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Gestational diabetes and the risk of type 2 diabetes in postnatal period

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Abstract
Gestational Diabetes Mellitus (GDM) is the most common pregnancy complication, affecting 14% of global pregnancies. This literature review emphasizes the importance of developing universal screening and diagnostic criteria in pregnancy. Screening criteria, as outlined by organizations like NICE and WHO, vary, reflecting the ongoing debate about the most effective diagnostic methods. GDM is linked with significant risk factors, and timely diagnosis enables intervention strategies to prevent adverse obstetric outcomes. This review underscores the lasting impact of GDM on maternal health, increasing the risk of Type 2 Diabetes (T2D), particularly in the first five years post-delivery. Despite this risk, there is a notable gap in preventive care and postnatal screening. Barriers include the absence of a universal protocol, unclear responsibilities among healthcare professionals, and challenges faced by women in the postnatal period. The low uptake of postnatal testing increases potential risks of entering a future pregnancy with undiagnosed type 2 diabetes. This review highlights the urgent need for effective postpartum interventions, emphasizing education for women to prevent type 2 diabetes and ensuring safe subsequent pregnancies. There is a need for comprehensive, universal postnatal care strategies to address the increasing prevalence of type 2 diabetes globally.

KEYWORDS
gestational diabetes, type 2 diabetes, preventive strategies

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1. INTRODUCTION AND DEFINITION

Gestational Diabetes Mellitus (GDM) is traditionally defined in literature as “any degree of glucose intolerance with onset or first recognition during pregnancy” [1]. This definition fails to exclude women who enter a pregnancy with undiagnosed Type 2 Diabetes Mellitus (T2D), thus the American Diabetes Association (ADA) recently classified GDM as glucose intolerance that is diagnosed in the second or third trimester of pregnancy and is clearly not pre-existing type 1 or type 2 diabetes [2]. The World Health Organization (WHO) agrees with ADA, that plasma blood glucose levels to diagnose GDM should be below those used in the diagnosis of diabetes (as seen in Tables 1, 2), but still suggests that GDM can be diagnosed at any time point in pregnancy [3].

Table 1. Definitions of plasma glucose levels to diagnose different dysglycaemic states according to different organisations

Types of Dysglycemia	Definition	Recommending organisation
Gestational Diabetes	Fasting plasma glucose ≥ 5.6 mmol/L And/or 2-hour post load plasma glucose ≥ 7.8 mmol/L	NICE (2015) [4]
	Fasting plasma glucose 5.1-6.9 mmol/L And/or 1-hour post load plasma glucose 10.0mmol/L or 2-hour post load plasma glucose 8.5-11.0mmol/L (If any result is above the specific thresholds, then it is classified as Diabetes in Pregnancy)	WHO (2013) [3]
Type 2 Diabetes	Fasting plasma glucose ≥ 7.0 mmol/L and/or 2-hour post load plasma glucose ≥ 11.1 mmol/L in OGTT or HbA1c ≥ 48 mmol/mol	WHO (2019) [5]
Impaired Glucose Tolerance	Fasting plasma glucose <7.0 mmol/L and 2-hour post load plasma glucose between 7.8-11.0 mmol/L	WHO (2019) [5]
Impaired Fasting Glucose	Fasting plasma glucose between 6.1 to 6.9 mmol/L	NICE (2012) [6]

2. THE IMPORTANCE OF SCREENING AND DIAGNOSIS FOR GESTATIONAL DIABETES

GDM is the most common complication in pregnancy and it is estimated that it affects over 14% of pregnancies worldwide [7]. Most publications historically quote that in United Kingdom (UK) only 1 in every 23 pregnancies is complicated by GDM(4), but the latest estimates of 2021 based on the IDF (International Diabetes Federation) Diabetes atlas demonstrate a sharp increase, with 1 in every 5 pregnancies affected by GDM [8,9]. The most established risk factors linked to GDM development are obesity (Body Mass Index >30kg/m2), previous pregnancy complicated with GDM, first-degree relative with diabetes, neonatal macrosomia in previous pregnancy, increased maternal age, an ethnicity with a high prevalence of diabetes (South Asian, Middle Eastern, African, African- Caribbean) [4,10], excessive weight gain in pregnancy [11], polycystic ovarian syndrome (PCOS) [12]. The National Institute for Health and Care Excellence (NICE) in UK uses most of these risk factors (excluding maternal age, weight gain and PCOS) to offer testing for gestational diabetes, NICE also recommends testing in the presence of glycosuria on dip stick testing (+1 in two occasions or +2 in one occasion) [4].

Diagnosing GDM allows healthcare professionals to work collaboratively with women in order to maintain normal glucose levels with diet, exercise and use of medication, in an effort to prevent adverse obstetric outcomes which are linked to GDM [13]. The Oral Glucose Tolerance Test (OGTT) has been used in medicine in the last 100 years for diabetes diagnosis [14] and is traditionally used in pregnancy to establish GDM diagnosis [13]. However, screening methods and diagnostic tools for GDM diagnosis vary and there is still not a universal agreement over the superiority of one method (Table 2). There are several variations of the OGTT, which usually occurs between 24-28 weeks of gestation (in women without a history of GDM), such as 50g (challenge test used for screening), 75g or 100g glucose load and testing plasma blood glucose at 0 hour (fasting, pre-load), followed by 1-hour, 2-hour or 3-hour post glucose load testing [4,5,15]. Different organizations support different screening and testing methods as they take into account risks, improvement of pregnancy outcome and cost-effectiveness [16].

During pregnancy early recognition of diabetes is of great importance, as there is an increased risk of

several adverse perinatal outcomes in the presence of any form of dysglycaemia [19,20]. These are stillbirth, hypertension, third- and fourth-degree perineal tears, post-partum haemorrhage, shoulder dystocia, induction of labour, emergency caesarean section, fetal macrosomia, admission to intensive care unit, neonatal hypoglycaemia and neonatal jaundice [21,22]. In an effort to prevent some of these complications, a specific care plan is arranged following diagnosis. Women receive diet and exercise advice and learn how to self-monitor their capillary blood glucose levels at home to identify abnormal readings. If switching to low glycaemic index food and regular exercise are not successful in maintaining euglycemia, then the clinician will recommend using metformin and/or insulin for the optimal control of the glucose levels [4,10]. In the immediate postnatal period GDM typically resolves and women discontinue using any blood glucose-lowering agents they used in pregnancy [4,23].

Table 2. OGTT variations and plasma glucose diagnostic levels for GDM based on different recommending groups

OGTT variations	Results	Recommending group
2-hour 75g OGTT used for diagnosis	1 or more of the following: Fasting plasma glucose ≥5.1 mmol/L 1-hour post load ≥10.0 mmol/L 2-hour post load ≥8.5 mmol/L	IADPSG (2010)[17]
2-hour 75g OGTT used for diagnosis	1 or more of the following: Fasting plasma glucose ≥5.6 mmol/L 2-hour plasma glucose ≥ 7.8 mmol/L	NICE (2015)[4]
2-hour 75g OGTT used for diagnosis	Fasting plasma glucose 5.1-6.9 mmol/L 1-hour plasma glucose 10.0mmol/L 2-hour plasma glucose 8.5-11.0mmol/L	WHO (2013)[3]
3-hour 100g OGTT used for diagnosis	2 or more of the following: Fasting plasma glucose ≥5.3 mmol/L 1-hour post load ≥10.0 mmol/L 2-hour post load ≥8.6 mmol/L 3-hour post load ≥7.8 mmol/L	Carpenter and Coustan (1982)[18]

The diagnosis of GDM not only poses a risk on the pregnancy outcome but can affect the woman's and the offspring's life-long health, by increasing maternal risk for T2D development and the child's risk of obesity and metabolic disorders [24,25]. Considering the rapid increase in the number of women diagnosed with GDM, there is a great need for interventions (either pharmacological or lifestyle modifications) to protect the lifelong health of these women and their families.

3. THE LIFELONG RISK OF DEVELOPING TYPE 2 DIABETES AND CHALLENGES WITH PREVENTIVE CARE

A GDM diagnosis has long term effects on maternal health. It increases the woman's risk of developing Type 2 Diabetes Mellitus (T2D) later on in life and especially in the first 5 years following delivery, where up to 50% of GDM women will develop T2D [26]. Later on in life, this figure increases to 70% [26,27]. A recent systematic review has shown that when compared with normal glycaemic women, women that had GDM have an 11-fold increased risk of T2D development (this risk remained increased throughout their lifespan, but even studies with a follow-up for one to five years postnatally also demonstrated an increased relative risk) [28,29]. Intervening in the early post-partum years (from the start of the postnatal period till the fifth postnatal year) is crucial to prevent or delay the progression to T2D [30].

An early intervention, prior to diabetes development, is important as it is known that people with T2D are at risk of cardiovascular diseases, diabetic foot, diabetic neuropathy, retinopathy and nephropathy [31]. There is an increase in the number of people who are diagnosed with T2D and predictive models show that it will continue to rise [32]. The burden of T2D not only affects the individual but is a serious public health concern. If prevention strategies are not implemented, this will result in significant implications to healthcare systems as specialists' care and patient treatment will not be sustainable [31].

Since there is awareness amongst clinicians about the risk of T2D postnatally and in the first years, why is there a lack of preventive care? There are several contributing factors leading to this result. Currently, there is no universal preven-

tive healthcare protocol, consequently highlighting the imperative for a comprehensive and rigorous postnatal follow-up plan. Still, the responsible healthcare professional to deliver this is yet to be identified. Many different professionals can be involved in the delivery of preventive strategies, such as gynaecologists, diabetologists, General Practitioners (GP), diabetes specialists midwives, diabetes specialists nurses, dietitians, health visitors, health coaches or nutritionists but currently there is no consensus on the preventive strategy or on the responsible professional [33]. Often, women have to deal with the result of this, which is a lack of awareness of their T2D risk and missing the opportunity to attend postnatal screening due to low knowledge and low-risk perception [33,34].

Apart from issues within the healthcare setting, there are also multiple barriers women face in the postnatal period that hinder the effective implementation of an intervention for diabetes prevention. These are lack of time, energy, motivation and support, emotional or financial, in combination with the pressures of caring for their family or work commitments [34,35]. Due to these challenges, healthcare professionals must consider the barriers when developing preventive strategies to support women.

4. SCREENING FOR TYPE 2 DIABETES IN THE POSTNATAL PERIOD

Current screening guidance for T2D in the postnatal period recommends that women should be offered fasting plasma glucose testing at 6 to 13 weeks postnatally, or HbA1c testing after 13 weeks and then once a year. Women should also follow a healthy lifestyle, including exercise and weight control and be aware of their risk of developing GDM in the next pregnancy and T2D in the future [4]. The burden to follow this advice falls on women. Multiple qualitative studies have described that GDM women in postnatal period often feel extremely tired, suffer from physical discomfort, and in some cases, might perceive their personal risk of developing diabetes as low [36]. All these factors provide an insight into the low uptake of postnatal diabetes testing, which is estimated to be less than 50% [37], with recent studies recording an even lower attendance of 18.5% before 6 months postnatally [38,39].

Several countries have implemented different screening strategies for type 2 diabetes in postnatal period. In the UK women who attend postnatal diabetes screening commonly receive extra care in the presence of Impaired Glucose Tolerance (IGT) or Impaired Fasting Glucose (IFG) and then they can be referred to the NHS Diabetes Prevention Programme (DPP) [4] (see table 1 for definitions). Women with normal results are not part of a national gestational diabetes register such as the one that Australia has recently implemented [40]. Recently the NHS Diabetes Prevention Programme amended its criteria for the 'Healthier you' DPP to include women with history of GDM with a normoglyceamic blood reading in the last 12 months. However, this criterion appears in the North Central London Integrated Care system webpage and not on the official NHS DPP webpage [41,42]. The NHS and Diabetes UK webpages for diabetes risk calculation have not been updated to include history of GDM in their criteria and their partner services with apps such as Oviva have not updated their guidance either. When accessing the 'healthier you' webpage GDM history does not appear in the criteria [43]. This can be an important step in the right direction for type 2 diabetes prevention, but the uptake for GDM women is not known. The available information remains unclear and conflicting, and it is only available to women that are not planning a pregnancy for the next 12 months. Data from GP referrals for this population is not yet published.

Since many women miss postnatal testing, they are at risk of entering another pregnancy with undiagnosed T2D or developing other health-related problems due to diabetes presence such as micro and macrovascular complications [44]. The earlier the development of hyperglycaemia in pregnancy, the more at risk the pregnant woman and the fetus are of several complications. In the presence of adequate postnatal support, the risk of complications can potentially be minimized.

5. CONCLUSION

The global increase of T2D has led to the need for postnatal interventions for women with GDM [45]. The lack of routine care for diabetes prevention in the crucial postnatal period has been identified and many different studies have tried to evaluate the best method to prevent diabetes and keep women engaged with the intervention in the long run [33]. So far, interventions implemented in women at risk of developing T2D have focused on increasing physical activity, changing diet, using pharmacological treatments, adopting behaviour modification strategies and using goal-setting techniques, to reduce weight and promote a healthy lifestyle [37,46,47]. These interventions have been found to reduce the risk of diabetes by more than 50% and have the potential to be beneficial for women with a history of GDM [33,37,47]

However, some of the studies that focused on preventing the progression of GDM to T2D, recruited participants with a history of GDM, later on in life and not in the immediate postnatal period, delivered a short-term intervention, focused on weight reduction and not on diabetes or faced barriers with recruitment and were underpowered [33,48,49]. It is evident, based on what was previously discussed, that development of effective postpartum interventions is necessary [28] with the realistic potential to improve outcomes.

Since the risk is known, an opportunity arises in the postnatal period where women can be educated about diabetes prevention. This can potentially allow them to change their lifestyle, not only to prevent diabetes development but also to enter safely a subsequent pregnancy, as they would have received postnatal testing, extra follow-up appointments and preconception support.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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