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Community Health / Policy

**Abstract Title**
Prenatal Exposure to Ambient $PM_{2.5}$ and Risk of Congenital Surgical Anomalies in Manitoba: A Population-Based Case–Control Study

**Background**
Climate change is increasing the frequency and severity of wildfires, elevating population exposure to fine particulate matter ($PM_{2.5}$). The effects of prenatal $PM_{2.5}$ exposure on congenital surgical anomalies are unknown.

**Objective**
We evaluated whether pregnancy-average ambient $PM_{2.5}$ in Manitoba was associated with congenital surgical anomalies or necrotizing enterocolitis (NEC).

**Methods**
We conducted a population-based case–control study of children born in Manitoba with conception dates 2002–2023. Cases included children with NEC or any of eight congenital surgical anomalies identified from a retrospective database. Up to ten birthdate–matched controls per case were included. Maternal region of residence during pregnancy was linked to National Air Pollution Surveillance (NAPS) $PM_{2.5}$ monitors; daily values were aggregated to pregnancy-average $PM_{2.5}$. Logistic regression models evaluated associations between pregnancy-average $PM_{2.5}$ and case status, adjusting for maternal region (North, West and Winnipeg) and season of conception. Subgroup analyses were performed for each surgical anomaly.

**Results**
We included 9,023 children (822 cases, 8,201 controls). Overall pregnancy-averaged $PM_{2.5}$ was not associated with case status (adjusted OR=1.00; p>0.9); therefore, we explored the effect of geographical region and conception season. The odds of mothers from the Winnipeg region bearing a case were lower than mothers from the North region (OR=0.81; p=0.039). In the subgroup analyses, West region mothers had increased odds of having a child with Hirschsprung disease compared to North region mothers (OR=2.91; p=0.038). Odds of NEC were lower after conceptions in the spring (OR=0.63; p=0.02) and fall (OR=0.67; p=0.04) compared to conceptions in the winter.

**Conclusion**
In Manitoba ambient $PM_{2.5}$ was not associated with congenital surgical anomalies or NEC. Larger studies with finer spatial exposure assessment are needed to clarify whether wildfire-driven $PM_{2.5}$ influences congenital surgical anomaly outcomes. Regional and seasonal differences point to potential area-level drivers (e.g., access to care, socioeconomic or other environmental exposures) that need further investigation.

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