RAPID LITERATURE REVIEW

Blood Glucose Monitoring in Pregnant Women Gestational Diabetes Mellitus: an update on International Evidence.

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ABSTRACT

Background: Why is the topic relevant? Women with gestational diabetes mellitus (GDM) are more likely to develop pre-eclampsia during pregnancy, and to have the birth induced, suffer trauma to the perineum during birth, or to give birth by caesarean section.
What is known about it?
Good blood glucose control throughout pregnancy will reduce the risk of fetal macrosomia, trauma during birth (for her and her baby), induction of labor and/or caesarean section, neonatal hypoglycemia, and perinatal death. Monitoring of blood glucose levels is an important way to maintain control of sugar concentrations in the blood.
What is not known about the topic?
However, it is not clear which is best method or frequency for monitoring blood glucose for limiting health complications for women and their babies.
The purpose of this rapid literature review is to identify the most recent evidence and knowledge concerning blood glucose monitoring in pregnant women with gestational diabetes mellitus.

Methods： We undertook a Rapid Literature Review focusing on articles published from 2020 to 2022 thus offering the readers access to most up-to-date evidence concerning the topic. We searched the online databases of Pubmed, EMBASE, Cochrane Library, and BMJ from January 2020 till May 15, 2022. Inclusion criteria were studies of blood glucose monitoring for pregnant women with gestational diabetes mellitus.

Results: Nine papers were included in the final review. Recent evidence on frequency of blood glucose monitoring, new glucose monitoring technologies, remote monitoring technologies and reminder systems in blood glucose monitoring were summarized.

Main Contribution to Evidence-Based Practice: Recommendations for frequency of blood glucose monitoring should be tailored according to pregnant women's blood glucose management plan. Continuous glucose monitoring (CGM) should be considered for pregnant women under some specific conditions. Remote monitoring technologies or reminder systems based on smartphones, computers and tablets could be considered to improve patient's compliance toward blood glucose monitoring.

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What do we already know about this topic?
Good blood glucose control throughout pregnancy will reduce the risk of fetal macrosomia, trauma during birth (for her and her baby), induction of labor and/or caesarean section, neonatal hypoglycemia, and perinatal death. Monitoring of blood glucose levels is an important way to maintain control of sugar concentrations in the blood.

What is the main contribution to Evidence-Based Practice from this article?
Recommendations for frequency of blood glucose monitoring should be tailored according to pregnant women's blood glucose management plan. Continuous glucose monitoring (CGM) should be considered for pregnant women under some specific conditions. Remote monitoring technologies or reminder systems could be considered to improve patient's compliance toward blood glucose monitoring.

What are your research's implications towards theory, practice, or policy?
Further evidence is needed to make strong recommendations for blood glucose monitoring in pregnant women with GDM. Long term efficacy of CGM and ISGMS (instantaneous scanning glucose monitoring system) on maternal and neonatal outcomes need further study.

Authors' Contributions Statement: Tian Qingxiu Conceptualization, Methodology; Xu Yuedong Writing-Reviewing and Editing; Zhai Jing Writing- Original draft preparation; Liu Xuechao Literature search; Wang Xiaofei Data interpreting; Li Yunfeng Supervision.

Gestational diabetes mellitus (GDM) is a glucose intolerance leading to high concentrations of glucose in the blood (hyperglycemia) that begins or is first recognized during pregnancy (Raman, Shepherd, Dowswell, Middleton, & Crowther, 2017). It is estimated that 21.1 million (16.7%) of live births to women in 2021 had some form of hyperglycemia in pregnancy. Of these, 80.3% were due to gestational diabetes mellitus (GDM) (IDF Diabetes Atlas, 10th edn, 2021). GDM is a topic of growing international interest due to its adverse effect on pregnancy outcomes. Women with GDM are more likely to develop pre-eclampsia during pregnancy, and to have the birth induced, or to give birth by caesarean section. Their babies are more likely to develop hypoglycemia, neonatal hyperbilirubinemia, and perinatal mortality. Close glucose monitoring is essential to achieve adequate control of diabetes and avoid the associated complications (García-Moreno et al., 2022).

However, it is not clear which is the best method or frequency for monitoring blood glucose for limiting health complications for women and their babies. In this article we will identify recently published evidence as well as recent international guidelines and summarize the related evidence for blood glucose monitoring in pregnant women with GDM.

Below we present our findings organized under four topics. One is the frequency of blood glucose monitoring in GDM. In this section we will clarify main recent recommendations for frequency of blood glucose monitoring in pregnant women with GDM on different regimens. A second topic is recent Evidence on new glucose monitoring technologies, including the application of continuous glucose monitoring and instantaneous scanning glucose monitoring system. A third topic is recent evidence on remote monitoring technologies. We focus on recent evidence about efficacy of telemedicine technologies, such as mobile applications, and the user perception of remote monitoring technologies. A fourth topic is recent evidence on reminder systems in GDM. This section provides some interventions for women with GDM who have low levels of blood glucose monitoring.

Methods

The authors undertook a Rapid Literature Review focusing on articles published from 2020 to 2022 thus offering the readers access to most up-to-date evidence concerning the topic.

Inclusion criteria were studies of blood glucose monitoring for pregnant women with gestational diabetes mellitus. Studies were reported in English.

Editorials, case reports, letters were excluded after screening for relevant references.

We searched the online databases of Pubmed, EMBASE, Cochrane Library, and BMJ from January 2020 till May 15, 2022. Reference lists of included studies and related reviews were also checked. Literature search strategies were developed using medical subject headings (MeSH) and text words related to 'gestational diabetes mellitus', 'blood glucose' and 'monitor'. The search strategy was tested in PubMed first and adjusted for other databases.

Study selection was conducted by two independent authors. Title and abstract screening of articles arising from the search was carried out to determine whether articles met the inclusion criteria. Full text articles were then identified and independently screened for eligibility by the same authors. Any disagreements regarding final inclusion were discussed with a third author until consensus was reached.

Results

From our search of recent evidence and guidelines, nine papers were included in the final review, including one guideline, five reviews and three original papers. The four sections below summarize the results within the defined topics.

Recent evidence on Frequency of blood glucose monitoring

On our search for evidence, we have come across the most recent international NICE guideline ("National Institute for Health and Care Excellence: Guidelines," 2020). From this we can extract some key recommendations for frequency of blood glucose monitoring in pregnant women with GDM For those who are on a multiple daily insulin injection regimen, they should be advised to test their fasting, pre-meal, 1-hour post-meal and bedtime blood glucose levels daily. And pregnant women with gestational diabetes should be advised to test their fasting and 1-hour post-meal blood glucose levels daily if they are: managing their diabetes with diet and exercise changes alone or taking oral therapy (with or without diet and exercise changes) or single-dose intermediate-acting or long-acting insulin.

Recent Evidence on New glucose monitoring technologies

As the application of continuous glucose monitoring (CGM), studies began to focus on its efficacy in gestational diabetes mellitus. A systematic review (García-Moreno et al., 2022) identified 6 RCTs and investigated the effect of CGM on maternal and neonatal outcomes in gestational diabetes mellitus (GDM). The meta-analysis revealed lower levels of HbA1c, lower gestational weight gain and a lower birth weight in children whose mothers using CGM compared to those using blood glucose monitoring (BGM). But the pooled effect showed no difference in neonatal macrosomia， mean fasting glucose level, mean postprandial glucose level, number of insulin treated patients , total dose of insulin at the end of pregnancy, gestational hypertension rate, preeclampsia and caesarean section rate between women using CGM and BGM.

A single centre RCT study (Zhang, Jiang, & Wang, 2021) compared ISGMS (instantaneous scanning glucose monitoring system) with fingertip blood glucose monitoring in improving the final pregnancy outcomes of patients with GDM. Results demonstrated that patients who used the ISGSM showed a lower incidence of hypoglycaemia and a greater qualified rate of weight gain at the end of pregnancy. Patients in the ISGMS group had higher blood glucose monitoring compliance and demonstrated better health behaviours compared to the fingertip blood glucose monitoring group after 2 weeks of intervention.

Still, current evidence is limited by the low number of studies and the small sample sizes of these studies. Larger clinical trials are needed to better understand the effects of CGM and ISGMS in GDM.

On Recent International Professional Guidelines

Firstly, according to recommendations in NICE guideline 2020, Consider continuous glucose monitoring for pregnant women who are on insulin therapy, if: they have problematic severe hypoglycaemia (with or without impaired awareness of hypoglycaemia) or they have unstable blood glucose levels that are causing concern despite efforts to optimise glycaemic control ("National Institute for Health and Care Excellence: Guidelines," 2020).

Secondly from the American Diabetes Association 2022 guideline we can identify some new key recommendations (Draznin et al., 2022). When used in addition to pre- and postprandial blood glucose monitoring, continuous glucose monitoring can help

to achieve A1C targets in diabetes and pregnancy. Continuous glucose monitoring metrics may be used in addition to but should not be used as a substitute for self-monitoring of blood glucose to achieve optimal pre- and postprandial glycaemic targets.

Recent Evidence on Remote monitoring technologies

Recent studies pay attention to the impact of remote monitoring technologies or telemedicine systems in GDM. A systematic review (Bertini et al., 2022) evaluated the impact of remote monitoring technologies in assisting patients with GDM. The digital technologies used for GDM monitoring were smartphones, computers, and tablets. 14 articles used only a smartphone, 4 articles used a smartphone and computer, 5 articles used a smartphone, computer, and tablet, 4 articles used only a computer and one article used a basic phone. Benefits include improved glycaemic control, increased satisfaction and acceptability, maternal confidence, decreased gestational weight gain, and increased knowledge of GDM. There were also positive comments regarding the optimization of the medical team's time.

For now, most digital technologies in GDM monitoring use mobile applications on smartphones for data collection. A comprehensive literature review (Garg, Arunan, Arora, & Kaur, 2022) evaluated the use of three mobile apps in pregnant women with GDM. Results suggested that mobile apps provided personalized health care services, patient care improvement, and enhanced patient's compliance toward blood glucose monitoring and treatment.

A pilot study (Poulter, Meloncelli, & Mack, 2022) examined patient satisfaction, impact on maternal and neonatal outcomes and resource utilisation of a smartphone-based, remote blood glucose level (BGL) monitoring platform with software surveillance in women with gestational diabetes (GDM) compared with historical controls. The NET-Health application intervention reduced resource utilisation, with less clinician time. There were no differences in maternal or neonatal outcomes. Patient satisfaction was high.

In addition to the glycaemic results of remote monitoring technologies in GDM, researchers are also interested in the maternal perception and the medical team perception of the technologies. Further studies are needed to understand the efficacy and economic impact that could arise from the use of remote monitoring technologies. Also, patients' psychological reactions to remote monitoring technologies should not be neglected.

Recent evidence on reminder systems in blood glucose monitoring

Monitoring of blood glucose levels is an important way to maintain blood glucose control in GDM. Some researchers focus on the intervention to remind GDM patients to check their blood glucose levels.

A systematic review (Horgan, Pierce-Williams, Saccone, & Berghella, 2022) evaluated the effectiveness of reminder systems in improving patient compliance with blood glucose monitoring in gestational diabetes. Reminder systems include phone application, internet-based reminder system and telemedicine-based systems. Meta-analysis demonstrates increased compliance with blood glucose monitoring, decreased mean blood glucose values and a reduced caesarean delivery rate with the use of technology-based reminder systems for patients with gestational diabetes.

One original paper (Blair, Horn, Dias, McDonnell, & Seely, 2022) tested the usability of a text messaging program designed for women with gestational diabetes. The automated 2-way texting program included (1) reminders to check blood glucose levels, (2) positive feedback to user-reported glucose levels, (3) weekly educational messages, and (4) weekly motivational messages. The trial lasted two weeks and a small improvement was found in the percentage of SMBG performed. The program may be helpful for women with GDM who have low levels of blood glucose monitoring.

Conclusion

Recommendations for frequency of blood glucose monitoring should be tailored according to pregnant women's blood glucose management plan. And shared decision making should be incorporated into the patient education process. For postprandial blood glucose monitoring, there are controversies about the ideal timepoints between different guidelines, whether it's 1-hour, 1.5-hour, or 2-hour after meal. Further evidence is still needed to make strong recommendations.

Continuous glucose monitoring (CGM) should be considered for pregnant women under some specific conditions, such as having problematic severe

hypoglycaemia or unstable blood glucose levels that are causing concern, but it should not be used as a substitute for self-monitoring of blood glucose. Long term efficacy of CGM and ISGMS (instantaneous scanning glucose monitoring system) on maternal and neonatal outcomes need further study. And pregnant women's psychological reactions to new glucose monitoring technologies should not be neglected.

Remote monitoring technologies or reminder systems based on smartphones, computers and tablets could be considered to improve patient's compliance toward blood glucose monitoring. The efficacy and economic impact still need further understanding. And both patient's and medical team's perception should be fully considered to make the new technology successful in clinical practice.

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