

## **Study Reveals Prenatal Phthalates Lower Boys' Verbal IQ but Lift Girls' Performance IQ**

A group of researchers tested whether prenatal phthalate metabolites, individually and as a mixture, forecast preschool Full Scale Intelligence Quotient (FSIQ), Performance Intelligence Quotient (PIQ), and [Verbal Intelligence Quotient](#) (VIQ), and whether these links vary by child sex and specific cognitive domains.



### **Study**

The present analysis used 511 singleton mother–child pairs from the [Maternal-Infant Research on Environmental Chemicals](#) (MIREC) study, which recruited women before 14 weeks' gestation in ten Canadian cities between 2008 and 2011 and followed children to age four.

Spot urine collected at 6–13 and 16–21 weeks was assayed via ultra-performance liquid [chromatography](#)–tandem mass spectrometry for 20 phthalate metabolites detected in at least 40 percent of samples. Concentrations were specific-gravity corrected and averaged; molar sums represented parent compounds such as di-isodecyl phthalate (DiDP). Intraclass correlation coefficients gauged stability between trimesters.

Intelligence was assessed with the Wechsler Preschool and Primary Scale of Intelligence, Third Edition (WPPSI-III), yielding FSIQ, PIQ, and VIQ normed to 100. Multiple linear regression quantified the change in each IQ domain per doubling in metabolite concentration, adjusting for site, maternal age, country of birth, [smoking](#), socioeconomic status (SES), and Home Observation Measurement of the Environment (HOME) score; interaction terms explored modification by child sex.

[Weighted Quantile Sum](#) (WQS) regression with repeated holdout validation and bidirectional indices summarized the joint influence of nine correlated metabolites. Sensitivity checks incorporated maternal Body Mass Index (BMI) and restricted analyses to metabolites detected in  $\geq 70$  percent of samples, while replacing  $\Sigma$ DiDPm with its dominant metabolite (MCiNP).

### **Findings**

Mothers averaged 33 years, 83 percent were Canadian-born, and only 4 percent fell below the low-income threshold; HOME scores (mean = 47/55) reflected enriched caregiving. Children tested at a mean age of 3.4 years scored slightly above the [population](#) norm (FSIQ = 106.9, PIQ = 103.2, VIQ = 109.3).

Detection frequencies ranged from 42 percent to 99 percent, and geometric means for summed phthalate groups spanned 0.27 µg/L for the sum of [DiDP metabolites](#) (ΣDiDPm), driven primarily by MCiNP (89 percent detection), to 59.9 µg/L for the sum of di-n-butyl phthalate metabolites (ΣDnBPm). Intraclass correlations between trimesters were modest (0.14–0.38), indicating within-person variability.

In single-metabolite regression, every doubling in ΣDiDPm was associated with lower scores in all domains (FSIQ = −0.6, PIQ = −0.6, VIQ = −0.5 points). [Monomethyl phthalate](#) (MMP) showed the opposite pattern, predicting gains of 1.6–1.7 points across domains, while mono-benzyl phthalate (MBzP) correlated with a 1.0-point rise in PIQ. No other parent-compound sums or individual metabolites were significant.

Striking [sex-domain](#) interactions emerged: The inverse ΣDiDPm–VIQ association was exclusive to boys (−1.1 points per doubling) and statistically significant (p interaction = 0.04), whereas the positive MMP–PIQ link appeared only in girls (+3.2 points per doubling, p interaction = 0.024). Similar but non-significant heterogeneity emerged for MEP–VIQ (p interaction = 0.099).

Bidirectional [WQS regression](#), integrating nine correlated metabolites into positive and negative indices, yielded no significant mixture effects on any IQ scale, and heterogeneity tests showed no sex-specific mixture vulnerability. Trimester-specific models echoed the main findings but lost statistical significance, likely owing to reduced precision from single-spot samples.

Sensitivity checks that adjusted for maternal BMI or substituted ΣDiDPm with MCiNP amplified the negative PIQ association (−1.35 points), confirming robustness. Notably, ΣDiDPm showed effects despite the lowest [exposure levels](#) (0.27 µg/L) among measured phthalates.

When geometric means were stratified by fetal sex, mothers carrying boys had significantly higher urinary concentrations of the sum of [di-iso-butyl phthalate metabolites](#) (ΣDiBPm, p = 0.02) and mono-3-carboxypropyl phthalate (MCP, p = 0.03), mirroring patterns reported in other birth cohorts.

Across analyses, mixture coefficients hovered near zero, suggesting that opposing effects of individual metabolites (e.g., MMP↑ vs. ΣDiDPm↓ IQ) may cancel [composite impacts](#).

Collectively, the data point to DiDP as a potential developmental neurotoxicant and highlight the need for sex-stratified [risk assessment](#). Although point changes appear modest, a one-point population shift in FSIQ can push thousands of children above or below educational thresholds, underscoring public health relevance.

## **Conclusion**

To summarize, results indicate prenatal DiDP exposure may slightly lower preschool FSIQ, with boys showing VIQ vulnerability, whereas MMP and MBzP show small positive links requiring confirmation. Caution is warranted as DiDP effects largely reflect its MCiNP metabolite, and low exposure levels (0.27 µg/L) suggest heightened [neurotoxicity potential](#).

Even minor IQ shifts influence classroom placement, [lifetime earnings](#), and population health, underscoring the need for prevention. Simply swapping plasticizers is not inherently safer; regulators and industry should reassess DiDP neurotoxicity and expedite truly benign substitutes.

Parents can curb phthalate uptake by limiting food-contact plastics and fragranced items. Cohort research employing repeated [biomarkers](#), diverse populations, and mixture-aware models is essential to clarify causality and guide evidence-based policy.

Worldwide, reducing phthalate burdens remains a [public health](#) priority.

**Source:**

<https://www.news-medical.net/news/20250729/Prenatal-phthalates-lower-boys-verbal-IQ-but-lift-girls-performance-IQ-Canadian-study-reveals.aspx>