# Pregnancy Outcomes of Young Women With Type 2 Diabetes: Poor Care and Inadequate Attention to Glycemia

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Type 2 diabetes (T2D), characterized by rising insulin resistance and deteriorating β-cell function, is one of the most common metabolic conditions worldwide (1,2). In parallel with the increasing prevalence of obesity during childhood and adolescence, ∼5% of T2D cases now occur in people under the age of 40 years (3). Compared with those who develop T2D after 40 years of age, those with early-onset T2D are more likely to be female, of minority ethnicity, socially deprived, and obese (3). T2D is now the commonest form of pregestational diabetes in pregnancy, with 5,085 pregnancies in women with T2D compared with 4,175 in women with type 1 diabetes (T1D), in England and Wales during 2019–2020 (4). This represents a doubling in the prevalence of T2D in pregnancy in the past two decades (4,5).

Early-onset T2D is characterized by a particularly rapid accumulation of diabetes-related complications and its associated comorbidities of hypertension and dyslipidemia. Data from the U.K. National Diabetes Audit show that despite their severe metabolic phenotype, young adults have suboptimal diabetes care and higher $HbA_{1c}$ than those aged ≥40 years (3). The Treatment Options for Type 2 Diabetes in Adolescents and Youth (TODAY) follow-up study highlighted the devastating burden of microvascular complications in those diagnosed with T2D during childhood and adolescence (6). By 26 years of age, approximately two-thirds had hypertension, over half had dyslipidemia, retinopathy, and/or nephropathy, and one-third had neuropathy (6). The average age of research participants with T2D is 63 years, with <5% diagnosed before 40 years of age, meaning that the evidence base for management of those with early-onset T2D is extremely limited (7).

The pregnancy outcomes in young women with youth-onset T2D followed in the TODAY study are reported in this issue of *Diabetes Care* (8). An earlier report of 63 pregnancies among 46 TODAY participants described high rates of congenital anomalies: ∼20% compared with an expected rate of 4–5% (9,10). The combined pregnancy outcomes of 141 TODAY participants, including the 63 pregnancies described earlier, are reported in the current study (8). Participants had a median age of 21.6 years, with an 8-year duration of T2D and mean BMI 35.6 kg/m$^2$. Their diabetes duration and hypertension rates are far higher (double and triple, respectively) than those in the U.K. National Pregnancy in Diabetes (NPID) cohort and Metformin in Women with Type 2 Diabetes (MiTy) trial (10,11). However, only a minority of TODAY participants (6.5%) received acetylsalicylic acid for prophylaxis of preeclampsia, reflecting the U.K. experience of poor diabetes care in early-onset T2D.

Details of glucose monitoring and diabetes treatment regimens of TODAY participants are limited, with incomplete $HbA_{1c}$ measures during pregnancy. Only a minority of TODAY participants had successful glycemic management before or during pregnancy. Earlier onset and/or longer T2D duration, higher BMI, higher deprivation, and minority ethnicity are all associated with higher $HbA_{1c}$ levels during pregnancy (10). TODAY mothers were notably younger (10–12 years) with longer T2D duration and higher $HbA_{1c}$ (∼1.5%) than the U.K. NPID and MiTy participants (10,11).

Importantly, consent for the initial TODAY intervention study, which included rosiglitazone use, required adequate contraception use. Female participants were counseled on the increased risks of fetal malformations associated with higher $HbA_{1c}$ during early gestation. However, despite regular health care engagement, methods for supporting contraception uptake among younger, obese, and socially deprived women were ineffective. Fewer than one in seven TODAY participants used any contraception,

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resulting in 260 pregnancies in 141 young women (1.8 pregnancies each). There were more pregnancies in women from lower income households and those with non-Hispanic Black race/ethnicity. This is consistent with sobering U.K. NPID data reporting a staggering seven times more pregnancies among women with T2D living in the poorest communities compared with those in the most affluent communities (10).

Approximately one-third of TODAY participants had chronic hypertension, one-third had glycemic failure ($HbA_{1c}$ ≥8% or 64 mmol/mol), and a quarter had diabetes neuropathy before pregnancy. Taken together, these high rates of unplanned pregnancies, existing com orbidities, and widespread treatment failures contributed to obstetric and neonatal complications in two-thirds of pregnancies. One-third of women had antenatal hospital admissions prior to the admission for labor/birth with high rates of hypertension and preeclampsia (17% and 20%, respectively). One-third were delivered before 37 weeks of gestation, with lower birth weights and higher preterm births, as previously described among younger mothers with T1D (12). The commonest complications were neonatal hypoglycemia and respiratory distress, increased among mothers with higher $HbA_{1c}$ during pregnancy and in preterm offspring.

Overall in the TODAY study, 7.8% and 26.8% of offspring were categorized as small for gestational age and large for gestational age (LGA), respectively. As babies at both extremes of birth weight have increased stillbirth risk, a relatively high stillbirth rate of 3% is not unexpected, although numbers were small and should be interpreted with caution. Rates of congenital anomalies were also high, ∼10%, consistent with early pregnancy $HbA_{1c}$ levels of 8.7% (71 mmol/mol). Importantly, cardiac anomalies were lowest, ∼5%, in those with $HbA_{1c}$ <8% (64 mmol/mol) but increased to almost 20% with $HbA_{1c}$ >8% (64 mmol/mol). There were 33 pregnancy losses or stillbirths, meaning that, overall, one in four young women experienced a baby death. These pregnancy losses represent missed opportunities to improve diabetes risk factor management (glycemia and obesity) and preparation for future pregnancies.

While obesity, social deprivation, and minority ethnicity all contribute to higher $HbA_{1c}$, it is important to recognize that antenatal glycemia rather than ethnicity, obesity, or social disadvantage is the key predictor for neonatal morbidity and death in T2D pregnancy (10). The association between antenatal glycemia and adverse pregnancy outcomes is as strong in T2D as in T1D, with recent data suggesting that pregnant women with T2D are even more susceptible to the consequences of hyperglycemia than those with T1D (4,10). Rates of preterm births, LGA, and neonatal care unit admissions are significantly reduced in women with T2D who achieve $HbA_{1c}$ <6.1% (43 mmol/mol) after 24 weeks of gestation (Fig. 1), emphasizing the crucial importance of antenatal glucose levels to obstetric and newborn complications.

There is an urgent need to improve the care and support packages offered to those with early-onset T2D, particularly women from ethnic minorities who are of younger age and lower income. First, more attention to the severe metabolic phenotype of early-onset T2D is needed among family doctors and in specialist services. Second, in relation to reproductive health and any future pregnancy, all women with diabetes aged between 15 and 50 years require access

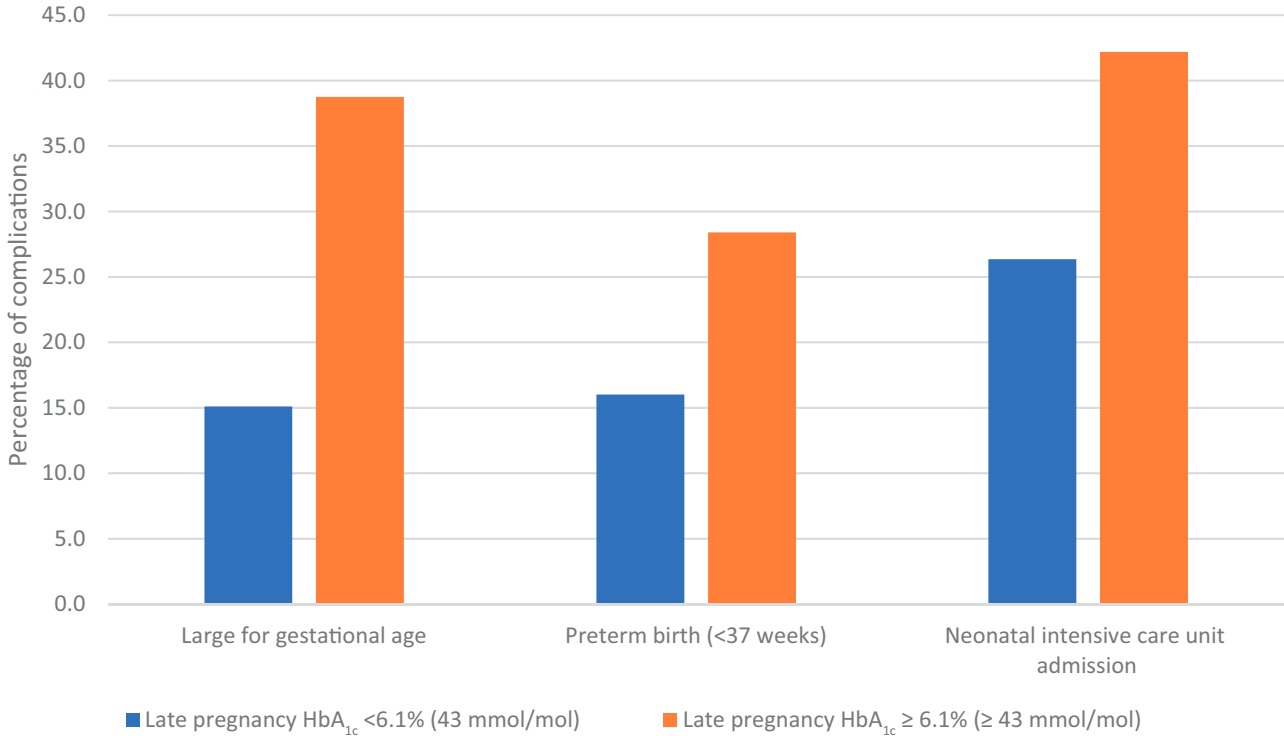


**Figure 1**—Maternal $HbA_{1c}$ and rates of obstetric and neonatal complications in pregnant women with T2D. Data are based on 5,085 pregnancies in women with T2D in the U.K. NPID during 2019–2020. Rates of LGA, preterm birth, and neonatal intensive care unit admission were significantly lower (15.1% vs. 38.7%, 16.0% vs. 28.4%, and 26.3% vs. 42.2%, respectively) in offspring of mothers with $HbA_{1c}$ <6.1% (43 mmol/mol) after 24 weeks of gestation (4).

to safe, effective contraception, recognizing that women with higher BMI, hypertension, and dyslipidemia may require specialist advice and support. Appropriate use of safe, effective, long-acting reversible contraception would enable early aggressive glycemic management with insulin, metformin, and possibly the newer glucose-lowering agents, for which more evidence in early-onset T2D is needed.

Data from TODAY and similar studies demonstrate that current clinical care models are inadequate for those diagnosed with T2D before 40 years of age and especially for women with higher risk of adverse pregnancy outcomes. Care models better targeted for aggressive management of obesity and glycemia as well as contraception and pregnancy are urgently needed in ethnic minority and socially deprived populations for the benefit of the women concerned, their families, and the community as a whole.

**Duality of Interest.** H.R.M. sits on the Medtronic UK and European scientific advisory boards and reports personal fees from Medtronic, Novo Nordisk, and Dexcom. No other potential conflicts of interest relevant to this article were reported.

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