Gestational diabetes: screening uptake, current challenges and the future – a focused review

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Abstract

The increased risk of developing type 2 diabetes mellitus (T2DM) in women with a history of previous gestational diabetes mellitus (GDM) has been established and is well recognised. Post-partum screening for T2DM is essential to identify those at higher risk and allow for the implementation of preventative interventions. However, attendance rates for post-partum glucose screening in women with previous GDM remain substantially low, with only half of them attending screening. This review aimed to outline the National Institute for Health and Care Excellence (NICE) post-partum screening recommendations and compare them with the guidelines being used worldwide, provide information on post-partum screening uptake and possible determinants of uptake in the UK, and to briefly discuss both patient health implications and the financial burden associated with T2DM progression in the context of the National Health Service (NHS).

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Background

Gestational diabetes mellitus (GDM) is a relatively common pregnancy complication, defined as glucose intolerance with onset or first diagnosis during the second or third trimester of pregnancy, that is clearly not either pre-existing type 1 or type 2 diabetes mellitus (T2DM).[1] In 2019 the International Diabetes Federation estimated that, on a global scale, hyperglycaemia in pregnancy affects 20.4 million or 15.8% of live births, with 83.6% of these cases being due to GDM.[2] A diagnosis of GDM during pregnancy has been associated with a considerable number of adverse maternal and perinatal outcomes.[3] Although it is a pregnancy complication that usually resolves following labour, GDM carries a lifetime risk of up to 60% for developing T2DM, being regarded as a natural opportunity to screen for future T2DM.[4] The effectiveness of preventative interventions for T2DM in women with a known history of GDM has been well established,[5] while post-partum screening for T2DM is essential to identify those at higher risk and allow for the implementation of these interventions. However, the rates of post-partum glucose screening in women with previous GDM remain substantially low, with only half of them attending screening.[6] Meanwhile, the prevalence of both GDM and T2DM is on the rise, with 463 million (9.3% of the global population) currently living with diabetes, and with these numbers expected to reach up to 700 million (10.9%) by 2045.[2]

This narrative review aimed to outline the National Institute for Health and Care Excellence (NICE) post-partum screening recommendations and compare them with the guidelines being used worldwide, provide detailed information on post-partum screening uptake and possible determinants of uptake in the UK by synthesising evidence from the existing literature, and to briefly discuss both patient future health implications and the financial burden associated with T2DM progression in the context of the National Health Service (NHS).

Methods

A literature search for studies on T2DM screening uptake following GDM was conducted using Ovid MEDLINE, PubMed and Google Scholar. Databases were searched from 2000 to 2019 and search terms included gestational diabetes, type 2 diabetes, post-partum screening and United Kingdom. All reference lists from relevant studies were hand-searched for any additional eligible studies.

Results

Screening recommendations and postnatal care

The NICE guidelines state that, following labour, women affected by GDM during pregnancy should be offered lifestyle advice, including diet and exercise, and are recommended to undergo a fasting plasma glucose (FPG) test.[7] The FPG test should be performed at 6–13 weeks post-partum, although in cases where it has not been performed by 13 weeks, either this test or a glycated

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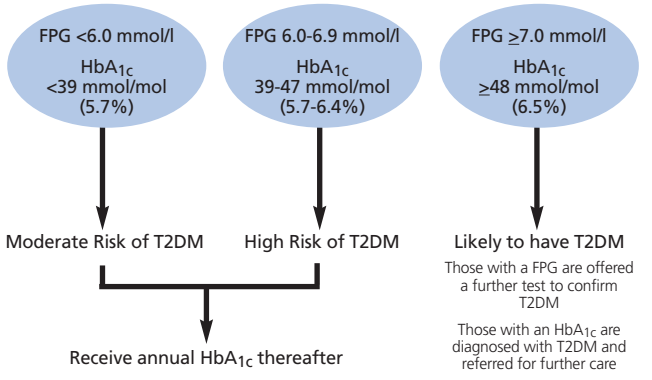
Figure 1. Risk classification of type 2 diabetes mellitus (T2DM) in women with previous gestational diabetes mellitus as recommended by NICE



FPG, fasting plasma glucose, HbA_{1c}, glycated haemoglobin, T2DM, type 2 diabetes mellitus

haemoglobin (HbA_{1c}) test can be performed after 13 weeks.[7] Women with previous GDM who receive a negative post-partum test result for T2DM should be offered an annual HbA_{1c} test.[7] NICE additionally recommends that the 75 g 2-hour oral glucose tolerance test (OGTT) should not be routinely performed for women with previous GDM, with normal blood glucose levels following labour.[7]

Based on the result of the post-partum screening test performed, women are categorised as having a moderate or high risk of developing T2DM in the future, or as likely to have T2DM (see Figure 1).[7]

Screening recommendations by international guidelines

The NICE screening recommendations in the UK have been outlined in detail in the previous section and are presented in Table 1, along with all international guidelines released to date. While both NICE and the American College of Obstetricians and Gynaecologists (ACOG)[8] recommend the FPG for early post-partum screening, the American Diabetes Association (ADA)[9], the Recommendations of the 5th International Workshop-Conference on Gestational Diabetes Mellitus,[10] the Canadian Diabetes Association (CDA),[11] the Royal Australian College of General Practitioners (RACGP)[12] and the Australasian Diabetes in Pregnancy Society (ADIPS)[13] suggest the 75 g 2-hour OGTT, focusing on its sensitivity in glucose intolerance detection for both prediabetes and T2DM. The lack of universal post-partum screening guidelines for T2DM highlights the uncertainty surrounding best clinical practice for post-partum screening after GDM.

The 75 g 2-hour OGTT is considered the gold standard test for the diagnosis of post-partum T2DM by the majority of international guidelines. It has been shown that, compared with both FPG and HbA_{1c}, the 75 g 2-hour OGTT can detect more cases of both prediabetes and T2DM.[14] A study by Kousta *et al* showed that post-partum screening for T2DM in women with previous GDM using a single FPG value lacks sensitivity for detecting abnormal glucose tolerance.[15] Additionally, a more recent study by Kim *et al* investigated the ability of isolated HbA_{1c} with a cut-off value equal to or above 5.7% (39 mmol/mol) and found that it had poor sensitivity and specificity in detecting abnormal glucose tolerance.[16] However, from a patient perspective, published systematic reviews assessing women's views on barriers to post-partum screening have identified the OGTT as a significant barrier – being inconvenient, unpleasant

Table 1 Post-partum screening guidelines for T2DM for women with previous GDM

	UK NICE[7]	ADA[9]	ACOG[8]	5th IWCGDM[10]	CDA[11]	RACGP[12]	ADIPS[13]
Screening Timeline	6–13 weeks PP; if normal, annually	4–12 weeks PP; if normal, every 1–3 years frequency depending on risk factors*	4–12 weeks PP; if normal, every 1–3 years; if IFG or IGT or both, annually	6–12 weeks PP	6 weeks–6 months PP	6–12 weeks PP; every 3 years	6–12 weeks PP
Screening Test	FPG, HbA_{1c} (13 weeks PP and on) (75 g 2-hour OGTT not recommended)	75 g 2-hour OGTT (HbA_{1c} not recommended at 4–12 weeks PP) Ongoing evaluation with HbA_{1c}, FPG, 75g 2h OGTT	FPG or 75 g 2-hour OGTT	75 g 2-hour OGTT	75 g 2-hour OGTT	75 g 2-hour OGTT FPG or HbA_{1c} (every 3 years)	75 g 2-hour OGTT

ACOG, American College of Obstetricians and Gynaecologists; ADA, American Diabetes Association; ADIPS, Australasian Diabetes in Pregnancy Society; CDA, Canadian Diabetes Association; FPG, fasting plasma glucose; GDM, gestational diabetes mellitus; HbA_{1c}, glycated haemoglobin; IFG, impaired fasting glucose; IGT, impaired glucose tolerance; IWCGDM, International Workshop-Conference on Gestational Diabetes Mellitus; OGTT, oral glucose tolerance test; PP, post-partum; RACGP, Royal Australian College of General Practitioners; T2DM, type 2 diabetes mellitus.

* Family history, pre-pregnancy body mass index (BMI), insulin or oral medication in pregnancy.

and time-consuming – and supported the view that a quicker test could have facilitated attendance.[17,18] A further qualitative study by Eborall *et al* demonstrated that these views were consistent beyond the scope of post-partum screening in a broader population of individuals at potential risk of T2DM.[19]

Acknowledging the aforementioned association of the 75 g 2-hour OGTT with poor screening uptake, Noctor *et al* investigated the efficacy of the FPG and HbA_{1c} tests, or a combination of both, in the diagnosis of post-partum T2DM.[20] They found that the combination of the cut-offs of FPG 5.6 mmol/L and HbA_{1c} 39 mmol/mol was capable of identifying 90% of women with abnormal post-partum glucose tolerance, and implementing this strategy will potentially lead to improved long-term post-partum screening uptake.[20] The HbA_{1c} is associated with several advantages over the OGTT as there is no need for fasting prior to receiving the test or ingesting a glucose load, while timed samples are not required.[21,22] Additionally, HbA_{1c} is not importantly affected by any derangements in glucose levels associated with conditions such as stress or acute illness.[21,22] However, it must be noted that the HbA_{1c} assay can be affected by the increased red blood cell turnover related to pregnancy[9] or by certain common post-partum conditions such as iron deficiency or acute blood loss, but this requires further investigation.[16]

The lack of consensus on post-partum screening for T2DM between existing guidelines is responsible for introducing multiple challenges in patient care. Apart from post-partum screening, there are also important inconsistencies regarding the diagnostic strategies for GDM being used during pregnancy.[23] Due to differences in both the approach (one-step versus two-step) as well as the diagnostic cut-off values for GDM, different guidelines identify slightly different patient cohorts, who then receive counselling and are recommended to undergo post-partum screening. Hence, there is a possibility that an important number of high-risk individuals are missed by guidelines using a higher diagnostic cut-off in pregnancy. The use of the OGTT for post-partum T2DM screening is associated with an important time barrier and could potentially be responsible for introducing health inequalities between women with a history of GDM from lower socioeconomic backgrounds, as the latter are less likely to afford a day off work or childcare and are therefore more likely to not attend screening.[19] The HbA_{1c} is a promising approach that should be considered, but more research is needed to determine the efficacy and cost-effectiveness of this test in the long term.

Screening uptake

All studies retrieved by our literature search demonstrated that post-partum screening uptake in women with a history of GDM in the UK is low and can be attributed to several factors, a fact that is consistent with findings from published systematic reviews.[17,24] Table 2 shows the key studies listed in chronological order.

A national survey of both hospitals and general practices by Pierce *et al* demonstrated that there is lack of long-term follow-up for women with previous GDM, and that 80% of secondary care specialists and 30% of general practitioners (GPs) performed an

Table 2 Studies reporting post-partum screening rates and determinants in the UK

Study (author, year)	Study design	No of patients/responders	Key findings
Fahami *et al,* 2019[27]	Cross-sectional	408 post-partum screening, 395 annual screening (GDM)	38% screened up to 13 weeks post-partum, 16% screened with annual HbA_{1c} South Asian women less likely to attend annual screening
Walsh *et al,* 2019[28]	Cohort	535 (pre-guidance n=306, post-guidance n=229) (GDM)	Follow-up rates improved from 60.5% to 69.9% after the release of updated NICE guidance, while over a third of women with GDM were not followed up
Curtis *et al,* 2017[30]	Prospective cohort	118 (GDM)	Post-partum screening with FPG in hospital associated with 94.9% screening attendance
Carmody *et al,* 2015[29]*	Prospective cohort	1520 (GDM)	Introducing a central coordinator to remind women about post-partum screening can achieve rates of 75% Older women and those who have used insulin for the management of GDM during pregnancy more likely to attend screening
McGovern *et al,* 2014[26]	Retrospective cohort	788 eligible for short-term and 718 for long-term follow-up (GDM)	Short-term follow up: 18.5%, long-term follow up: 20%
Pierce *et al,* 2011[25]	Nationwide postal survey	915 GPs, 342 specialists	80% of GPs and 98% of specialists reported that women with GDM had short-term follow-up 73% of specialists recommended long-term follow-up and 39% of GPs recalled women for that 80% of specialists and 30% of GPs used OGTTs instead of FPGs for short-term follow-up

FPG, fasting plasma glucose; GDM, gestational diabetes mellitus; GP, general practitioner; HbA_{1c}, glycated haemoglobin; OGTT, oral glucose tolerance test.
* This is a study from Ireland

OGTT rather than a FPG test for short-term post-partum follow-up, despite the NICE recommendations.[25] The authors additionally reported that short-term follow-up in this population was sufficient,[25] but these results need to be carefully interpreted because of the nature of this study. A retrospective cohort study in 127 primary care practices in the UK by McGovern *et al* reported short-term follow-up of 18.5% and long-term follow-up of around 20% over a 5-year period.[26] They also reported that Asian women were more likely to attend long-term follow-up.[26] Similarly, the recent cross-sectional analysis by Fahami *et al* showed that only 38% of women with previous GDM received screening for T2DM up to 13 weeks post-partum, while only 16% of them received an annual HbA_{1c} test.[27] The study additionally identified a significant association between South Asian ethnicity and poor uptake to annual screening.[27] Following the release of the updated NICE guidelines in 2015 recommending routine follow-up, Walsh *et al* compared post-partum follow-up rates before and after the update.[28] They found that the rate of post-partum follow-up improved from 60.5% to 69.9%, suggesting that the use of the HbA_{1c} is potentially responsible.[28] However, although uptake improved, over a third of the study population were still not followed up.[28]

In an attempt to improve regional post-partum screening attendance, Carmody *et al* demonstrated that the implementation of a central coordinator responsible for reminding women about the importance of screening could effectively achieve screening attendance rates of 75%.[29] Finally, Curtis *et al* showed that early post-partum glycaemic assessment with a FPG performed before hospital discharge was associated with a total uptake of 94.9%, and is therefore an effective strategy to increase screening uptake in women with previous GDM.[30] While this is a relatively new strategy for post-partum glucose screening, the authors suggested that these results would not be much different to those of the 6-week post-partum testing recommended by NICE.[30] The subsequent follow-up of women with previous GDM should still remain a priority, while the validity of this strategy needs to be further evaluated by studies on larger populations.[30]

Women with a history of GDM are high-risk individuals who require a consistent, patient-centred approach and management. Previous surveys assessing views of women with a history of GDM on post-partum screening have identified time restrictions and child responsibilities as key determinants of poor post-partum screening attendance.[31–33] There is an overall lack of awareness and low risk perception for future T2DM in this patient group,[31,33] indicating major gaps in communication between healthcare professionals and patients as well as poor patient education. There is also a lack of public health commissioned services targeting women with previous GDM by focusing on their individual needs, which has an important impact on screening attendance.[34,35]

Progression to T2DM and future impact

There have been several studies in the UK examining T2DM progression in women with previous GDM. A study in the Dundee and Angus region of Scotland by Eades *et al* demonstrated that 25% of women with previous GDM developed T2DM during a mean follow-up period of 8 years, and identified increased pregnancy weight, use of insulin for management of GDM and higher HbA_{1c} and FPG levels at diagnosis of GDM as the main factors associated with increased progression.[36] A retrospective cohort using data from a primary care database in the UK showed that women with GDM were over 20 times more likely to be diagnosed with T2DM compared with healthy controls.[37] Similarly, another study investigating the impact of ethnicity on progression showed that impaired glucose regulation or T2DM was present in 37% of women with previous GDM, with rates being higher in non-European women.[38]

Other than T2DM, women with previous GDM are more likely to develop cardiovascular disease or be diagnosed with non-alcoholic fatty liver disease,[39,40] conditions that contribute to a significant reduction in average life expectancy. When it comes to patient perception about their overall quality of life, Dalfra *et al* found that women with GDM had a poor perception of their general health during pregnancy, and following labour they had worse symptoms of depression.[41]

According to an analysis of data from a cluster-randomised trial, a diagnosis of GDM has been associated with 25% higher healthcare costs, with both the cost of inpatient visits and the use of neonatal intensive care unit being over 40% higher in women with GDM compared with those not diagnosed with GDM.[42] For the NHS, annual costs for blood glucose-lowering medication have exceeded £1 billion,[43] while it is expected that the overall cost of diabetes will account for 17% of the NHS total expenditure by 2035.[44]

The early identification and prevention of T2DM in women affected by GDM during pregnancy should be regarded as an immediate priority. As a diagnosis of GDM serves as an opportunity to target high-risk individuals, it is important to build effective strategies to engage with this patient group. Healthcare professionals should provide these women with counselling and prioritise them for preventative interventions, using a patient-centred approach that accounts for the additional challenges motherhood brings.

Conclusions

This review highlights that, regardless of all the evidence, the uptake of both short-and long-term post-partum T2DM screening in women with previous GDM is low in the UK. This trend is consistent on a global scale, as several studies from European countries, the USA and Canada have similarly reported that the majority of women with previous GDM do not adhere with post-partum screening for T2DM.[45–48] Personal factors as well as factors associated with the healthcare system are likely to influence post-partum screening attendance. Therefore, there is an urgent need to improve women's understanding about the subsequent risk of T2DM following a diagnosis of GDM in pregnancy, while changes are required in healthcare provision to reduce barriers to post-partum screening and improve screening attendance.[49]

The implementation of post-partum screening reminders is recognised as an effective strategy to improve screening.[50–52] However, the results of studies assessing the effectiveness of screening reminders are mixed,[53] while there is a lack of large randomised

Key messages

- There is strong evidence supporting the necessity of post-partum screening for type 2 diabetes in women diagnosed with gestational diabetes during pregnancy
- Both short-term and long-term post-partum screening for type 2 diabetes is suboptimal in the UK and worldwide, with only half of these women attending screening
- Barriers to screening include time restrictions, child responsibilities, low risk perception, poor patient-physician communication, as well as the nature of the oral glucose tolerance test
- Future research should focus on identifying the most accurate, efficient, timely and convenient post-partum screening test for type 2 diabetes

controlled trials investigating outcomes in heterogeneous populations. The use of screening reminders recommending child examinations combined with post-partum screening could potentially be successful in reducing barriers and improving screening attendance.[53] In addition, it has been suggested that the focus of health visiting services, which is currently centred on children's health, could be extended to maternal health as well, to encourage more women to attend screening.[35]

While both the timing of screening and the type of screening test used can have an impact on screening attendance, as discussed in this review, there is no consensus between universal guidelines on the optimal test and timing of screening. The advantages of routine follow-up of women with GDM are profound as ongoing risk factors for future T2DM could be identified and optimised.[28] Future research needs to focus on identifying the most accurate, timely and convenient screening test, assessing both the efficacy and associated costs. As the need for long-term screening in this high-risk population is still unmet, large studies with long-term follow-up are required to investigate both determinants of post-partum screening attendance and how attendance rates can be increased.

Conflict of interest KK has acted as a consultant and speaker for Novartis, Novo Nordisk, Sanofi-Aventis, Lilly, Servier and Merck Sharp & Dohme. He has received grants in support of investigator and investigator-initiated trials from Novartis, Novo Nordisk, Sanofi-Aventis, Lilly, Pfizer, Boehringer Ingelheim and Merck Sharp & Dohme. He has received funds for research, honoraria for speaking at meetings and has served on advisory boards for Lilly, Sanofi-Aventis, Merck Sharp & Dohme and Novo Nordisk. MJD has acted as consultant, advisory board member and speaker for Novo Nordisk, Sanofi-Aventis, Lilly, Merck Sharp & Dohme, Boehringer Ingelheim, AstraZeneca and Janssen and as a speaker for Mitsubishi Tanabe Pharma Corporation. She has received grants in support of investigator and investigator-initiated trials from Novo Nordisk, Sanofi-Aventis and Lilly. All other authors declare there is no duality of interest in connection with their involvement in this study.

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