



Maternal diabetes associated with increased risk of neurodevelopment disorders in children

Maternal diabetes during pregnancy is associated with an increased risk of impaired neurodevelopmental performance, as well as neurodevelopmental conditions such as autism spectrum disorder (ASD) and attention-deficit hyperactivity disorder (ADHD), in the offspring, according to this systematic review and meta-analysis involving more than 56 million mother–child pairs published in *Lancet Diabetes & Endocrinology*. The association was stronger in those with pre-gestational type 1 or type 2 diabetes than with gestational diabetes, in those with gestational diabetes diagnosed earlier versus later in the pregnancy, and in those requiring medication for the gestational diabetes versus those in whom no drug treatment was required. The risk ratios were 1.25 for ASD and 1.30 for ADHD when multiple confounders were taken into account. However, as these data come from observational studies, the increased risk should be viewed as an association; causation cannot be confirmed.

Diabetes, particularly young-onset type 2 diabetes and gestational diabetes, are increasingly prevalent in pregnancy. Globally, pre-gestational type 1 and type 2 diabetes occur in 0.5–2.4% of pregnancies, while gestational diabetes occurs in up to 27.6%.

Initially, concerns about increasing rates of maternal obesity and hyperglycaemia in pregnancy related to the risk of acute complications during pregnancy, delivery and the postnatal period, as well as the risk of the mother developing type 2 diabetes. However, evidence has also been accumulating of an association between hyperglycaemia in pregnancy and long-term metabolic programming and obesity, as well as other health risks, in children (Meek, 2023).

Evidence for possible associations between maternal obesity or hyperglycaemia in pregnancy and increased risk of neurodevelopmental disorders in the offspring, particularly autism spectrum disorder (ASD) and attention-deficit hyperactivity disorder (ADHD), has been expanding over the last 10 years. However, studies have shown conflicting outcomes, and many have not explored the full range of neurodevelopmental disorders.

Rates of ASD, ADHD, communication disorders such as developmental language disorder and speech disorder, motor disorders including tic disorder, co-ordination disorders and learning disorders have been increasing in recent years, and these conditions now affect more than three in every 100 children globally. Although there is evidence for a genetic component impacting the risk of all neurodevelopmental disorders, environmental factors such as obesity and hyperglycaemia are also thought to play a role.

The present study

In this systematic review and meta-analysis published in *Lancet Diabetes & Endocrinology*, [Ye et al \(2025\)](#) sought to synthesise and evaluate the observational evidence to date on the potential effects of maternal diabetes (type 1, type 2 or gestational diabetes) on the full range of neurodevelopmental disorders and neurodevelopmental performance outcomes in children and adolescents. The review was much larger than previous studies and included data from 202 observational studies, including 55 mega cohorts (>100 000 participants), and examined the outcomes of more than 56 million mother–child pairs.



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Practice points

1. Diabetes in pregnancy is associated with increased risk of adverse neurodevelopmental outcomes, although causality cannot be inferred.
2. Young women with excess weight should be supported to lose weight prior to pregnancy, lowering their risk of type 2 and gestational diabetes.
3. For women with pre-existing type 1 or type 2 diabetes, highlight the benefits of optimal pre-conception glycaemic control to reduce risk of adverse pregnancy outcomes.
4. Treat this subject sensitively and avoid introducing weight bias or stigma.



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Results

The authors conclude that maternal diabetes is associated with increased risks of all types of neurodevelopmental conditions in the offspring, as well as impaired neurodevelopmental test performance. It should be noted that, as these data come from observational studies, the findings are only associations and, thus, causation cannot be confirmed.

In studies adjusting for at least one confounder, compared with offspring not exposed to diabetes, maternal diabetes was associated with a risk ratio (RR) of 1.30 for overall neurodevelopmental disorders, as well as lower intelligence and psychomotor scores, in the offspring. In studies adjusting for multiple (three or more) confounders, maternal diabetes was associated with an RR of 1.28 for any neurodevelopmental disorder, 1.25 for ASD and 1.30 for ADHD, compared to children of mothers without diabetes. Associations between maternal diabetes and increased risk of intellectual disability, communication disorders and motor disorders in the offspring were also identified.

In the case of ADHD, intellectual disability, specific developmental disorder and other neurodevelopmental disorders, a risk gradient was observed across the different types of diabetes, such that the greatest risk was in maternal type 1 diabetes, followed by type 2 diabetes, with the lowest risk associated with gestational diabetes.

In general, pre-existing maternal diabetes was more strongly associated with the risk of most conditions than gestational diabetes. The impact of maternal diabetes may depend on exposure duration. Additionally, in mothers with gestational diabetes, the severity and timing of the condition and whether medication is required to treat it appear to impact the offspring's risk.

These findings are similar to a previous meta-analysis of the associations between abnormal gestational weight gain and risk of developmental disruption (Wu et al, 2023). Globally, abnormal gestational weight gain occurs in 47% of pregnancies, and Wu and colleagues demonstrated an association between either excessive or insufficient gestational weight gain and increased risk of ASD, ADHD and

intellectual disability in the offspring. However, the authors stress, as do Ye and colleagues, that causality cannot be demonstrated from these studies. Further research is urgently needed.

Implications for practice

These findings could further motivate the young women we support to reduce their weight pre-pregnancy, thus reducing the risk of type 2 or gestational diabetes during pregnancy. In women with pre-existing type 1 or type 2 diabetes, we should already be highlighting the benefits of optimal pre-conception glycaemia in terms of risk of congenital defects; however, the evidence for reducing associations with neurodevelopmental disorders is less certain.

Providing adequate surveillance for neurodevelopmental disorders as well as support after diagnosis is important. This review should alert us to be more proactive in identifying children whose mothers had diabetes of any kind during pregnancy. Coding this in the child's record as well as the mother's problem list may be helpful but will require maternal consent. We can then have a lower threshold for considering referral for detailed assessment should parents become aware of any possible neurodevelopment problems.

This is a sensitive subject and, as clinicians, we will need to tread carefully to avoid introducing weight bias or stigma to our consultations and care delivery.

Meek CL (2023) An unwelcome inheritance: Childhood obesity after diabetes in pregnancy. *Diabetologia* **66**: 1961–70

Wu D, Li Y, Chen L et al (2023) Maternal gestational weight gain and offspring's neurodevelopmental outcomes: A systematic review and meta-analysis. *Neurosci Biobehav Rev* **153**: 105360

Ye W, Luo C, Zhou J et al (2025) Association between maternal diabetes and neurodevelopmental outcomes in children: A systematic review and meta-analysis of 202 observational studies comprising 56.1 million pregnancies. *Lancet Diabetes Endocrinol* **13**: 494–504

Association between maternal diabetes and neurodevelopmental outcomes in children: A systematic review and meta-analysis of 202 observational studies comprising 56.1 million pregnancies

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