breathing exercises [39, 47] (Table 2).

Overall, eleven studies contained self-care interventions that aimed to improve mental health, and stress

Table 1 Characteristics of included studies

Author, year [Ref]	Country (LIC/ LMIC/ UMIC)	Study design	Participant		Intervention		Mode of delivery		Comparator (SC = standard care; NA = not applicable)	Outcome measure
			Sample size (N) (I/C)	Age [mean/ range] (I/C)	Type of self-care intervention (P/M/S)	Intervention content	Doses	Follow-up [months]		
Xu, 2024 [29]	China (UMIC)	RCT	504 (248/256)	28.6 (I) 29.1 (C)	P (Lifestyle modification)	Subsidised GDM care (health education on diet, exercise, SMBG; telephone reminders; and follow-up BG retesting)	Face-to-face individual education Digital: reminders (telephone calls/WeChat) Printed materials: dietary and exercise guidelines, free glucose test vouchers Self-monitoring tools: written daily logbook Self-practice: Self-recording diet, exercise A 30-min session at diagnosis time Three free glucose retests up to 34 weeks Clinical obstetricians, nurses	~2.5	SC (diet, exercise) without any subsidies	Continuous/dichotomous outcomes: 15 maternal and 14 neonatal complications associated with GDM were identified through a literature search. E.g. preterm labour (defined as regular uterine contractions occurring at least once every 10 min and resulting in cervical dilatation or effacement before 37 weeks/gestation); fetal macrosomia (defined as birth weight > 4000 g); neonatal jaundice (defined as neonatal jaundice in 28 days after birth). Authors report composite outcomes across the 29 outcomes (proportion)
Guo, 2023 [23]	China (UMIC)	RCT	140 (70/70)	31 (I) 31.1 (C)	P (Lifestyle modification) + S (Couple support)	Couple coping with GDM Program (GDM education on healthy diet and PA; SMBG; weight management; medication; and postpartum management; shared illness appraisals; initiation of collaborative action; and consolidation of collaborative action)	Digital: online educational sessions (Tencent Meeting software), remote counselling, follow-up voice calls, and couple-level discussions (WeChat) Self-monitoring tools: written monitoring log Self-practice: self-recording diet, PA, and SMBG Five 2-h online sessions in the first 2 weeks Follow-up: every 2 weeks until childbirth Researchers	2.5–3.5	SC + Individual GDM education: Two 2-h online sessions in the first 2 weeks period and follow-up every 2 weeks until childbirth Digital: online educational sessions (Tencent Meeting software), remote counselling, follow-up voice calls (WeChat) Self-monitoring tools: written weekly logbook (diet, PA, and SMBG)	Continuous outcome: GDM self-management was measured using the SDSCA questionnaire; 11 items evaluated the number of days in the past week that patients ate a healthy diet, engaged in physical activity, monitored glucose, practised foot care, or smoked. Minor modifications were made to the questionnaire to ensure instrument sensitivity to GDM. Specifically, the term 'diabetes' was replaced with 'gestational diabetes mellitus', and the items of foot care and smoking were removed as they are not typically included in the GDM management plan. The final scale consisted of eight items and three subscales, which were the diet subscale (4 items), physical activity subscale (2 items), and glucose monitoring subscale (2 items). Each entry was scored ranging from 0 to 7, with a total score of 0–56 (lowest to highest)

Table 1 (continued)

Author, year [Ref]	Country (LIC/LMIC/UMIC)	Study design	Participant Sample size [N] (I/C)	Intervention		Intervention content	Mode of delivery Doses Provider	Follow-up [months]	Comparator (SC = standard care; NA = not applicable)	Outcome measure
				Type of self-care intervention (P/M/S)	Age [mean/ range] (I/C)					
Chahed, 2022 [46]	Tunisia (LMIC)	RCT	121 (61/60)	P (Lifestyle modification) + S (Peer support)	20–45	Tailored-care education programme (pathophysiology of GDM and its complications, the technique of injecting insulin by syringe, the equipment and technique of self-monitoring by glucometer, and the nutrition and diet) AND SC	<i>Face-to-face individual:</i> educational sessions, behaviour counselling <i>Face-to-face group:</i> experience exchange subgroups <i>Self-monitoring tools:</i> written daily booklet of GDM self-monitoring, glucometer <i>Self-practice:</i> self-regulate the diet and daily SMBG Educational sessions: 1 h/day x 6 consecutive days, Follow-up consultations: monthly Multidisciplinary team (a midwife, an endocrinologist, a nurse, and a dietitian)	8	SC (endocrinologist consultation with lifestyle, medical advice, regular obstetric consultations, and hospitalisation from 38 weeks, neonatal care)	(1) Continuous outcome: hospitalisations. Measured as the number of times admitted to hospital during pregnancy (2) Continuous outcome: days in the hospital. Measured as the number of days spent in hospital during pregnancy (3) Continuous outcome: BG. A self-monitoring glycaemic cycle at home consists of repetitive blood glucose tests 6 times a day at home: before meals and 2 h after meals 3 times per day with a glucometer provided by the research team. In a glycaemic cycle, if the FBG was ≥ 5.3 mmol/L and/or the blood glucose 2 h after the meal was ≥ 6.7 mmol/L, this means that the woman did not respect the recommendations
Jin, 2022 [24]	China (UMIC)	RCT	131 (65/66)	P (Exercise)	33.51 (I) 32.14 (C)	Original gymnastics (aerobic and resistance combined) and aerobic exercises focus on the upper and lower limbs) AND SC	<i>Face-to-face individual:</i> exercise guidance <i>Digital:</i> Online guidance and consultations (phone/WeChat) <i>Printed materials:</i> a diabetes diary, "Gestational Diabetes Self-Management Helper" <i>Self-monitoring tools:</i> a diary <i>Self-practice:</i> practice 15 min/time and 10 times/week during pregnancy, self-recording diet, SMBG, heart rate while exercising, exercise duration and frequency, and weight gain One guidance at first Follow-up: weekly Clinical obstetricians, exercise specialists, researchers, and nutritionists	0.5	SC (health education on MNT, exercise guidance, and SMBG; individual diet plan and nutritional counselling; suitable exercise types and times; SMBG instructions, and self-recording in the diabetes diary)	(1) Continuous outcome: glycaemic control 2 weeks post-intervention. Hyperglycaemia was defined as fasting plasma glucose (FBG) ≥ 95 mg/dL (5.3 mmol/L) and/or 2-h postprandial plasma glucose ≥ 120 mg/dL (6.7 mmol/L) (2) Continuous outcome: glycaemic control postpartum. T2D was diagnosed when FBG ≥ 7 mmol/L or ≥ 11.1 mmol/L according to the 2-h OGTT, while an FBG ≥ 6.1 mmol/L indicated impaired fasting glucose and 2-h OGTT ≥ 7.8 mmol/L indicates impaired glucose tolerance (3) Continuous outcome: exercise (no description*)

Table 1 (continued)

Author, year [Ref]	Country (LIC/ LMIC/ UMIC)	Study design	Participant		Intervention		Mode of delivery		Comparator (SC = standard care; NA = not applicable)	Outcome measure
			Sample size (N) (I/C)	Age (mean/ range) (I/C)	Type of self-care intervention (P/M/S)	Intervention content	Doses	Provider		
Rokni, 2022 [36]	Iran (LMIC)	Quasi-experimental study	54 (27/27)	33.55 (I) 32.66 (C)	P (Lifestyle modification)+M (stress management)+S (group discussion)	Self-management education (5A model) [BG management, complications, exercise, nutrition, stress management, medication, foot hygiene]	<i>Face-to-face individual:</i> education, behaviour counselling <i>Face-to-face group:</i> education, behaviour counselling, group discussions <i>Digital:</i> movie presentation, slides follow-up (phone calls) <i>Printed materials:</i> pamphlet <i>Self-monitoring tools:</i> a logbook <i>Self-practice:</i> rate and record the scores in their behaviour goal logbook Three 1.5-h educational sessions Follow-up: daily in the first 2 weeks, twice weekly in the next 2 weeks and weekly till the end of 2 months Researchers	2	SC [Routine education on healthy eating and adequate PA] + provided all documents and modules at the end of the study	(1) Continuous outcome: QoL. DQoL was measured using a 15-item questionnaire that evaluated the QoL of patients with type 1 and 2 diabetes. DQoL items were scored using a 5-point Likert scale ranging from 1 (completely disagree) to 5 (completely agree). The minimum and maximum scores of the questionnaire were 15 and 75, with higher scores indicating better QoL. DQoL was then categorised into three groups: acceptable (achieving 75% of the maximum score), somehow acceptable (achieving 50% to 75% of the maximum score), and poor (achieving less than 50% (2) of the maximum score) QoL (3) Continuous outcome: BG. Glucose level was self-monitored and recorded in a researcher-made checklist (No further description)

Table 1 (continued)

Author, year [Ref]	Country (LIC/ LMIC/ UMIC)	Study design	Participant	Intervention		Mode of delivery	Follow-up (months)	Comparator (SC = standard care; NA = not applicable)	Outcome measure
				Type of self-care intervention (P/M/S)	Intervention content				
						Doses			
						Provider			
Simsek-Cetinkay, 2022 [48]	Turkey (UMIC)	RCT	45 (23/22)	P (Lifestyle modification) + M (Psychological counselling) + S (group counselling))	Smartphone-based nursing counselling and feedback (digital education booklet about GDM, diet compliance tracking, BG levels, the status of initiation of insulin therapy, insulin doses, PA monitoring, and a Q&A platform) AND SC	Digital: education with Q&A platform (Mobile application), short reminder (SMS), warning online message from the system, online individual and group counselling Self-monitoring tools: digital diary tracking, PA monitoring, GDM book Self-practice: self-recording SMBG, diet, PA A 15-min hands-on training about the application Daily report (SMBG, diet, PA) to admin page 30-min/group counselling/week x 7 times Researchers, nurses, admin page	2.5	SC (use instructions in glucometer, insulin, dietary counselling, SMBG 4 times/day and record BG, diet, PA in a diary)	(1) Continuous outcomes GDM knowledge, GDM knowledge test scores varied between 0 and 16 points, 0–7 points: low knowledge level, and 8–16 points: high knowledge level (16 MCQ). (2) Continuous outcome: BG (no description*) (3) Compliance in diet and PA (not clear how it was measured). The form consisted of a total of 6 questions to determine the number of daily meals, the status of diet and reasons for noncompliance, BG values, insulin initiation status, GWC, and average daily water consumption. The participants filled in the form themselves daily. The physical activity diary was developed by the researcher to determine the type, frequency, and duration of PA in women and the reasons for not doing PA daily by researching the related literature (4) Patient satisfaction (not clear how it was measured). The questionnaire consisted of 3 open and closed-ended questions. The first question was prepared to determine the satisfaction levels of women, the second question was prepared to determine their opinions about satisfaction, and the third question was prepared to determine their suggestions*

Table 1 (continued)

Author, year [Ref]	Country (LIC/ LMIC/ UMIC)	Study design	Participant		Intervention		Mode of delivery	Follow-up (months)	Comparator (SC = standard care; NA = not applicable)	Outcome measure
			Sample size [N] (I/C)	Age [mean/ range] (I/C)	Type of self-care intervention (P/M/S)	Intervention content	Doses			
Tandon, 2022 [43]	India, Sri Lanka, Bangladesh (LMIC)	RCT	1601 (800/801)	30.7 (I) 31.0 (C)	P (Lifestyle modification) + M (stress management) + S (group counselling)	Lifestyle intervention: diet, exercise, weight gain, stress management	<i>Face-to-face individual:</i> Q&A sessions, discussion <i>Face-to-face group:</i> education, behaviour counselling <i>Digital:</i> pre-recorded voice/text messages and phone calls; Four × 90-min group sessions Two individual sessions 84 voice/text messages 9 phone calls Facilitators	12	SC	(1) Continuous outcome: BG Measured through fasting and 2-h plasma glucose levels from the OGTT: NGT: < 100 mg/dL (to convert to millimoles per litre, multiply by 0.0555) fasting and < 140 mg/dL at 2 h; IFG: 100 to 125 mg/dL at 2 h; IGT: < 100 mg/dL fasting and 140 to 199 mg/dL at 2 h; IFG and IGT: 100 to 125 mg/dL fasting and 140 to 199 mg/dL at 2 h; and T2D: 126 mg/dL or more fasting or 200 mg/dL or more at 2 h
Fiskin, 2021 [47]	Turkey (UMIC)	RCT	60 (30/30)	30.6 (I) 31.4 (C)	P (Exercise) + M (breathing exercise)	Diaphragmatic breathing exercise (BDE)	<i>Face-to-face individual:</i> DBE training <i>Printed materials:</i> DBE brochures <i>Self-monitoring tools:</i> Upper-arm, digital, blood pressure monitor, and glucometer <i>Self-practice:</i> practice 5 min/day for 30 days each morning before getting up at home, self-recording FBGs, pulse rates, respiratory rates, and blood pressures One training course at first Follow-up: check the measurement charts on the 15th and 30th day Researcher	1	SC + taught DBE at the end of the study	Dichotomous outcomes Over a period of 30 days, the intervention group took their measurements before and after the 5 min of DBE, and the control group took their own measurements every morning, before and after a period of 5 min. All outcome measurements were recorded in their charts. When participants came to the hospital for follow-ups (days 15 and 30), the researchers took the measurement outcomes from them and recorded them (1) Decrease the FBG levels in the intervention group* (2) Maintain pulse rates at normal levels of 60–100/min in the intervention group* (3) Maintain respiratory rates at normal levels of 16–20/min in the intervention group (4) Maintain blood pressure at normal levels of < 140/90 mmHg in the intervention group *

Table 1 (continued)

Author, year [Ref]	Country (LIC/ LMIC/ UMIC)	Study design	Participant	Intervention		Intervention content	Mode of delivery	Follow-up [months]	Comparator (SC = standard care; NA = not applicable)	Outcome measure
			Sample size [N] (I/C)	Age [mean/ range] (I/C)	Type of self-care intervention (P/M/S)					
Frank, 2021 [41]	India (LMIC)	Pilot study with quasi-experimental design	30 (15/15)	28.07 (I) 30.20 (C)	P (Exercise)	Exercise [an exercise combined with aerobic and resistance exercises focused on large upper-extremities muscle(s) AND SC	Face-to-face individual: exercise training and supervision Digital: videos, telephonic reminders, remote supervision Self-monitoring tools: diary of exercise Self-practice: practice 45 min/time and thrice/ week with a 2-day gap until 35 weeks of gestation completion One training course at first Supervision: Once in a week (remote supervision), once in 2 weeks (face-to-face supervision) Trained and certified investigator	3	SC (medication, diet, and regular walking)	(1) Continuous outcome: FBG. (No description*) (2) Continuous outcome: PBG. (No description*) (3) Continuous outcome: HbA1c. (No description*) (4) Dichotomous outcome: pregnancy outcome. Measured 24 h after the delivery by using a checklist, which included complications of GDM, are pre-eclampsia, polyhydramnios, maternal distress)

Table 1 (continued)

Author, year [Ref]	Country (LIC/ LMIC/ UMIC)	Study design	Participant	Intervention		Mode of delivery	Follow-up [months]	Comparator (SC = standard care; NA = not applicable)	Outcome measure
				Type of self-care intervention (P/M/S)	Intervention content	Doses			
Ghasemi, 2021 [31]	Iran (LMIC)	RCT	126 (42/42/42)	NA	Educational trial by the GATHER approach counselling [pathophysiology of GDM and its complications, lifestyle changes and self-care behaviours, test BG, childbirth and postpartum preparation]	Face-to-face individual group (I₁): Face-to-face individual counselling Face-to-face group: Printed materials: a GDM booklet, worksheets Social network group (I₂): Digital: WhatsApp, online worksheets, online counselling, online Q&A sessions Printed materials: a GDM booklet I₁ group: Four 45-min individual counselling sessions/4 consecutive weeks (26–32 weeks of gestation) One group counselling (32–34 weeks of gestation) I₂ group: Four 45-min online counselling sessions/4 consecutive weeks (26–32 weeks of gestation) Always available online Q&A sessions Counsellor	5–5.5	SC without counselling service + AGDM booklet	(1) Continuous outcome: self-care behaviours Measured using a 32-item questionnaire that was scored based on a 4-point Likert scale (always = 4, often = 3, sometimes = 2, and never = 1). The total score was between 32 and 128; the higher the score, the better the self-care (2) Continuous outcome: QoL. QoL was measured using a 9-item questionnaire (quality of life gravidarum: QoL-GRAV) that was scored using a 5-point Likert scale. A lower score indicated a higher quality of life. There is no further description of the min–max score (3) Continuous outcome: OGTT. (No description*)

Table 1 (continued)

Author, year [Ref]	Country (LIC/ LMIC/ UMIC)	Study design	Participant		Intervention		Mode of delivery	Follow-up [months]	Comparator (SC = standard care; NA = not applicable)	Outcome measure
			Sample size [N] (I/C)	Age [mean/ range] (I/C)	Type of self-care intervention (P/M/S)	Intervention content				
Renugasundari, 2021 [39]	India (LMIC)	Pilot intervention*	15	20–40	P (Lifestyle modification) + M (QoL)	Short yoga course: Asanas, slow pranayama, relaxation	Face-to-face individual: Yoga training	0.3 (10 days)	NA	(1) Continuous outcome: heart rate, blood pressure rate, pressure product (No description *) (2) Continuous outcome: Bg. (No description *) (3) Continuous outcome: stress Measured using the Perceived Stress Scale (PSS), a 10-item questionnaire with a 5-point Likert scale from 0 to 4. The total score ranged from 0 to 40. Scores ranging from 0 to 13 are indicative of low stress, 14–26 is moderate stress, and 27–40 is considered as high stress level) (4) Continuous outcomes: QoL. QoL was measured using a 16-item questionnaire that covered 5 domains. The domains included physical and material well-being; relations with others; social, community, and civic activities; personal development and fulfillment; and recreation. The questionnaire used a 7-point Likert scale ranging from delighted to terrible. The total score ranged from 16 to 112. The average total score for a healthy population was 90
							Self-practice: 30 min for 7–10 days Daily yoga support is given at the bedside in the obstetrics ward Certified yoga instructor			

Table 1 (continued)

Author, year [Ref]	Country (LIC/ LMIC/ UMIC)	Study design	Participant		Intervention		Mode of delivery	Follow-up (months)	Comparator (SC = standard care; NA = not applicable)	Outcome measure
			Sample size [N] (I/C)	Age [mean/ range] (I/C)	Type of self-care intervention (P/M/S)	Intervention content				
Meng, 2021 [27]	China (UMIC)	RCT	93 (45/48)	26.8	P (Lifestyle modification) + M (Psychological)	Complex nursing intervention: Psychological + health education + lifestyle (diet, exercise) + pregnancy monitoring (the regular production examination), prevention of postpartum complications	<i>Face-to-face individual:</i> education, counselling, discussion <i>Digital:</i> multimedia teaching, WeChat, QQ health education short film <i>Printed materials:</i> health manual reading <i>Self-practice:</i> daily diet, exercise, SMBG, and blood pressure recording Three stages of intervention: First stage: < 28 weeks) Second stage 28–36 weeks Third stage: 36 weeks to discharge Nursing staff and nutritionist	3.5	SC + one-off health education and nutrition and exercise guidance, regular pregnancy monitoring, regular postpartum care, etc)	(1) Continuous outcomes: GWG, amniotic fluid index, BG, * (2) Continuous outcomes: anxiety (no description*) (3) Dichotomous outcomes (no description*) (4) Dichotomous outcomes: neonatal outcomes (no description*) (5) Categorical outcome: nurse satisfaction. Measured using a self-made nursing satisfaction questionnaire that assessed the working attitude and nursing quality. Evaluated by patients and categorised into two groups. Scores ≥ 90 points, 60–89 points, and < 60 points presented very satisfied, satisfied, and dissatisfied, respectively. The satisfaction rate was calculated as follows: Satisfaction rate % = (very satisfied number + satisfied number / total number) $\times$ 100
Rafei, 2021 [35]	Iran (LMIC)	RCT	56 (28/28)	31.6 (I) 33.3 (C)	M (problem-solving) + S (group discussion)	Solution-oriented counselling	<i>Face-to-face group:</i> discussions and Q&A sessions Six 60-min sessions for 6 weeks Researcher with an MSc degree in midwife counselling	1.5	SC + one training session (GA35) + brochure at end of study	Continuous outcome: coping strategy measured using several scales**
Tian, 2021 [28]	China (UMIC)	RCT	269 (133/136)	31.23 (I) 30.93 (C)	P (Lifestyle modification) + S (peer support)	WeChat Group Management [Health education, lifestyle management, and peer support] ANDSC	<i>Digital:</i> WeChat, online management counselling and task cards, photos, online individual guidance, peer support, group lessons <i>Self-practice:</i> self-recording meals and snacks, daily exercise, and SMBG Online management: weekly until delivery Researcher	~2.5–4	SC [one GDM management lesson, patients' lifestyle diaries, including daily diet, exercise, weight, SMBG (5 BG times/day), blood pressure, schedule clinic visits, simple lifestyle guidance, medicine if needed]	Continuous outcome: BG The glycaemic qualification rate was calculated as the number of BG levels within the control range/30 $\times$ 100%. The BG control ranges were FBG (fasting and pre-sleep BG) < 95 mg/dL (5.3 mmol/L) and 2-h PBG (post-breakfast, post-lunch, and post-dinner BG) < 120 mg/dL (6.7 mmol/L)

Table 1 (continued)

Author, year [Ref]	Country (LIC/LMIC/UMIC)	Study design	Participant Sample size [N] (I/C)	Intervention		Intervention content	Mode of delivery Doses Provider	Follow-up [months]	Comparator (SC = standard care; NA = not applicable)	Outcome measure
				Type of self-care intervention (P/M/S)	Age [mean/ range] (I/C)					
Kolivand, 2019 [33]	Iran (LMIC)	RCT	151 (75/76)	P (Lifestyle modification) + M (mental health) + S (group, Spouse discussion)	32.4 (I) 30.2 (C)	Self-care guide package (educational package on diabetes, nutrition, SMBG, PA, insulin injections, mental health on stress reduction, relaxation, respiratory and meditation techniques, pregnancy, delivery, and postpartum care, individualised self-management software)	<i>Face-to-face group:</i> education, discussion, Q&A sessions (5 pregnant women and their spouses or a companion) <i>Digital:</i> educational DVDs, HOMA software, slideshows, telephone calls <i>Printed materials:</i> self-care guidebook <i>Self-monitoring tools:</i> A logbook <i>Self-practice:</i> self-record diet, PA, liquid intake, times and results of SMBG, and times and amounts of insulin injection Three group education sessions Follow-up: 4 weeks Researcher with diabetes self-care educational certificate	1.6 (7 weeks)	SC (visits by physician and short training courses (10 min) about nutrition, BG control, and insulin injections) + self-care guidebook at the end of the intervention	(1–2) Continuous outcomes: BG. Data on plasma glucose results were collected directly from the test results sheet, and the obstetric outcomes were extracted from maternal and neonatal care hospital records. The plasma glucose evaluation tests were performed at a central laboratory using a testing set and by a laboratory expert. The plasma glucose test was performed using the glucose oxidase method with a Mira autoanalyzer (Italy)
Mighafoorvand, 2019 [34]*	Iran (LMIC)	RCT	92 (46/46)	P (Lifestyle modification)	31.0	Self-care training (GDM complications, self-care concept, SMBG, glucose levels, exercise, diet, prevention of infections, foot care)	<i>Face-to-face group:</i> education, Q&A sessions <i>Digital:</i> phone calls <i>Printed materials:</i> educational booklet Four 1-h group training sessions Individual phone calls: every week until delivery Researcher	2.5–3	SC (GDM education + instruction on SMBG at home)	(1) Dichotomous outcome: C-section. Measured by a checklist (no further description*) (2) Dichotomous outcome: macrosomia. Measured by a checklist (no further description*) (3) Continuous outcome: other neonatal outcomes: Preterm labour (no further description*), infant weight/height (measured using a scale, which was calibrated with a 500-g standard weight before each measurement, and the head circumference and height were measured with a tape measure.)

Table 1 (continued)

Author, year [Ref]	Country (LIC/ LMIC/ UMIC)	Study design	Participant		Intervention		Mode of delivery		Comparator (SC = standard care; NA = not applicable)	Outcome measure
			Sample size [N] (I/C)	Age [mean/ range] (I/C)	Type of self-care intervention (P/M/S)	Intervention content	Doses	Follow-up [months]		
Shahzeidi, 2019 [37]	Iran (LMIC)	RCT	80 (40/40)	29.26 (I) 28.57 (C)	P (Nutrition)	Oat bran supplement [2x 100 g of low-fat yogurt plus 15 g of oat bran] + nutritional counselling	<i>Face-to-face individual:</i> nutritional counselling <i>Digital:</i> remote monitoring (telephone) <i>Self-monitoring tools:</i> a recording table <i>Self-practice:</i> daily diet recording Yogurt consumption: before lunch and dinner every day Remote monitoring: weekly counselling; every 2 weeks	1	SC [2 x 100 g of low-fat yogurt] + nutritional counselling	(1–2) Continuous outcomes: BG. The FBS levels were measured using an enzyme colorimetric method based on the glucose level and by an auto-analyser. The HbA1c levels were measured using ion exchange chromatography (3) Continuous outcome: GWG (No further description*)
Liu, 2018 [25]	China (UMIC)	RCT	930 (460/470)	32.5 (I) 32.5 (C)	P (Lifestyle modification)	One-year weight loss program [Diet, PA]	<i>Face-to-face individual:</i> behaviour counselling <i>Digital:</i> telephone calls <i>Printed materials:</i> a nutrition handbook <i>Self-practice:</i> self-select diet, exchange foods, practice exercise 15 to 30 min/day Six counselling sessions Two telephone calls	12	SC [general education about healthy lifestyle on diet and PA]	(1) Continuous outcome: weight loss measured in kilograms (no further description*) (2) Continuous outcome: reduction in initial weight measured in percentages (no further description*)
Tawfik, 2017 [45]	Egypt (LMIC)	RCT	201 (103/98)	30.5 (I) 31.4 (C)	P (Lifestyle modification)	HBM-based health education intervention [T2D risk and prevention, barriers and how to overcome the barriers, self-efficacy, optimal gestational weight gain (GWG), postpartum screening for T2DM, exclusive breastfeeding]	<i>Face-to-face individual:</i> education, guidance Two times (at 24 weeks and before delivery) Treating physicians	~5.5	SC without information on proper gestational and postpartum weight	(1) Dichotomous outcome: knowledge and beliefs. These outcomes were recorded at baseline (24 weeks gestation) and 6 weeks postpartum. Knowledge was assessed using 27 MCQs (2) Dichotomous outcome: breastfeeding (measured by closed-ended questions (Y/N) (3) Continuous outcome: GWG*** (4) Dichotomous outcome: Postpartum weight retention****

Table 1 (continued)

Author, year [Ref]	Country (LIC/ LMIC/ UMIC)	Study design	Participant		Intervention		Mode of delivery	Follow-up (months)	Comparator (SC = standard care; NA = not applicable)	Outcome measure
			Sample size [N] (I/C)	Age [mean/ range] (I/C)	Type of self-care intervention (P/M/S)	Intervention content				
Uma, 2017 [13]	India (LMIC)	Intervention	1048 (212/836)	288 (GDM) 276 (non-GDM)	P (Lifestyle modification)	Structured model of care (MOC) [medical nutrition therapy (MNT), regular PA, insulin, monitoring FBG and PBG]	Face-to-face individual: counselling Digital: a GDM educational game Printed materials: educational booklet Self-monitoring tools: a booklet, a pedometer Self-practice: daily PA and meal recording, weight of mother and baby recording Perform BG testing and adjustment of diet and insulin doses every 2 weeks Follow-up counselling: until delivery Healthcare professionals and trained nutritionists	~3–7	SC	(1) Dichotomous outcome: C-section (y/n) (2) Continuous outcome: birth weight (infants exceeding the 90th percentile for any specific gestation age were considered macrosomia or large for gestational age (LGA). In Indian people, the 90th percentile of birthweight corresponds to 3.45 kg (3) Hence, the cut-off used for macrosomia was 3.5 kg. Low birth weight was defined as <2.5 kg (4) Dichotomous outcome: neonatal hypoglycaemia (y/n) was defined as BG concentration <47 mg/dL (<2.6 mmol/L)

Table 1 (continued)

Author, year [Ref]	Country (LIC/ LMIC/ UMIC)	Study design	Participant		Intervention		Intervention content	Mode of delivery		Follow-up (months)	Comparator (SC = standard care; NA = not applicable)	Outcome measure
			Sample size [N] (I/C)	Age [mean/ range] (I/C)	Type of self-care intervention (P/M/S)			Doses	Provider			
Zandinava, 2017 [38]	Iran (LMIC)	RCT	92 (46/46)	30.3 (I) 31.7 (C)	P (Lifestyle modification) + M (QoL)	Self-care education on group (definition of diabetes, causes, symptoms, treatment and prevention of diabetes complications; PA, proper nutrition) AND SC	Face-to-face group: education, Q&A sessions Printed materials: educational booklet Four sessions (once per week) N/A		SC	1	SC	(1) Continuous outcome: self-care behaviour was measured using 30 questions about PA, diet, and medication. The items were scored based on a four-point Likert scale ranging from always (score 4), often (score 3), sometimes (score 2), and never (score 1). The total score ranged from 30 to 120, with higher scores indicating better self-care (2) Continuous outcome: QoL measured through a 9-item questionnaire in 4 dimensions (physical, psychological, social relations and environment) to evaluate individual experiences of the QoL during pregnancy. The scoring was based on a Likert scale ranging from never (score 0) to absolutely (score 4). The last three questions (questions seven, eight, and nine) had reversed scoring (3–4) Continuous outcomes: fasting + 1 h blood glucose. The blood samples were taken from the participants to measure FBG and blood glucose levels at time points of 1 h-OGTT and 2 h-OGTT. The samples were sent to the laboratory of Tohid Hospital in Sanandaj, Iran

Table 1 (continued)

Author, year [Ref]	Country (LIC/ LMIC/ UMIC)	Study design	Participant Sample size [N] (I/C)	Intervention		Mode of delivery Doses Provider	Follow-up [months]	Comparator (SC = standard care; NA = not applicable)	Outcome measure
				Type of self-care intervention (P/M/S)	Intervention content				
Anjana, 2016 [42]	India (LMIC)	Intervention	151/0	Median (IQR): 29.0 (6.0)	WINGS MOC (Women in India with GDM Strategy Model of Care) (education on GDM and its implications, dietary principles, monitoring, pharmacotherapy, monitoring BG)	<i>Face-to-face individual:</i> counselling, PA guidelines <i>Printed materials:</i> "Having a Baby" handbook (self-care GDM and illustrations of exercises) <i>Self-monitoring tools:</i> a pedometer, booklet <i>Self-practice:</i> daily PA recording One session at first Follow-up: until delivery (alongside ANC) Trained nutritionists and health care professionals	3	NA	(1) Categorical outcome: PA. PA was measured through 4 main domains: work, transport, recreation, and the general activities of daily living domain. Frequency, intensity, type, and duration of activities were calculated in the various domains. Physical Activity Level scores were then computed to determine whether the woman had a sedentary, moderate, or vigorously active lifestyle (2) Continuous outcome: plasma glucose (PG) was measured using the glucose oxidase–peroxidase method using auto-analyser AU2700 (Beckman, Fullerton, CA). (HbA1c) was measured using high-performance liquid chromatography (HPLC) and a Variant machine (BIO-RAD, Hercules, CA) (3) Dichotomous outcome: neonatal outcomes, [Macrosomia (birth weight > 3.5 kg), Shoulder dystocia, neonatal hypoglycaemia (blood glucose < 30 mg/dl in the first 24 h of life), polycythaemia, congenital anomalies, hyperbilirubinemia, fetoscopy tracheal occlusion and admission to neonatal ICU] Continuous outcome: BG****
Carreiro, 2016 [49]	Brazil (UMIC)	RCT	33 (11/11/11*)	32 (GDM1) 34 (GDM2) 30 (NGM)	Diet counselling [30–35 kcal/kg body weight, 40% carbohydrate, 25% protein, 35% fat]	<i>Face-to-face individual:</i> counselling Diet compliance: 2 weeks N/A	0.5	SC	

Table 1 (continued)

Author, year [Ref]	Country (LIC/ LMIC/ UMIC)	Study design	Participant		Intervention		Mode of delivery		Comparator (SC = standard care; NA = not applicable)	Outcome measure
			Sample size [N] (I/C)	Age [mean/ range] (I/C)	Type of self-care intervention (P/M/S)	Intervention content	Doses	Follow-up [months]		
Kaur, 2016 [40]	India (LMIC)	RCT	60 (30/30)	20–40 years	P (Lifestyle modification)	Nutrition counselling and PA	Face-to-face individual: counselling Printed materials: educational booklet	2.5	NA	(1) Continuous outcome: BG, fasting and postprandial blood glucose were calculated using the method Trinder (1969) gave (2) Continuous outcome: serum total cholesterol was calculated based on the method given by Richmond (1973), HDL-C by Lopes-Virella et al. (1997), LDL-C by Friedewald's Eq. (1972), and serum triglycerides by Fossati and Principle (1982)
							Six consultations 15 days apart over 3 months N/A			
KhorshidiRoobahani, 2015 [50]	Iran (LMIC)	RCT	80 (40/40)	30.7 (I) 30.9 (C)	P (Lifestyle modification)	Telephone intervention [insulin injections, diet, clinical tests, and next visit reminder] AND SC	Digital: counselling (phone calls) Self-practice: SMBG 5 times daily 8 × 10–15-min phone calls counselling	2.5	SC [SMBG 5 times daily, 4 telephone calls to record BG without counselling]	(1) Continuous outcome: BG * (2) Dichotomous outcomes: postpartum glucose screening (y/n)
							N/A			
Ma, 2015 [26]	China (UMIC)	RCT	83 (41/42)	30.1 (I) 30.0 (C)	P (Nutrition)	Intensive low-GL dietary intervention AND SC	Face-to-face individual: dietary instruction and counselling Printed materials: Dietary Guidance Handbook with exchange list of low-GL foods Follow-up and diet adjustment: every 2 weeks Dietitians	3–3.5	SC [general dietary intervention, Dietary Guidance Handbook for GDM Women with exchange list of intermediate-to high-GL foods]	(1–3) Continuous outcomes: BG, Venous or postprandial blood samples were collected before and after the intervention at admission to the hospital for delivery. The serum was separated by centrifugation (3000 rpm for 10 min) after clotting at room temperature. The samples were processed and analysed by the Central Laboratory of Guangdong General Hospital. Glucose levels were determined by the oxidase method within 2 h after sampling

Table 1 (continued)

Author, year [Ref]	Country (LIC/ LMIC/ UMIC)	Study design	Participant		Intervention		Mode of delivery	Follow-up (months)	Comparator (SC = standard care; NA = not applicable)	Outcome measure
			Sample size [N] (I/C)	Age [mean/ range] (I/C)	Type of self-care intervention (P/M/S)	Intervention content				
Yang, 2014 [30]	China (UMIC)	RCT	700 (339/361)	29.8	P (Lifestyle modification)	Lifestyle modifications [dietary, PA, SMBG, insulin if needed]	Face-to-face individual: education, counselling	3–3.5	SC [Hospital-based group education (diet, PA), Insulin therapy]	(1) Dichotomous outcome: macrosomia (defined as birth weight ≥ 4000 g). Authors also used large for gestational (2) Age (LGA) as a clinical outcome defined using the Tianjin local reference (3) Continuous outcome: (4) birth weight (measured in grams)
							Face-to-face group: Self-monitoring tools: glucometer with memory function and free test strips Self-practice: SMBG; daily PA recording Three individual sessions at entry, 30th, 34th week Three 2-h group sessions at 27th, 29th, 33rd week Trained nurses and doctors			
Youngwanichsetha, 2014 [44]	Thailand (UMIC)	RCT	170 (85/85)	32.58 (I) 31.24 (C)	P (Lifestyle modification) + M (yoga)	Mindfulness eating, yoga exercise AND SC	Face-to-face individual: training (mindfulness eating, yoga exercise) Digital: videos Printed materials: practice manuals Self-practice: Practice five times/week, 15–20 min/time Two 50-min sessions N/A	2	SC	(1–3) Continuous outcomes: BG. Capillary blood glucose was used for glucometer, and venous blood was sampled for HbA1c testing. A1c was tested in a hospital laboratory using a method certified by the National Glycohemoglobin Standardization Program (NGSP) certified and standardised to the Diabetes Control and Complications Trial (DCCT) assay

Table 1 (continued)

Author, year [Ref]	Country (LIC/LMIC/UMIC)	Study design	Participant		Intervention		Mode of delivery	Follow-up (months)	Comparator (SC = standard care; NA = not applicable)	Outcome measure
			Sample size [N] (I/C)	Age [mean/range] (I/C)	Type of self-care intervention (P/M/S)	Intervention content				
Cao, 2012 [22]	China (UMIC)	RCT	275 (127/148)	30.4	P (Lifestyle modification)	Comprehensive intensive therapeutic regimen [diabetes education, diet, exercise, scheduled clinic visits, strict glucose control, SMBG, insulin therapy]	Face-to-face individual education, behaviour counselling Self-practice: SMBG 4 times/day Regular monitoring and adjustment of diet and therapy: at least every 2 weeks Follow-up: 1–3 years after delivery Diabetes physician	~15–39	SC [group education on diet, exercise, SMBG, insulin therapy]	(1) Dichotomous outcome: postnatal outcomes were recorded for all individuals and included parameters related to the GDM patients (caesarean delivery, pre-eclampsia, and postpartum complications). Measured (y/n) (2) Continuous outcome: birth weight (measured in kilograms) (3) Dichotomous outcome: other neonatal outcomes (y/n); neonatal care unit (NCU) admission, premature delivery, stillbirth, jaundice, neonatal death, congenital malformation, and neonatal hypoglycaemia)

LIC Low-income country, LMIC Lower-middle-income country, UMIC Upper-middle-income country, I intervention group, C Control group, RCT Randomised controlled trial, P Physical health, M Mental health, S Social health, GDM Gestational diabetes mellitus, T2D Type 2 diabetes, SMBG Self-monitoring blood glucose, PA Physical activities, SC Standard care, N/A Not applicable, BG Blood glucose, FBG Fasting blood glucose, 1-h-PBG 1-h postprandial blood glucose, 2-h-PBG 2-h postprandial blood glucose, HbA1c Glycated haemoglobin, HBM Health belief model, HCP Health care professional, GL Glycaemic load, QoL Quality of life, DQOL Diabetes quality of life, Q&A Question and answer, SMS Short message service, GWG Gestational weight gain, SAS Self-Rating Anxiety Scale, SDS Self-Rating Depression Scale, Y/N Yes/no, OR Odds ratio, RR Relative ratio, 95% CI 95% confidence interval, BMI Body mass index, NGDM Non-gestational diabetes mellitus

* Caution for interpretation of outcome due to limited description of outcome measurement and/or results

** (1) DASS-21: 21-item self-assessment tool consisting of 3 equal parts about each of the indicators under study, which was designed to measure negative emotional states of depression, anxiety, and stress, scored based on a 4-point Likert scale (0 = never, 1 = low, 2 = medium, and 3 = very high) over the past week. The total score was between 21 and 63; the higher the score, the worse the mental issue. The scores of depression, anxiety, and stress were calculated by the total score of the relevant items. (2) 48-item Endler and Parker's coping inventory for stressful situations intervention (CISS) contained 3 main fields: 16 items for problem-solving behaviours, 16 for emotion-based behaviours, and 16 for avoidant behaviours. The items were scored using a 5-point Likert scale. The high score in each coping strategy indicated that the subject used that strategy more. The minimum and maximum scores for each coping strategy were 16 and 80

*** Was measured at baseline and before delivery. Pre-pregnancy weight was calculated based on the first obtained weight measurement ($\leq 12 + 6$ -week gestation) and the reported mean range in weight gain in the first trimester according to the Institute of Medicine (IOM) Guidelines. Participants' BMIs were computed using their heights and calculated pre-pregnancy weights. The World Health Organization calibration system was used for categorising pre-pregnancy BMI. Recommended baseline/end-of-pregnancy weight gain was determined for each woman based on the IOM guidelines. Women were weighed at the end of pregnancy (≥ 37 -week gestation), and absolute baseline-end-of-pregnancy weight gain was calculated and checked for meeting recommended levels

**** Was measured at 6 weeks postpartum. Absolute weight retention was determined by subtracting pre-pregnancy weight from weight obtained 6 weeks postpartum. Weight retention at 6 weeks postpartum was classified as meeting recommendations for normal-weight women if reaching pre-pregnancy weight and for overweight and obese if a 5% reduction was achieved from their pre-pregnancy weight based on guidelines of the National Diabetes Education Program (NDEP)

***** CGMS records are measured every 5 min, providing 12 data points per hour, thus reaching 36 data points per hour per patient for the whole 72-h period (12 data points vs 3 days). These 36 measures were organised into frequency percentiles so that each woman had one value representing the 25th, another representing the 50th, and a last representing the 75th percentiles of each hour out of the 24 h. The area under the median (50th percentile) curve (AUC), as calculated by the trapezoid method for each patient, was used to represent potential fetal glucose exposure and consequent insulin secretion, which is, in turn, a growth factor. The average difference between the maximum and minimum measures shows the amplitude, while the difference between the 75th and 25th percentiles represents the interquartile range (IQR). Both amplitude and IQR represent glucose variability, which was also assessed by the hourly standard deviation (SD) average. We used all these three measures to assess variability since there is no consensus on the best way to assess it. Glucose variability is believed to be associated with oxidative stress and inflammation and may lead to cellular damage with potential consequences to both the mother and the foetus. Specific pregnancy-relevant glucose time points were chosen, as suggested by Hernandez et al.: fasting glucose (mean of the 6 measures immediately before 06:00 h), nocturnal glucose (mean of measures from midnight to 06:00 h), premeal glucose (mean of three measures immediately before the beginning of each meal) and glucose within 2 h post-meal, including peak value (highest value within 2 h period after meal), time to peak in minutes and 1-h and 2-h glucose values after meals (taken as the mean of three consecutive values for each). We also included glucose between meals, which was the mean of all the values between 2 h after a meal and the next premeal value. For each one of these variables, the patients had three values, one per day, repeated measures. The groups were also compared by the percentages of time spent with glucose levels less than 60 mg/dL, between 60 and 140 mg/dL, and greater than 140 mg/dL

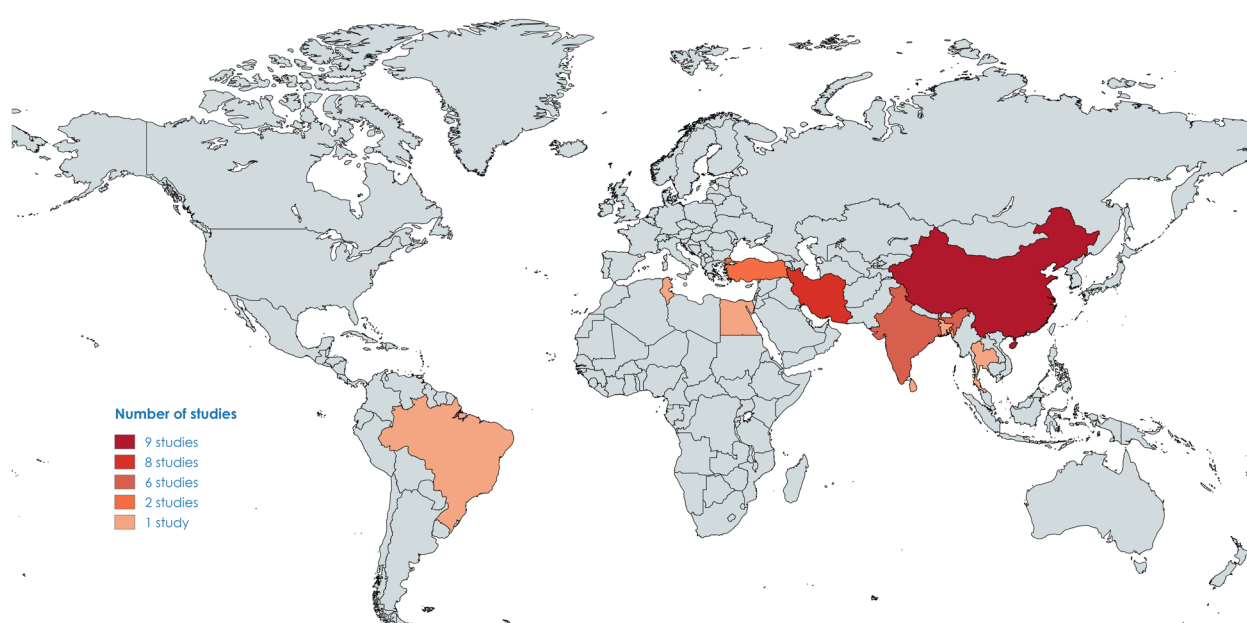


Fig. 2 Heat map: geographic distribution of reviewed studies

Table 2 Classification of self-care interventions according to WHO health dimensions

	No. of studies, <i>n</i> (%)	Reference
Target health dimension		
Physical health	28 (96.6)	[13, 22–34, 36–49]
Mental health	11 (37.9)	[27, 31, 33, 35, 36, 38, 39, 43, 44, 47, 48]
Social health	9 (31.0)	[23, 28, 31, 33, 35, 36, 43, 46, 48]
Self-care intervention elements		
Physical health		
Dietary Modifications	25 (86.2)	[13, 22–34, 36–38, 40–44, 46, 48, 49]
Physical activity: diaphragmatic breathing exercise, original gymnastics, and combined exercises with aerobic and resistance exercises	22 (75.9)	[13, 22, 25, 27–31, 33, 34, 36, 38–44, 47, 48]
SMBG	16 (55.2)	[13, 22–24, 27–34, 36, 42, 46, 48]
Medication/insulin therapy (if needed)	12 (41.4)	[13, 22, 23, 28, 30, 32, 33, 36, 41, 42, 46, 48]
Weight management	5 (17.2)	[23–25, 28, 45]
Foot care	2 (6.9)	[34, 36]
Postpartum care/management	5 (17.2)	[23, 27, 31, 33, 45]
Mental health		
Stress management	5 (17.2)	[27, 33, 36, 39, 43]
Psychological counselling	4 (13.8)	[27, 31, 35, 48]
Mindfulness and relaxation (meditation, breathing exercise)	4 (13.8)	[33, 39, 44, 47]
Problem-solving	1 (3.4)	[35]
Unclear	1 (3.4)	[38]
Social health		
Peer support	8 (27.6)	[28, 31, 33, 35, 36, 43, 46, 48]
Couple support	1 (3.4)	[23]

management was the most common focus area [27, 31, 33, 35, 36, 38, 39, 47], followed by psychological counselling, mindfulness and relaxation techniques, such as meditation (13.8%) or breathing exercises (13.8%). Further, problem-solving was addressed in one study [35] and one aimed to improve quality of life [38].

The social health dimension was an integrated element in nine studies, and eight interventions contained peer support or group discussions [28, 31, 33, 35, 36, 43, 46, 48], while one study contained couple support [23].

Delivery modes

A wide variety of intervention delivery modes were used across the studies. Face-to-face individual education or a behaviour counselling approach was the most common delivery mode—either as a stand-alone approach ($n=8$) [22, 26, 39, 40, 42, 45, 47, 49] or combined with other delivery modes ($n=14$) [13, 24, 25, 27–31, 36, 37, 41, 43, 44, 46]. Further, approximately 55% of studies had a digital element incorporated into the intervention, and the dominant digital mode was phone calls/messages ($n=11$) [24, 25, 29, 32–34, 36, 37, 41, 43, 48], WeChat ($n=5$) [23, 24, 27–29], and mobile applications such as WhatsApp, HOMA software, and a web-based mobile application ($n=3$) [31, 33, 48]. Additionally, six studies utilised video/movie tutorials in the intervention [27, 33, 36, 41, 44, 48] (Table 1 and Additional file 4).

Printed educational materials were also widely used (52%), e.g. booklets ($n=5$) [13, 31, 34, 38, 40], handbooks/guidebooks ($n=5$) [25, 26, 29, 33, 42], manuals ($n=2$) [27, 44], tailored daily menu, pamphlets, or brochures ($n=3$) [25, 36, 47]. Almost 70% of the studies required that the participants self-practiced or self-recorded at home [13, 22–25, 27–31, 33, 36, 37, 39, 41, 42, 44, 46–48] and provided a logbook, a written or digital diet tracking sheet or a self-monitoring tool [13, 23–25, 27–29, 31, 33, 36, 37, 41, 42, 46–48]. In addition, four interventions also provided a free glucometer or a continuous glucose monitoring system (CGMS) [30, 46, 47, 49], a pedometer [13, 42], or a blood pressure monitor [47] (Table 1 and Additional file 4).

Intensity, modality, and duration

The intensity and modality of the interventions varied widely (Table 1 and Additional file 4). The intensity ranged from a single session [24, 29, 41, 42, 47, 49], 2–3 sessions [27, 33, 36, 37, 44, 45], and up to four or more sessions [13, 22, 23, 25, 26, 28, 30–32, 34, 35, 38–40, 43, 46, 48] each lasting from 30 to 120 min.

Additionally, the delivery setting and the providers involved in the interventions varied. Approximately 90% of the studies implemented the intervention in a health-care setting, but nearly 50% also integrated a home-based/

remote counselling/education element. Nine studies had a multidisciplinary staff team to provide health education/behaviour counselling [13, 24, 27, 29, 30, 42, 43, 46, 48], whilst approximately 52% employed a single provider to provide self-care counselling/education. Further, 10 studies utilised a researcher or instructor [23, 28, 31, 33–36, 39, 41, 47], three studies used a nutritionist or dietitian [25, 26, 37], and two involved a physician [22, 45]. Five studies did not specify who provided the self-care counselling for the intervention [32, 38, 40, 44, 49] (Table 1 and Additional file 4).

The duration of follow-up ranged from 10 days to 3 years postpartum (Table 1), with the majority of studies (62%) following up pregnant women/new mothers between 2.5 and 12 months [13, 23, 25–32, 34, 40–43, 45, 46, 48], or between 0.5 and 2 months (31.0%) [24, 33, 35–38, 44, 47, 49]. The median duration of follow-up was 3 months, and only one study had a follow-up duration of 1–3 years postpartum [22].

Outcomes

The overall outcomes, outcome measures, and outcomes reporting varied widely across studies (Table 3 and Additional file 5).

Learning outcomes

Learning outcomes were assessed using two indicators: self-efficacy (confidence in self-management) and women's GDM knowledge and beliefs. One study measured self-efficacy through an 8-item questionnaire scored on a Likert scale from 1 to 10, where 1 indicated "I am not sure at all" and 10 meant "I am quite sure." The scores ranged from 8 to 80 [33]. Two studies evaluated the effect of the interventions on GDM knowledge [45, 48] (Table 3 and Additional file 5).

Behavioural outcomes

Eleven studies examined self-care behavioural outcomes, including various diets, physical activities, self-monitoring of blood glucose (SMBG), or problem-solving/coping [23, 24, 27, 31, 35, 36, 38, 39, 42, 45, 48]. Four studies combined various self-care behaviours [23, 31, 38, 48], whilst three studies evaluated a single self-care behaviour, such as physical activity [24, 42] or problem-solving/coping scores [35]. For example, Rafie et al. [35] measured the difference in problem-solving/coping for stressful situations between the intervention and control, whilst another measured changes in daily step count and the intensity of activities post-intervention [42]. Further, another study measured the mean exercise time in the intervention group [24], whilst another study assessed the breastfeeding rate between the two groups [45] (Table 3 and Additional file 5).

Table 3 Type of primary outcomes

Author, year	Type of primary outcomes			
	Learning outcome	Behavioural outcome	Clinical outcome	Other
Xu, 2024 [29]			Maternal and neonatal outcomes	
Guo, 2023 [23]		Self-management (diet, PA, SMBG)		
Chahed, 2022 [46]			Hospitalisation days, BG, hypo-glycaemia	
Jin, 2022 [24]		Exercise	FBG, 2 h-PBG, 2 h-OGTT (postpartum)	
Rokni, 2022 [36]		QoL	BG	
Simsek Cetinkay, 2022 [48]	GDM knowledge	Diet, PA compliance	BG	Patient satisfaction
Tandon, 2022 [43]			BG	
Fiskin, 2021 [47]			FBG, respiration rate, pulse rate, BP	
Frank, 2021 [41]			FBG, PBG, HbA1c, maternal outcomes	
Ghasemi, 2021 [31]		Self-care behaviours (diet, PA, medication pregnancy and diabetic mothers' risk symptoms, and examination of fetal movement), QoL	OGTT (postpartum)	
Renugasundari, 2021 [39]		Stress reduction, QoL	Heart rate, BP, BG	
Meng, 2021 [27]		Anxiety	FBG, PBG, HbA1c, GWG, amniotic fluid index, pregnancy outcomes	Nursing satisfaction
Rafie, 2021 [35]		Problem-solving coping		
Tian, 2021 [28]			BG	
Kolivand, 2019 [33]	Self-efficacy		FBG, 2 h-PBG	
Mirghafourvand, 2019 [34]			C-section, macrosomia, other neonatal outcomes	
Shahzeidi, 2019 [37]			FBG, GWG, HbA1c	
Liu, 2018 [25]			Weight loss	
Tawfik, 2017 [45]	Women's knowledge and beliefs	Breastfeeding	GWG, postpartum weight	
Uma, 2017 [13]			Maternal and neonatal outcomes	
Zandinava, 2017 [38]		Self-care behaviours (diet, PA, medication), QoL	FBG, 1 h-OGTT, 2 h-OGTT	
Anjana, 2016 [42]		PA	FBG, 1 h-PBG, 2 h-PBG, neonatal outcomes	
Carreiro, 2016 [49]			BG	
Kaur, 2016 [40]			FBG, PBG, lipid index	
Khorshidi Roozbahani, 2015 [32]			FBG, postpartum screening rate	
Ma, 2015 [26]			FBG, 2 h-PBG, HbA1c	
Yang, 2014 [30]			Neonatal outcomes	
Youngwanichsetha, 2014 [44]			FBG, PBG, HbA1c	
Cao, 2012 [22]			Maternal and neonatal outcomes	

BG Blood glucose, FBG Fasting blood glucose, 1 h-PBG 1-h postprandial blood glucose, 2 h-PBG 2-h postprandial blood glucose, HbA1c Glycated haemoglobin, GDM Gestational diabetes mellitus, SMBG Self-monitoring blood glucose, BG Blood glucose, PA Physical activities, c-section Caesarean section, OGTT Oral glucose tolerance tests, QoL Quality of life

Mental health outcomes included stress, anxiety, depression, and Quality of Life (QoL). One study used the Perceived Stress Scale (PSS) to measure stress reduction [39], whilst another used the Self-Rating Depression Scale (SAS) and the Self-Rating Anxiety Scale (SDS) [27] to assess changes in anxiety and depression. Four studies measured QoL using different metrics, including the WHOQOL-BREF questionnaire [38], the Flanagan QoL scale [39], the Diabetes QoL questionnaire [36], and the QoL gravidarum (QOL-GRAV) [31].

Clinical outcomes

Clinical outcomes were the most common type of outcome, as reported in 27 of 29 studies. Several different clinical outcomes were reported, including fasting blood glucose (FBG), 1-h postprandial blood glucose (1 h-PBG), 2-h postprandial blood glucose (2 h-PBG), glycated haemoglobin (HbA1c), oral glucose tolerance tests (OGTT), hypoglycaemia, blood pressure (BP), heart rate, respiration rate, lipid indexes, amniotic fluid index, hospitalisation duration, and other maternal and neonatal outcomes. The most frequent clinical outcomes were glycaemic parameters, with 19 studies monitoring FBG alone or combined with 1-h or 2-h PBG [24, 26–28, 32, 33, 36–44, 46–49]. Changes in weight were reported in four studies (25, 27, 37, 45), and three studies addressed gestational weight gain [27, 37, 45], whilst one study reported weight loss after 1 year [25]. Other maternal clinical outcomes included cardio-metabolic risk parameters, such as heart rate and lipid indexes [39, 40, 47], complications or hospitalisation due to GDM and c-sections [13, 22, 27, 29, 34, 41, 46]. Further, neonatal outcomes were assessed solely or in addition to maternal outcomes in seven studies. Birthweight/macrosomia was measured in four studies [13, 22, 30, 34], and the pre-term delivery rate was assessed in three studies [22, 27, 34]. Further, three studies assessed adverse neonatal outcomes [27, 29, 42], and two studies measured neonatal hypoglycaemia [13, 27] (Table 3 and Additional file 5).

Other outcomes

In addition to the learning, behavioural and clinical outcomes, nurse or patient satisfaction was an outcome in two studies [27, 48] (Table 3 and Additional file 5).

Discussion

Key findings

This review provides an overview of GDM self-care intervention studies in low- and middle-income countries. We found that self-care primarily addresses physical health aspects, whilst the mental health and social health dimensions were addressed to a lesser extent. Overall, most interventions were complex and included several

different interacting elements, and the content, duration, mode of delivery, follow-up time, and outcomes were heterogeneous across studies. Most studies were conducted in Asia, and none in low-income countries.

Comparison with other literature

A 2022 systematic review assessed the effect of “non-pharmacological community GDM interventions” compared to placebo and usual care [51], whilst a 2017 Cochrane review on “lifestyle interventions” assessed maternal physical and mental health as well as neonatal health [52]. In contrast to our review, the 2022 review also included healthcare-administered interventions and studies from high-income countries and solely focused on physical health outcomes, whilst the Cochrane review primarily included studies from high-income countries and assessed physical and mental health outcomes but not social health outcomes. It appears that there may be a remarkable overlap between the concepts “self-care intervention”, “non-pharmacological community interventions”, and “lifestyle interventions as non-pharmacological intervention contained self-care programs that aimed to improve self-efficacy, lifestyle behaviours and BG control through education and support as well as exercise activities, diet therapy, and continuous glucose monitoring [51] whilst “lifestyle interventions” contained also contained, e.g. dietary advice, physical activity, education and self-monitoring of blood glucose [52]. This scoping review does not evaluate whether the effects of the interventions are consistent across different income levels or assess their economic and practical feasibility in resource-limited settings. However, it is important to notice that there is an inconsistency in current terminology for similar interventions, which may create confusion and misinterpretation among researchers, healthcare providers, and patients and complicate the comparison and synthesis of study results and meta-analyses. Further, reported outcomes are heterogeneous, which may not only reflect the complex association between GDM and various dimensions of health but also reflect that not all studies align their outcomes with the core outcome set (COS) for GDM [53]. Therefore, the scientific community should standardise the terminology used in GDM interventions, and future studies should, as a minimum, use the COS for GDM when developing future intervention studies.

Strengthens and limitations

This is the first comprehensive overview of GDM self-care interventions in LMIC in relation to the physical, mental, and social health dimensions in line with the WHO definition. Our review enhances understanding of the components of GDM self-care interventions and the types of outcomes interest. This insight may guide the

planning of future research studies in LMICs to develop effective self-care interventions, and it shows a need for future studies to address mental and social health to a greater extent in future GDM self-care studies. There are a number of limitations of this scoping review, which should be highlighted. No meta-analysis was conducted, and we are therefore unable to assess the overall effect of different self-care interventions on physical, mental, and social health. Further, the quality of the included studies was not assessed; thus, we cannot rule out biases in the included studies.

Conclusions

This review shows that GDM self-care interventions conducted in LMICs are often complex and address various maternal and neonatal physical, mental, and social health outcomes. The content is heterogeneous and overlaps to a wide extent with non-pharmaceutical and lifestyle interventions, and we recommend that the scientific community use a standardised terminology and that future studies use the GDM COS when developing future intervention studies.

Abbreviations

GDM	Gestational diabetes mellitus
c-section	Caesarean section
T2D	Type 2 diabetes
WHO	World Health Organization
LMICs	Low- and middle-income countries
PRISMA-SCR	Preferred Reporting Items for Systematic Reviews and Meta-Analysis-Extension for Scoping Review
QoL	Quality of life
RCT	Randomised controlled trial
PA	Physical activities
SMBG	Self-monitoring blood glucose
OGTT	Oral glucose tolerance tests
BG	Blood glucose
FBG	Fasting blood glucose
1h-PBG	1-h postprandial blood glucose
2h-PBG	2-h postprandial blood glucose
HbA1c	Glycated haemoglobin
SDS	Self-Rating Anxiety Scale
PSS	Perceived Stress Scale
SAS	Self-Rating Depression Scale
COS	Core Outcome Set

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s13643-025-02790-7>.

Additional file 1.
Additional file 2
Additional file 3
Additional file 4
Additional file 5

Acknowledgements

Not applicable.

Authors' contributions

NATD participated in developing the search strategy, screening the articles, contributing to the analysis and interpretation of the data, and writing and revising the manuscript. HML participated in screening the articles and writing and revising the manuscript. AN participated in data extraction, manuscript writing, and revision. PCG participated in developing the search strategy, screening the articles, and extracting the data. CV participated in the study's design, contributed to the data analysis, and substantively revised the study. KDN participated in data extraction and substantively revised the study. JN participated in data analysis, manuscript writing, and revision. TG participated in the study's design, contributed to the data analysis, and substantively revised the study. DSL participated in the study's design, developing the search strategy, screening the articles, contributing to the analysis and interpretation of the data, and writing the manuscript. All authors read and approved the final version of the manuscript.

Funding

This review was conducted as part of the research project "Living Together with Chronic Disease: Informal Support for Diabetes Management in Vietnam—Phase II: Gestational Diabetes in Vietnam (VALID II)". The research project is funded by the Danish Ministry of Foreign Affairs, grant number "21-M03-KU". The funder was not involved in the study and had no role in developing the study design, conduct, analysis, reporting, or decision to submit for publication.

Data availability

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

Author details

¹Thai Binh University of Medicine and Pharmacy, Thai Binh, Vietnam. ²Department of Clinical Research, University of Southern Denmark, Odense, Denmark. ³Department of Gynaecology & Obstetrics, Odense University Hospital, Odense, Denmark. ⁴Department of Public Health, University of Copenhagen, Copenhagen, Denmark. ⁵Department of Anthropology, University of Copenhagen, Copenhagen, Denmark.

Received: 22 February 2024 Accepted: 7 February 2025

Published online: 27 February 2025

References

- World Health Organization. Ten years in public health, 2007–2017. 2017. Available from: <https://www.who.int/publications/i/item/ten-years-in-public-health-2007-2017>.
- World Health Organization. Non-communicable Diseases: Key Facts. 2022. Available from: <https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases>.
- Marchetti D, Carrozzino D, Fraticelli F, Fulcheri M, Vitacolonna E. Quality of life in women with gestational diabetes mellitus: a systematic review. *J Diabetes Res*. 2017;2017:7058082.
- Parsons J, Sparrow K, Ismail K, Hunt K, Rogers H, Forbes A. Experiences of gestational diabetes and gestational diabetes care: a focus group and interview study. *BMC Pregnancy Childbirth*. 2018;18(1):25.
- Wilson CA, Newham J, Rankin J, Ismail K, Simonoff E, Reynolds RM, et al. Is there an increased risk of perinatal mental disorder in women with gestational diabetes? A systematic review and meta-analysis. *Diabetic Med*. 2020;37(4):602–22.

6. Kramer CK, Campbell S, Retnakaran R. Gestational diabetes and the risk of cardiovascular disease in women: a systematic review and meta-analysis. *Diabetologia*. 2019;62(6):905–14.
7. Wang Z, Kanguru L, Hussein J, Fitzmaurice A, Ritchie K. Incidence of adverse outcomes associated with gestational diabetes mellitus in low- and middle-income countries. *Int J Gynecol Obstet*. 2013;121(1):14–9.
8. Weschenfelder F, Hein F, Lehmann T, Schleussner E, Groten T. Contributing factors to perinatal outcome in pregnancies with gestational diabetes-what matters most? A retrospective analysis. *J Clin Med*. 2021;10(2):348. <https://doi.org/10.3390/jcm10020348>.
9. Bellamy L, Casas JP, Hingorani AD, Williams D. Type 2 diabetes mellitus after gestational diabetes: a systematic review and meta-analysis. *Lancet*. 2009;373(9677):1773–9.
10. Damm P. Future risk of diabetes in mother and child after gestational diabetes mellitus. *Int J Gynaecol Obstet*. 2009;104(Suppl 1):S25–6.
11. Vounzoulaki E, Khunti K, Abner SC, Tan BK, Davies MJ, Gillies CL. Progression to type 2 diabetes in women with a known history of gestational diabetes: systematic review and meta-analysis. *BMJ*. 2020;369:m1361.
12. Alejandro EU, Mamerto TP, Chung G, Villavieja A, Gaus NL, Morgan E, et al. Gestational diabetes mellitus: a harbinger of the vicious cycle of diabetes. *Int J Mol Sci*. 2020;21(14):5003. <https://doi.org/10.3390/ijms21145003>.
13. Uma R, Bhavadharini B, Ranjani H, Mahalakshmi MM, Anjana RM, Unnikrishnan R, et al. Pregnancy outcome of gestational diabetes mellitus using a structured model of care: WINGS project (WINGS-10). *J Obstet Gynaecol Res*. 2017;43(3):468–75.
14. Fabienke R, Hod M, Kapur A. Take home message: start where life begins and follow the life-course approach. *Diabetes Res Clin Pr*. 2018;145:214–5.
15. Kapur A, Schmidt M, Barcelo A. Diabetes in socioeconomically vulnerable populations. *Int J Endocrinol*. 2015;2015:247636.
16. Zimmet PZ. Diabetes and its drivers: the largest epidemic in human history? *Clin Diabetes Endocrinol*. 2017;3:1.
17. World Health Organization. WHO Guideline on Self-care Interventions for Health and Well-being. 2022. Available from: <https://www.who.int/publications/i/item/9789240052192>.
18. World Health Organization. WHO defines self-care. 2022. Available from: <https://www.who.int/news/item/22-06-2022-message-from-the-acting-director>.
19. PRISMA. The PRISMA checklist for scoping reviews. 2022. Available from: <https://prisma-statement.org/Extensions/ScopingReviews>.
20. World Bank. World Bank country classification income level 2022–2023. 2022. Available from: <https://blogs.worldbank.org/opendata/new-world-bank-country-classifications-income-level-2022-2023>.
21. Arksey H, O'Malley LJ. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol*. 2005;8(1):19–32. <https://doi.org/10.1080/1364557032000119616>.
22. Cao X, Wang Z, Yang C, Mo X, Xiu L, Li Y, et al. Comprehensive intensive therapy for Chinese gestational diabetes benefits both newborns and mothers. *Diabetes Technol Ther*. 2012;14(11):1002–7.
23. Guo M, Shi W-X, Parsons J, Forbes A, Kong M, Zhang Y-P, et al. The effects of a couple-based gestational diabetes mellitus intervention on self-management and pregnancy outcomes: a randomised controlled trial. *Diabetes Res Clin Pr*. 2023;205:110947.
24. Jin Y, Chen Z, Li J, Zhang W, Feng S. Effects of the original Gymnastics for Pregnant Women program on glycaemic control and delivery outcomes in women with gestational diabetes mellitus: A randomised controlled trial. *Int J Nurs Stud*. 2022;132:104271.
25. Liu H, Wang L, Zhang S, Leng J, Li N, Li W, et al. One-year weight losses in the tianjin gestational diabetes mellitus prevention programme: a randomised clinical trial. *Diabetes Obes Metab*. 2018;20(5):1246–55.
26. Ma W-J, Huang Z-H, Huang B-X, Qi B-H, Zhang Y-J, Xiao B-X, et al. Intensive low-glycaemic-load dietary intervention for the management of glycaemia and serum lipids among women with gestational diabetes: a randomised control trial. *Public Health Nutr*. 2015;18(8):1506–13.
27. Meng Y. Effects of comprehensive nursing intervention on maternal and infant outcomes for gestational diabetes mellitus patients. *Int J Diab Dev Ctries*. 2021;41(4):650–6.
28. Tian Y, Zhang S, Huang F, Ma L. Comparing the efficacies of telemedicine and standard prenatal care on blood glucose control in women with gestational diabetes mellitus: randomized controlled trial. *JMIR Mhealth Uhealth*. 2021;9(5):e22881.
29. Xu T, Xia Q, Lai X, He K, Fan D, Ma L, et al. Subsidised gestational diabetes mellitus screening and management program in rural China: a pragmatic multicenter, randomised controlled trial. *BMC Med*. 2024;22(1):98.
30. Yang X, Tian H, Zhang F, Zhang C, Li Y, Leng J, et al. A randomised translational trial of lifestyle intervention using a 3-tier shared care approach on pregnancy outcomes in Chinese women with gestational diabetes mellitus but without diabetes. *J Transl Med*. 2014;12:290.
31. Ghasemi F, Vakilian K, Khalajinia Z. Comparing the effect of individual counseling with counseling on social application on self-care and quality of life of women with gestational diabetes. *Prim Care Diabetes*. 2021;15(5):842–7.
32. Khorshidi Roozbahani R, Geranmayeh M, Hantoushzadeh S, Mehran A. Effects of telephone follow-up on blood glucose levels and postpartum screening in mothers with Gestational Diabetes Mellitus. *Med J Islam Repub Iran*. 2015;29:249.
33. Kolivand M, Rahimi MA, Keramat A, Shariati M, Emamian MH. Effect of a new self-care guide package on maternal and neonatal outcomes in gestational diabetes: A randomised control trial. *J Diabetes*. 2019;11(2):139–47.
34. Mirghafourvand M, Zandina H, Shafaei FS, Mohammad-Alizadeh-Charandabi S, Ghanbari-Homayi S. Effectiveness of self-care training on pregnancy consequences in gestational diabetes: a randomised controlled clinical trial. *Shiraz E-Med J*. 2019;20(6):e82704.
35. Rafie Z, Vakilian K, Zamanian M, Eghbali H. The effect of solution-oriented counseling on coping strategies in mental health issues in women with gestational diabetes. *Adm Policy Ment Health*. 2021;48(6):983–91.
36. Rokni S, Rezaei Z, Noghabi AD, Sajjadi M, Mohammadpour A. Evaluation of the effects of diabetes self-management education based on 5A model on the quality of life and blood glucose of women with gestational diabetes mellitus: an experimental study in eastern Iran. *J Prev Med Hyg*. 2022;63(3):E442–7.
37. Shahzeidi M, Nadjarzadeh A, Rahmanian M, Salehi Abarghuoei A, Fallahzadeh H, Mogibian M, et al. The effect of oat bran supplement on fasting blood sugar and glycosylated hemoglobin in patients with gestational diabetes mellitus: single-blind randomized clinical trial. *JNFS*. 2019;4(1):7–16. <https://doi.org/10.18502/jnfs.v4i1.395>.
38. Zandina H, Shafaei FS, Charandabi S-A, Homayi SG, Mirghafourvand M. Effect of educational package on Self-Care behavior, quality of life, and blood glucose levels in pregnantwomen with gestational diabetes: a randomised controlled trial. *Iranian Red Crescent Med J*. 2017;19(4):1–9. <https://doi.org/10.5812/ircmj.44317>.
39. Renugasundari M, Krushna PG, Chaturvedula L, Nanda N, Harichandrakumar K, Vidyalakshmi L. Assessment of a short-course yoga practice on cardiometabolic risks, fetomaternal outcomes and psychophysical health in gestational diabetes mellitus. *Biomedicine*. 2021;41(2):337–43.
40. Kaur K, Kochhar A. Impact of nutrition counseling on the blood glucose and lipid profile of the gestational diabetes. *J Eco-friendly Agric*. 2016;11(2):175–9.
41. Frank RW, Gopal KR, Rodrigues DE. Effectiveness of exercises in glycaemic control and maternal outcome among women with gestational diabetes mellitus- a pilot study. *JCDR*. 2021;15(5):QC06–10. <https://doi.org/10.7860/JCDR/2021/46594/14924>.
42. Anjana RM, Sudha V, Lakshmi Priya N, Anitha C, Unnikrishnan R, Bhavadharini B, et al. Physical activity patterns and gestational diabetes outcomes - The wings project. *Diabetes Res Clin Pract*. 2016;116:253–62.
43. Tandon N, Gupta Y, Kapoor D, Lakshmi JK, Praveen D, Bhattacharya A, et al. Effects of a lifestyle intervention to prevent deterioration in glycaemic status among South Asian women with recent gestational diabetes: a randomised clinical trial. *JAMA Netw Open*. 2022;5(3):e220773.
44. Youngwanichsetha S, Phumdoung S, Ingkathawornwong T. The effects of mindfulness eating and yoga exercise on blood sugar levels of pregnant women with gestational diabetes mellitus. *Appl Nurs Res*. 2014;27(4):227–30.
45. Tawfik MY. The impact of health education intervention for prevention and early detection of type 2 diabetes in women with gestational diabetes. *J Community Health*. 2017;42(3):500–10.
46. Chahed S, Lassouad L, Dardouri M, Mtiraoui A, Maaroufi A, Khairi H. Impact of a tailored-care education programme on maternal and neonatal outcomes in pregnant women with gestational diabetes: a randomised controlled trial. *Pan Afr Med J*. 2022;43:128. <https://doi.org/10.11604/pamj.2022.43.128.34084>.

47. Fiskin G, Sahin N. Non-pharmacological management of gestational diabetes mellitus: diaphragmatic breathing exercise. *Altern Ther Health Med*. 2021;27(S1):90–6.
48. Simsek-Cetinkaya S, Koc G. Effects of a smartphone-based nursing counseling and feedback system for women with gestational diabetes on compliance, glycemic control, and satisfaction: a randomised controlled study. *Int J Diab Dev Ctries*. 2022;43(4):529–37.
49. Carreiro MP, Lauria MW, Naves GNT, Miranda PAC, Leite RB, Rajão KMAB, et al. Seventy two-hour glucose monitoring profiles in mild gestational diabetes mellitus: differences from healthy pregnancies and influence of diet counseling. *Eur J Endocrinol*. 2016;175(3):201–9.
50. Roozbahani RK, Geranmayeh M, Hantoushzadeh S, Mehran A. Effects of telephone follow-up on blood glucose levels and post- partum screening in mothers with Gestational Diabetes Mellitus. *Med J Islam Repub Iran*. 2015;29.
51. Igwesi-Chidobe CN, Okechi PC, Emmanuel GN, Ozumba BC. Community-based non-pharmacological interventions for pregnant women with gestational diabetes mellitus: a systematic review. *BMC Womens Health*. 2022;22(1):482. <https://doi.org/10.1186/s12905-022-02038-9>.
52. Brown J, Alwan NA, West J, Brown S, McKinlay CJ, Farrar D, et al. Lifestyle interventions for the treatment of women with gestational diabetes. 2017(5).
53. Egan AM, Bogdanet D, Griffin TP, Kgosidialwa O, Cervar-Zivkovic M, Dempsey E, et al. A core outcome set for studies of gestational diabetes mellitus prevention and treatment. *Diabetologia*. 2020;63(6):1120–7. <https://doi.org/10.1007/s00125-020-05123-6>.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.