

Recurrent GDM and the development of type 2 diabetes have similar risk factors

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Gestational diabetes mellitus (GDM) is an increasingly common condition complicating pregnancy. The International Diabetes Federation estimates its global prevalence at 17 %, with the highest rates (25 %) in Southeast Asia and the lowest (10 %) in North America and the Caribbean [1]. This estimate totaled 21.4 million live births worldwide to mothers with GDM in 2013. The same report estimated that approximately 16 % of GDM cases are attributable to (presumably undiagnosed) pre-existing diabetes in pregnancy. Attempts were made to compensate for the many different diagnostic criteria, by adjusting the estimates to reflect the International Association of Diabetes in Pregnancy Study Groups (IADPSG)-recommended diagnostic criteria [2]. The increasing prevalence of GDM most likely reflects the worldwide epidemic of obesity and type 2 diabetes. Mothers who experience GDM during their pregnancies have an approximately 50 % recurrence risk for GDM in a subsequent pregnancy [3], with wide variations from study to study. If it is possible to predict the recurrence risk from the characteristics of women with GDM and of their GDM pregnancies, it should be possible to concentrate resources on these individuals in order to lessen their chance of recurrence and to identify GDM earlier in subsequent pregnancies.

The meta-analysis by Schwartz et al. published in this issue of *Endocrine* [4] follows a previous meta-analysis by the same authors [3] that found a pooled GDM recurrence risk of 48 % and reported that ethnicity was a strong

predictor of GDM recurrence, with non-Hispanic whites and primiparous women less likely than other ethnicities and parous women to experience GDM in a subsequent pregnancy (39 % vs 56 %; 40 % vs 73 %, respectively). This analysis updates a number of previous publications by other investigators aimed at determining the strongest risk factors predictive of recurrence of GDM, by adding the results of 4 more recently published large studies. The strongest predictors included oral glucose tolerance test (OGTT) results (fasting, 1-h and 2-h), neonatal birth weight, insulin use during pregnancy, body mass index (BMI), and weight gain between pregnancies. The inter-pregnancy interval was not a significant predictor. Calculation of a standardized mean difference for each factor allowed comparison of effect size; weight gain between pregnancies had the greatest effect size, with OGTT glucose levels, BMI, and neonatal birth weight having approximately one-third to one-half as much effect. These risk factors can be grouped as measures of severity of GDM and of maternal obesity. All except weight gain between pregnancies should be known at the end of the initial GDM pregnancy so that it might be useful in predicting future GDM. In a nutshell, the more severe the GDM the greater the maternal BMI, and the bigger the baby the greater the likelihood of recurrence. These data should help inform patient counseling. It would be extremely useful if the information could be analyzed so as to allow individual patient information to be plugged into a paradigm that provides a point estimate of a patient's chance to have recurrent GDM; this must await future developments.

Women experiencing GDM have an approximately 50 % likelihood of developing type 2 diabetes in the ensuing years, with point estimates varying widely depending upon the duration of follow-up and population characteristics. Women who will ultimately develop type 2 diabetes are presumably the most likely to have recurrent GDM in a

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subsequent pregnancy. It has been demonstrated that, in former GDMs with prediabetes, intensive lifestyle modification or metformin treatment can reduce the likelihood of diabetes over the subsequent 10 years by 35–40 % [5]. Unfortunately, one of the biggest obstacles to applying such preventive measures is the low rate of adherence to testing for diabetes and prediabetes subsequent to pregnancy [6–9], despite strong recommendations from authoritative professional organizations. Identification of risk factors could also allow concentration of resources on ensuring postpartum diabetes testing.

One would expect that the same risk factors for recurrent GDM would predict the development of future type 2 diabetes. A 2002 systematic review [10] reported that fasting plasma glucose during pregnancy was the strongest predictor of future diabetes, and that by 10 years after the index pregnancy a large proportion of women who were going to develop type 2 diabetes had done so. Other risk factors were difficult to interpret because of wide variation among studies with regard to definitions of GDM and variables reported. A subsequent 2009 systematic review [11] confirmed that fasting plasma glucose, OGTT 2-h plasma glucose, and OGTT area under the curve were strong and consistent predictors of subsequent type 2 diabetes among women with previous GDM. Another systematic review [12] found three risk factors to be substantially predictive of future type 2 diabetes: (1) anthropometric characteristics (e.g., maternal obesity), (2) insulin treatment during GDM pregnancy, and (3) earlier gestational age at diagnosis of GDM. The need for insulin is reflective of the severity of GDM, and earlier diagnosis might reflect severity or could be confounded by risk factors that prompted early testing. Thus it appears that there are similar risk factors for recurrent GDM and for the development of type 2 diabetes. Women with previous GDM who develop recurrent GDM, and who did not undergo post partum testing for glucose intolerance after their index pregnancy, may have developed undetected type 2 diabetes or prediabetes rather than recurrent GDM. The management of preexisting diabetes in pregnancy is different from that of GDM, so efforts to increase adherence to postpartum diabetes testing are a critical first step in dealing with prevention of recurrent GDM and prevention of type 2 diabetes. Another important need is for interventions to prevent GDM in subsequent pregnancies. Initial efforts have focused on lifestyle changes to prevent interpregnancy weight gain and reduce obesity. Studies have supported the feasibility of an intervention initiated during pregnancy [13] or after pregnancy in anticipation of future pregnancy [14]. While the Diabetes Prevention Program focused on prevention of type 2 diabetes [5], there is a great need for large controlled trials of similar interventions to prevent the recurrence of GDM.

Compliance with ethical standards

Conflict of interest The author declares that he has no conflict of interest.

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