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Review Article

Practise of self-monitoring of blood glucose among pregnant women with gestational diabetes mellitus: A review

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ABSTRACT

Gestational Diabetes Mellitus (GDM) is defined as glucose intolerance of varying degree diagnosed first time during the pregnancy. Blood glucose values revert to the normal level soon after the delivery. But the women carry a lifetime risk of getting overt diabetes within 5 years. The management of GDM mainly comprises of medical nutrition therapy, exercise, weight management and Self-Monitoring of Blood Glucose (SMBG). Among all the management components, SMBG is the mostly neglected especially among pregnant women with GDM. Patient empowerment and imparting proper information regarding SMBG may be helpful in managing the GDM with better maternal and foetal outcomes. Overall, the practise of SMBG in developing nation like India is not up to the mark.

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1. Introduction

Gestational diabetes mellitus (GDM) is a frequent pregnancy medical issue that can severely affect both the mother's wellbeing (high blood pressure, increased risk of delivery by caesarean section, polyhydramnios, preeclampsia, etc.) and the baby's health (intrauterine growth retardation, macrosomia, neonatal jaundice, hypoglycaemia, and shoulder dystocia).¹ GDM is defined as high blood sugar that is detected for the first-time during pregnancy in the absence of any pre-existing Type-1 or type-2 diabetes.² In GDM, the high blood sugar is temporary and usually returns to normal after the delivery of the baby.³

Self-Monitoring of Blood Glucose (SMBG) is the checking and monitoring of blood glucose readings by a patient, caretaker and/or healthcare provider at different times of the day, at home or in the hospital.^{4,5} It is a

vital part of diabetes treatment. It allows pregnant women and their healthcare providers to select the most efficient method (for example, medical nutrition therapy, physical exercise, insulin/ oral hypoglycaemic agents) for managing glucose levels and minimizing the risk of diabetes-related complications. SMBG serves an essential role in keeping precise blood glucose control, which is required during pregnancy. Fasting blood glucose readings of less than 95 mg/dL and 2-hour post-prandial glucose values of less than 120 mg/dL are recommended for women diagnosed with GDM as per the newly updated recommendations for the diagnosis and treatment of GDM by the Ministry of Health and Family Welfare, Govt. of India.

The first step toward a successful SMBG during pregnancy is patient education and acknowledgment of the significance of SMBG in preventing medical complications during and after pregnancy. It is extremely important that the patient get precise instructions on how to use the glucometer in all of its features. It is also extremely important to educate people about how the glucose in their diet may affect the

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results of a test. It is essential to keep in mind that only recording one's blood glucose levels each day is insufficient if there is no follow-up on the information. Structured SMBG (sSMBG) incorporates daily glucose monitoring at predetermined times.⁶ It is a methodical approach to blood glucose monitoring that allows patients and clinicians to comprehend the blood glucose trend throughout the day and make the appropriate changes in management plan. Patients must track their nutritional intake and physical activity in addition to their blood glucose levels. Patients should be trained not only on how to do SMBG and how to adjust their insulin dosage and implement suitable lifestyle changes based on their results but also, on the need of maintaining blood glucose level under control as per guidelines and their importance.⁷ At each follow-up appointment, the physician is responsible for evaluating SMBG data and discussing the results with the patient. sSMBG works when both the physician and patient are dedicated and motivated to execute the steps, have the knowledge to interpret glucose levels, recognize the pattern, and take the essential actions to achieve optimal glycaemic control.^{6,8}

Postmeal glucose levels are particularly important to track throughout pregnancy. Foetal macrosomia is strongly predicted by postprandial hyperglycaemia after the 16th week of pregnancy, according to several studies.^{9,10} Postprandial monitoring of capillary blood glucose lowered the risk of preeclampsia and the triceps skinfold thickness of the new-born compared to pre-meal monitoring.¹¹ Peak plasma glucose levels during pregnancy occur between 60 and 90 minutes after a meal. It is suggested that SMBG be performed one hour after a meal to ascertain any changes in food composition and/or insulin dosage. In some circumstances, including as in women with delayed stomach emptying, after a high-fat meal, or in women who take regular insulin for a prandial bolus, doing SMBG two hours after meals rather than one may be helpful. Glucose levels should be measured at night to detect and avoid nocturnal hypoglycemia.¹²

Recently in 2017, Research Society for the Study of Diabetes in India (RSSDI) published guidelines for the management of type 1 diabetes mellitus, type 2 diabetes mellitus and diabetes in pregnancy. These guidelines included a section on SMBG. RSSDI provides two levels of recommendations: "Recommended care" and "Limited care." The details are presented in Table 1.¹³

1.1. Indian scenario of practicing SMBG

The current practice of SMBG in India seems to be mostly unstructured and haphazard. Despite of SMBG being an essential component in managing diabetes, very little importance is given to self-monitoring of blood glucose. Self-Monitoring of Blood Glucose is performed routinely in other parts of the world, it is less prevalent in India. In 2008, the SMBG International Working Group surveyed the

Table 1: Recommended care and limited care for frequency/timing of SMBG for diabetes in pregnancy

Patients on lifestyle modifications		Patients on OADs or insulin	
Recommended care	Limited care	Recommended care	Limited care
Fasting blood glucose profile once a week & Three post-meal values at least once a week or staggered over the week	One fasting blood glucose and one post-prandial value every week (any meal, preferably largest meal of the day)	Fasting blood glucose value and 3 post-prandial values everyday	Pre- and post-breakfast on 1st day, pre- and post-lunch on 2nd day, pre and post dinner on 3rd day, and then keep repeating the cycle every day

use of SMBG in thirteen countries, including India. India was reported to have the lowest SMBG practice. (0.2%).¹⁴

In Delhi, research by Nagpal J et al. in 2006 found that 77.4% of patients were doing the prescribed SMBG, and 28.4% of diabetes patients had glucometers at home.¹⁵ In order to assess the understanding and practice of SMBG at home among patients with type 2 diabetes mellitus, a research was carried out in Chennai in 2016. Only a quarter of the research participants had sufficient understanding of the SMBG process and were correctly following it.¹⁶ We have a scarcity of data related to SMBG practise in India among pregnant women with gestational diabetes. This review aims to consolidate the findings of data regarding SMBG practise across the different nations among GDM women.

2. Materials and Methods

A literature search was conducted using PubMed, Google Scholar, Medline, Web of Science, and Scopus to fully achieve the objective of this review. The abstracts of all peer-reviewed publications published in the previous 10 years (2012–2022) have been extracted. The following inclusion criteria were used to review abstract submissions:¹ Any study design involving pregnant women with gestational diabetes mellitus.² The study should have reported SMBG adherence/compliance among GDM-positive pregnant women.³ The article must have published in English and⁴ the article must be published in a journal with peer review and within the specified timeframe. (2012–2022). Articles excluded were those not written in English language. Those articles in which the pregnant

Table 2: Summary of studies showing the practice of SMBG among pregnant women with GDM

Author, year, Country	Study design	Study population	Results	Barriers for SMBG
Jesrine Gek Shan Hong et al, ¹⁷ 2022, Malaysia	Randomised control trial	106 pregnant women with GDM randomized to SMBG3 (n = 52) ie, SMBG performed thrice a week and SMBG1 (n = 54) ie, SMBG performed once a week between 20-30 weeks	The compliance rate in SMBG1 arm was 86.5% and SMBG 3 arm it was 81.3%	
Jia Guo et al, ¹⁸ 2020, China	A mixed-methods design (Cross sectional survey semi structured interview &)	323 pregnant women with gestational diabetes mellitus between 32-42 weeks	42.9% of women with GDM performed SMBG in diet-controlled group and none in insulin treated GDM	Advanced maternal age, not owning glucose meters, not receiving SMBG information (e.g., SMBG frequency, not trusting their blood glucose meters), and low awareness of the importance of SMBG.
Sarah A. Wernimont et al, ¹⁹ 2019, Iowa	Prospective cohort study	103 pregnant women with GDM (treated with diet-A1 or insulin A2) and type 2 diabetes mellitus	Testing adherence rates were 51%, 66%, and 70% for T2DM, GDM, class A1, and GDM, class A2, respectively	
Mendez-Figueroa et al, ²⁰ 2017, USA	Randomised control trial	286 women with GDM who were randomized, 149 (51%) were tested four times a day and 144 (49%) were tested every other day.	Rate of compliance with blood glucose testing was higher in the every-other-day group compared with women who tested every day (92%, vs 89% P<.01).	
Emmanuel Cosson et al, ²¹ 2017, France	Prospective study	91 pregnant women with GDM	61.5% of the women were considered compliant with self-monitoring of blood glucose	
Youngwanichsetha S et al, ²² 2017, Thailand	Qualitative study	30 pregnant women with GDM between 24- 30 weeks		Fear and worry
Ana Maria da Silva Sousa et al, ²³ 2014, Brazil	Longitudinal study	122 pregnant women with GDM	97.5% of women performed SMBG	Obtaining lancets, times, fear, pain, understanding the results and the amount of blood.
Mackillop L et al, ²⁴ 2014, UK	Quasi-experimental study	54 pregnant women with GDM	Adherence to SMBG was observed in 85% (46 out of 54) of participants who tested the minimum weekly blood glucose recordings.	

females already had type 1 or type 2 diabetes mellitus before pregnancy. The keywords used for searching the articles were 'self-monitoring of blood glucose,' 'hyperglycemia in pregnancy,' 'pregnancy, adherence,' 'compliance,' 'glycemic control,' 'maternal outcomes,' 'foetal outcomes,' 'non-pharmacological management'.

3. Results

A total of 8 studies were identified, all of which met the inclusion criteria for this review (Table 2).

4. Discussion

The National Institute of Clinical Excellence (NICE) UK, the American Diabetes Association (ADA), and the American College of Obstetricians and Gynecologists (ACOG) all currently advocate SMBG as the first line of monitoring for GDM. There is insufficient data to determine the ideal frequency of blood glucose monitoring in women with GDM, according to ACOG's 2018 practice advisory. However, NICE UK guideline supports measuring blood glucose levels daily, in fasting and one hour after meals, whereas ACOG guidance suggests glucose monitoring four times a day, once after each meal and one reading of fasting. The ADA did not provide the recommendations about the frequency of SMBG for mild GDM in their 2021 report.^{25–27} A randomised control trial in 2022, Jesrine Gek Shan Hong et al. compared three days of SMBG (SMBG3) to one day (SMBG 1) per week in women with GDM between 20 and 30 weeks who were managed by lifestyle changes. The less-intensive SMBG1 arm had a greater compliance rate for self-monitoring blood glucose (86.5% vs. 81.3%). Each participant were provided with a personal glucometer, glucose strips, lancet needles, and alcohol swabs.¹⁷ Distribution of glucometer could be one of the reasons for the adherence rate of 80%. In 2018, J Guo et al. found that 115 out of 268 patients with diet-controlled GDM practiced SMBG at least four times a week, but no patient with insulin-treated GDM performed SMBG i.e. seven times per day to fulfil the criteria for active SMBG participation.¹⁸ Lack of information about SMBG and its importance by the health care provider were the main reason for not performing SMBG at an active level.¹⁸ Feeling of stress and anxiousness about performing SMBG test was identified as a barrier in a research project carried out in Thailand with a sample size of thirty participants.²² According to Sousa AM da S et al., 17% of GDM patients reported that the lancet of the needle and the duration of time it took to perform the SMBG test were obstacles to SMBG.²³ This is line with findings from other studies which mentions that patients find SMBG inconvenient because of pain, a cumbersome procedure, difficult to adopt SMBG as a daily routine practise, cost of the test strips and needles and carrying glucometer while travelling.^{28,29} Cosson et al. in the year

2017 reported 61.5% of GDM affected women tested their blood glucose at least 80% of both pre and postprandially. This finding was significantly associated with family history of Type-2 diabetes among first-degree relatives (OR = 0.38, 95% confidence interval [CI] 0.15–0.98), P = 0.044).²¹ In 2016, Sousa et al. reported that 119 out of the 122 research participants (or 97.5%) had complied with the SMBG guidelines.²³ According to the Mackillop et al. study from 2014, which included 104 women with GDM as participants, using a smartphone to record blood glucose levels led to high SMBG-testing compliance. Nearly 85% (46 out of 54) of the participants in this study performed the test in accordance with the advice.²⁴ In 40 low- and lower-middle-income nations in Africa, South Asia, and Latin America, including India, a cross-sectional survey was carried out. The survey results revealed that some respondents described measurement of blood glucose by using glucometer as a challenge. Women were unable to self-monitor their glucose because of illiteracy and the difficulties in obtaining a private glucometer.³⁰

5. Conclusion

To help patients to adhere to medical recommendation for performing SMBG, we must allocate more resources on schooling women and their families about GDM and devising therapeutic approaches and recommendations that are specific to their requirements. Effective communication between patients and doctors might increase patient compliance with medical recommendations. Data on the use of SMBG among Indian women with GDM are scarce. Culturally relevant strategies to increase SMBG involvement are recommended. Pregnant women with GDM may be inspired to take part in SMBG by highlighting how important it is to promote the health of unborn children.

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7. Conflict of Interest

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