Prenatal particulate matter exposure is linked with neurobehavioral development in early life

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HIGHLIGHTS

Prenatal $PM_{2.5}$ exposure is linked to neurobehavior:
- In newborns aged 1-2 months
  → State changes
- In children aged 4-6 years
  → Peer problems
  → Prosocial behavior

BACKGROUND

Neurobehavior = Interaction brain & behavior
  → Shaped by genetical & environmental factors

Air pollution → Impact on cognitive development & social abilities in children

METHODS

ENVIRONAGE birth cohort
  → 88 newborns (1-2 months)
  → 393 children (4-6 years)

ENVIRONAGE
Environmental influences on early ageing
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Prenatal ambient $PM_{2.5}$ exposure: High-resolution spatial-temporal interpolation method based on maternal residential address
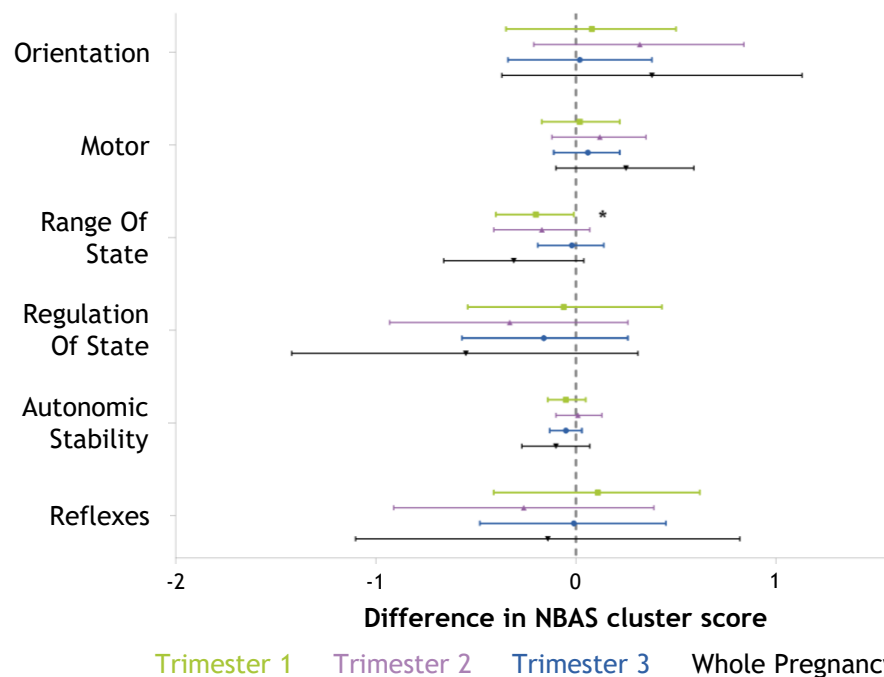
Neonatal Behavioral Assessment Scale (NBAS)

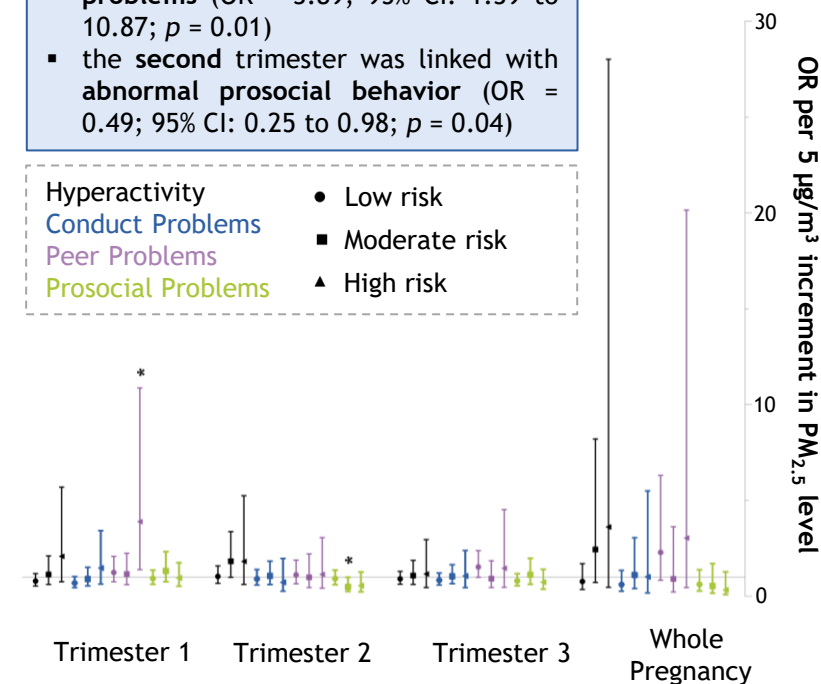Strengths and Difficulties Questionnaire (SDQ; parent-administered)

RESULTS

A 5 µg/m³ increase in first-trimester $PM_{2.5}$ levels was linked with -0.20 (95% CI: -0.40 to -0.01; p = 0.04) lower NBAS Range Of State scores

A 5 µg/m³ increase in $PM_{2.5}$ levels in:
- the first trimester was linked with increased odds of having peer problems (OR = 3.89; 95% CI: 1.39 to 10.87; p = 0.01)
- the second trimester was linked with abnormal prosocial behavior (OR = 0.49; 95% CI: 0.25 to 0.98; p = 0.04)

Hyperactivity • Low risk
Conduct Problems ■ Moderate risk
Peer Problems ▲ High risk
Prosocial Problems

(Forest plot) Difference in NBAS cluster score — clusters: Orientation, Motor, Range Of State, Regulation Of State, Autonomic Stability, Reflexes. X-axis: -2, -1, 0, 1.

Trimester 1   Trimester 2   Trimester 3   Whole Pregnancy

(Right plot) OR per 5 µg/m³ increment in $PM_{2.5}$ level. Y-axis: 0, 10, 20, 30.
Trimester 1   Trimester 2   Trimester 3   Whole Pregnancy

DISCUSSION

Prenatal $PM_{2.5}$ exposure in early to mid-pregnancy was linked with neurobehavioral development in newborns and early childhood

A role for black carbon?
  → Reaches fetal side of the placenta[1]
  → Found in fetal brain tissue[2]

Neuroinflammation & oxidative stress

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[1]Bové H et al. Nat Commun. 2019   [2]Bongaerts E et al. Lancet Planet Health. 2022