

Maternal obesity, diabetes associated with autism, other developmental disorders

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A major study of the relationships between maternal metabolic conditions and the risk that a child will be born with a neurodevelopmental disorder has found strong links between maternal diabetes and obesity and the likelihood of having a child with autism or another developmental disability.

Conducted by researchers affiliated with the UC Davis MIND Institute, the study found that mothers who were obese were 1-2/3 times more likely to have a child with [autism](#) as normal-weight mothers without [diabetes](#) or hypertension, and were more than twice as likely to have a child with another [developmental disorder](#).

Mothers with diabetes were found to have nearly 2-1/3 times the chance of having a child with [developmental delays](#) as [healthy mothers](#). However, the proportion of mothers with diabetes who had a child with autism was higher than in healthy mothers but did not reach statistical significance.

The study also found that the [autistic children](#) of diabetic mothers were more disabled -- had greater deficits in language comprehension and production and adaptive communication -- than were the [children](#) with autism born to healthy mothers.

However, the children without autism born to diabetic mothers also exhibited impairments in socialization in addition to language comprehension and production, when compared with the non-autistic

children of healthy women. Children without autism of mothers with any of the metabolic conditions displayed mild deficits in problem solving, [language comprehension](#) and production, motor skills and [socialization](#).

"Over a third of U.S. women in their childbearing years are obese and nearly one-tenth have gestational or [type 2 diabetes](#) during pregnancy. Our finding that these maternal conditions may be linked with neurodevelopmental problems in children raises concerns and therefore may have serious public-health implications," said Paula Krakowiak, a biostatistician affiliated with the MIND Institute.

The study, "Maternal metabolic conditions and risk for autism and other neurodevelopmental disorders," is published online today in *Pediatrics*, the journal of the American Academy of Pediatrics. Its authors said that it is the first study to examine the associations between neurodevelopmental disorders and maternal metabolic conditions not restricted solely to type 2 or gestational diabetes, including obesity and hypertension, which have similar underlying biological characteristics, and to investigate correlations between these conditions and impairments in the skills and abilities of children in specific developmental domains.

More than 60 percent of U.S. women of childbearing age are overweight, 34 percent are obese, and 16 percent have metabolic syndrome. Nearly 9 percent of U.S. women of childbearing age are diabetic, and more than 1 percent of U.S. pregnancies were complicated by chronic hypertension. In California, where the study was conducted, 1.3 percent of women had type 2 diabetes and 7.4 percent had gestational diabetes.

Autism is characterized by impairments in social interaction, communication deficits and repetitive behaviors and often is accompanied by intellectual disability. An estimated 1 in 110 children born today will be diagnosed with autism spectrum disorder, and its

incidence appears to be growing. An estimated 1 in 83 U.S. children has another developmental disorder, which includes other disorders resulting in intellectual disability.

The study included 1,004 mother/child pairs from diverse backgrounds enrolled in the Childhood Autism Risks from Genetics and the Environment Study (CHARGE), most of them living in Northern California, with a small subset living in Los Angeles. The children were between 24 and 60 months old, born in California and resided with at least one biological parent who spoke either English or Spanish. There were 517 children who had autism; 172 with other developmental disorders; and 315 were developing normally. The participants were enrolled between January 2003 and June 2010.

The researchers obtained demographic and medical information for the mothers and their children using the CHARGE Study Environmental Exposure Questionnaire, a telephone survey, the study participants' birth files and medical records. The primary metabolic conditions of interest were type 2 diabetes or gestational diabetes.

Women were considered diabetic if the condition was noted in their medical records or if during the telephone surveys they answered yes to the questions "During this pregnancy were you ever told by a physician or nurse that you had gestational diabetes?" or "At any time before you became pregnant were you told by a doctor that you had [type 2] diabetes?" The same wording was used to obtain information about hypertension. BMI was calculated using height and weight prior to pregnancy from medical records or telephone interview.

To confirm the developmental diagnoses of the children with autism researchers used the Autism Diagnostic Interview-Revised (ADIR) and the Autism Diagnostic Observation Schedules (ADOS). All of the children were administered the Mullen Scales of Early Learning and the

Vineland Adaptive Behavior Scales to assess their cognitive and adaptive development. Spanish-speaking children were administered the tests in Spanish. The participants were then divided into groups of children with autism, developmental disability or normal development.

Among children whose mothers were diabetic during their pregnancies, the study found that the percentage of children with autism born to women with type 2 diabetes or gestational diabetes -- 9.3 percent -- or developmental disability -- 11.6 percent -- was higher than the 6.4 percent of children born to women without these metabolic conditions.

Over 20 percent of the mothers of children with autism or other [developmental disability](#) were obese, compared with 14 percent of the mothers of normally developing children.

Approximately 29 percent of the children with autism had mothers with a metabolic condition, and nearly 35 percent of the children with another developmental disorder had mothers with metabolic conditions, compared with 19 percent of the normal children had mothers with a metabolic condition.

The study also examined the link between hypertension and autism or developmental disorder. The prevalence of high blood pressure was low for all groups, but more common among mothers of children with autism or developmental disorder, though the finding did not reach [statistical significance](#).

Analyses of the children's cognitive abilities found that, among the children with autism, children of mothers with diabetes exhibited poorer performance on tests of expressive and receptive language and communication skills of everyday living when compared with the children of non-diabetic mothers. And the presence of any metabolic condition was associated with lower scores on all of the tests among

children without autism.

The authors note that obesity is a significant risk factor for diabetes and hypertension, and is characterized by increased insulin resistance and chronic inflammation, as are diabetes and hypertension. In diabetic, and possibility pre-diabetic pregnancies, poorly regulated maternal glucose can result in prolonged fetal exposure to elevated maternal glucose levels, which raises fetal insulin production resulting in chronic fetal exposure to high levels of insulin.

Because elevated insulin production requires greater oxygen use this may result in depleted oxygen supply for the fetus. Diabetes also may result in fetal iron deficiency. Both conditions can adversely affect fetal brain development, the authors said.

"The sequence of events related to poorly regulated maternal glucose levels is one potential biological mechanism that may play a role in adverse fetal development in the presence of maternal metabolic conditions," Krakowiak said.

Maternal inflammation, which accompanies metabolic conditions, may also adversely affect fetal development. Certain proteins involved in cell signaling that are produced by cells of the immune system can cross the placenta from the mother to the fetus and disturb brain development.

Provided by University of California - Davis

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