Air Purifier Use During Pregnancy, Fetal Growth, and Early Childhood Development: The UGAAR Study

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Combatting urban air pollution impacts on maternal and child health in Asia: A Science and Policy Dialogue
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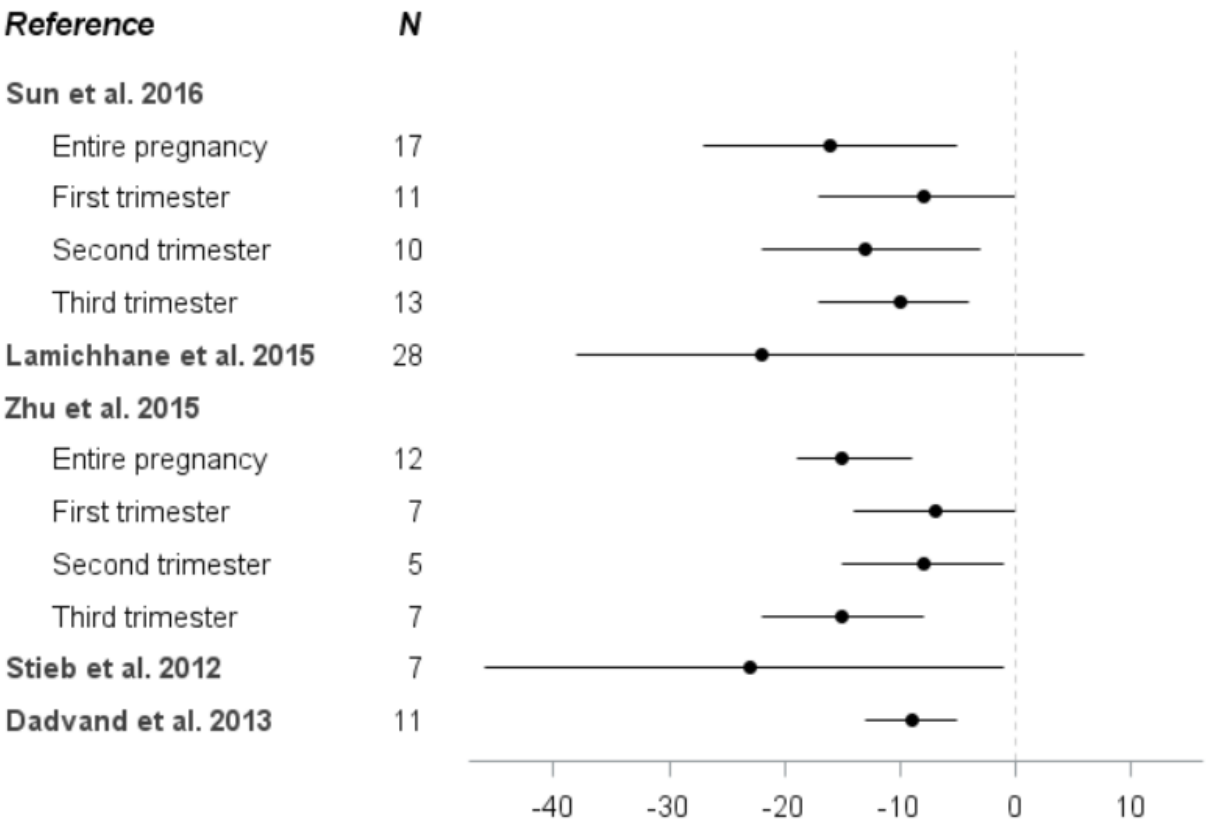
Rationale

- Meta-analyses of observational studies report ~10-20 gram decreases in mean birth weight per 10 µg/m^3 $PM_{2.5}$



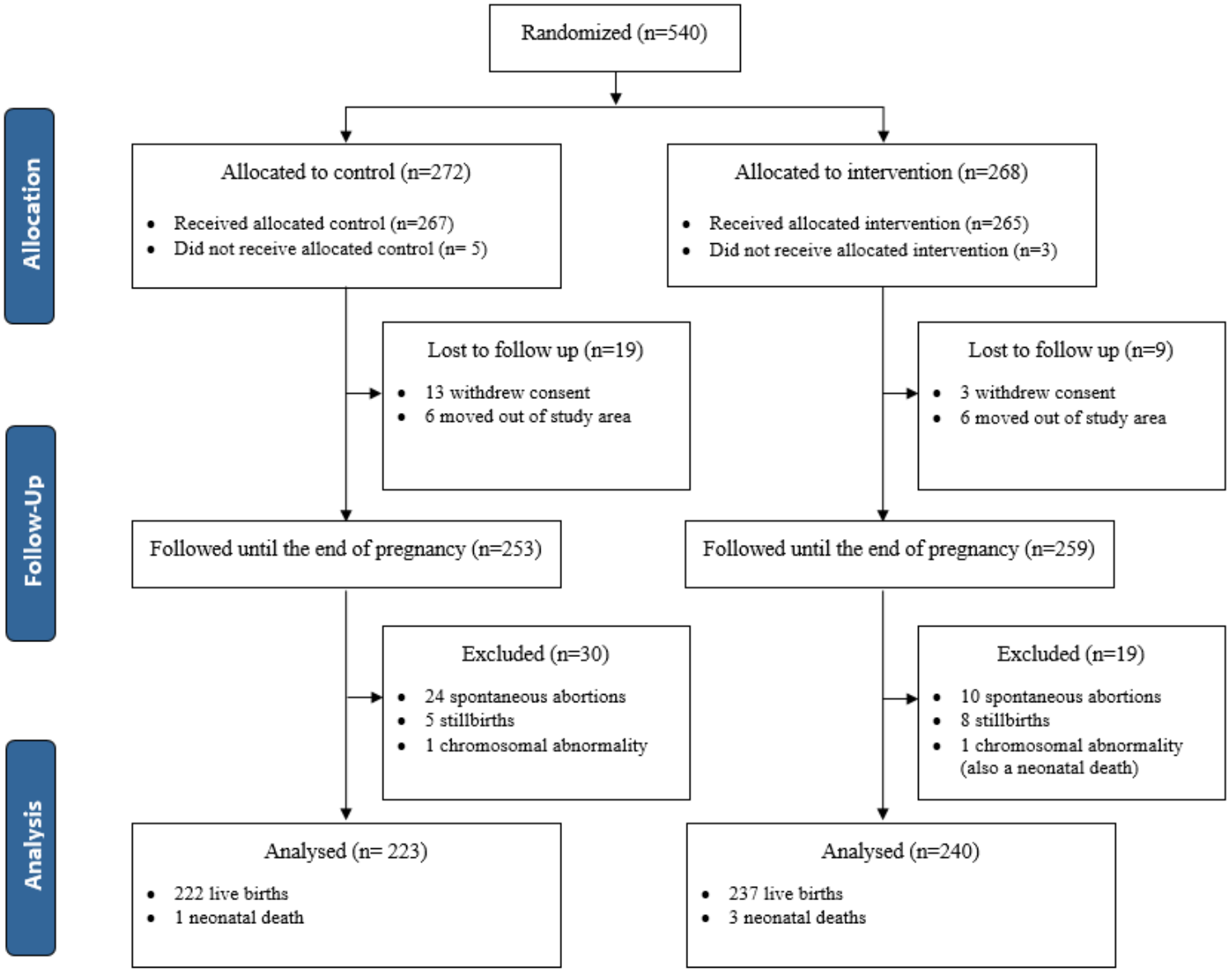
Study Design

- **Randomized controlled trial**
  - Intervention group received 1-2 HEPA filter air cleaners for use in homes during pregnancy, and control group received no air cleaners

  Study sample:

  - Non-smoking, ≥ 18 years, ≤ 18 weeks pregnancy, single gestation pregnancy, residing in apartments in UB
- **Sample size:** 540 participants recruited

Trial Profile



Barn et al., *Environ Int*, 2018

Data Collection

Conception

Delivery

~11 weeks

~31 weeks

Air cleaner deployed (intervention homes)

7-day $PM_{2.5}$ measurements

Questionnaires

Birth measurements

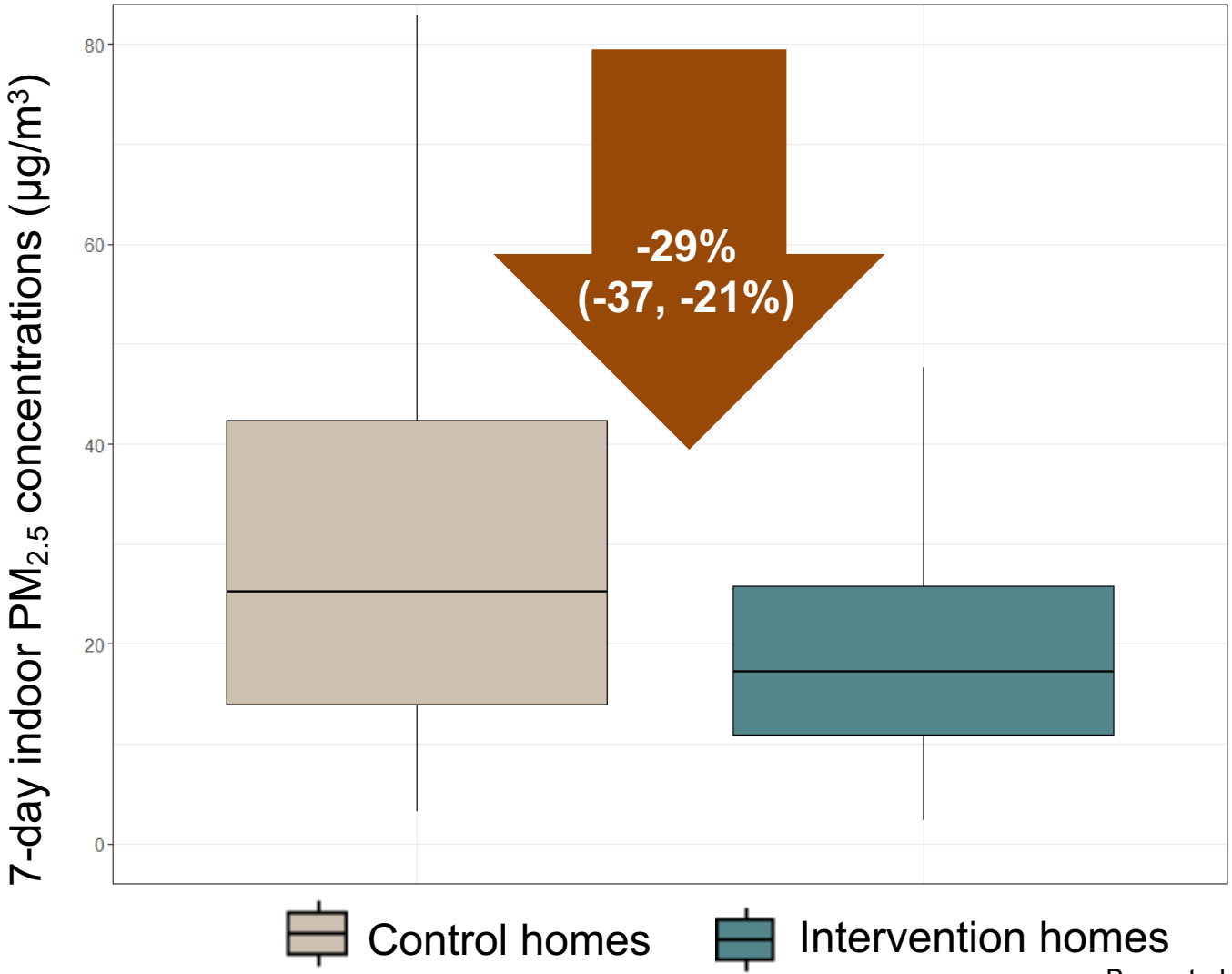
Select Cohort Characteristics

	Control (n = 223) ---------- Median (25%-75%) or N (%)	Intervention (n = 240) ---------- Median (25%-75%) or N (%)
Mother's age at enrollment, yr	28 (25 – 33)	30 (25 – 33)
Gestational age at enrollment, weeks	11 (9 – 12)	11 (9 – 13)
Mother completed university	179 (80%)	191 (80%)
Married / common-law	184 (83%)	191 (80%)
Pre-pregnancy BMI, kg/m^2	21.7 (19.6 – 23.9)	21.4 (19.8 – 24.0)
Smoked at any time during pregnancy	19 (9%)	20 (8%)
Lived w/ smoker at any time during pregnancy	112 (50%)	115 (48%)
Caesarean delivery	88 (39%)	86 (36%)
Female child	108 (48%)	109 (45%)
Birth weight, grams	3450 (3150 – 3800)	3550 (3200 – 3800)

Barn et al., *Environ Int*, 2018

Air Cleaner Impact on $PM_{2.5}$

7-day average $PM_{2.5}$ concentrations



Barn et al., *Sci Total Environ*, 2018

Unexpected Intervention Effects

- The intervention was associated with:
  - A *lower* risk of spontaneous abortion:

    OR = 0.38 (95% CI: 0.18, 0.82)

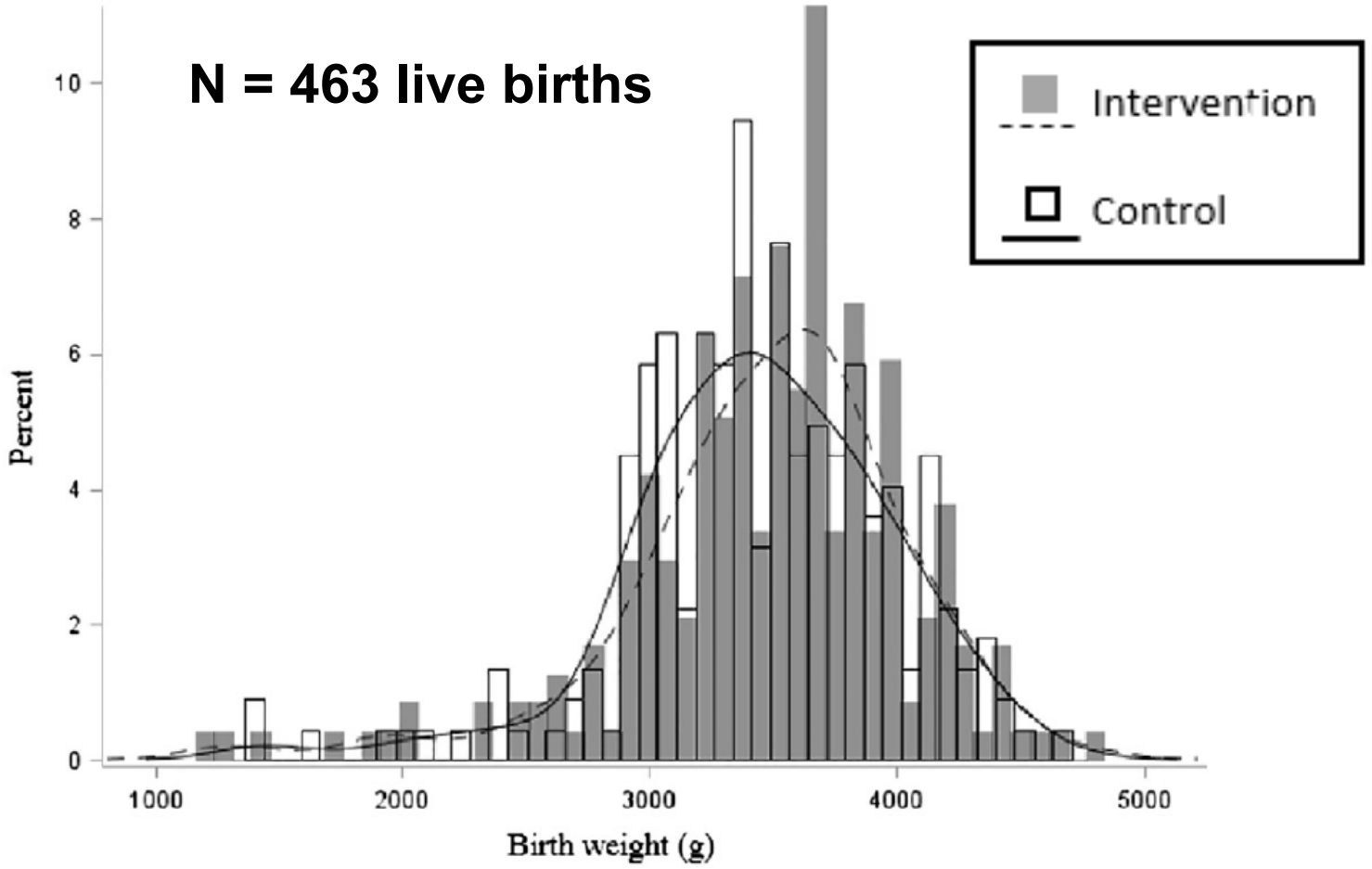
  - A *higher* risk of preterm birth:

    OR = 2.37 (95% CI: 1.11, 5.07)

- "…the presence of the intervention may have enabled fetuses to survive long enough to be born preterm."

Barn et al., *Environ Int*, 2018

Intervention Effect on Mean Birth Weight



- After accounting for differences in pre-term birth, the intervention was associated with an increase in mean birth weight: **84 g (95% CI: -1, 170 g)**

Barn et al., *Environ Int*, 2018

Is this a “big” effect?

- Effect of air purifier intervention on mean birth weight:

  84 grams

Is this a “big” effect?

- Effect of air purifier intervention on mean birth weight:

  84 grams

- Pooled effect of maternal nutrition interventions on mean birth weight in high-income countries:

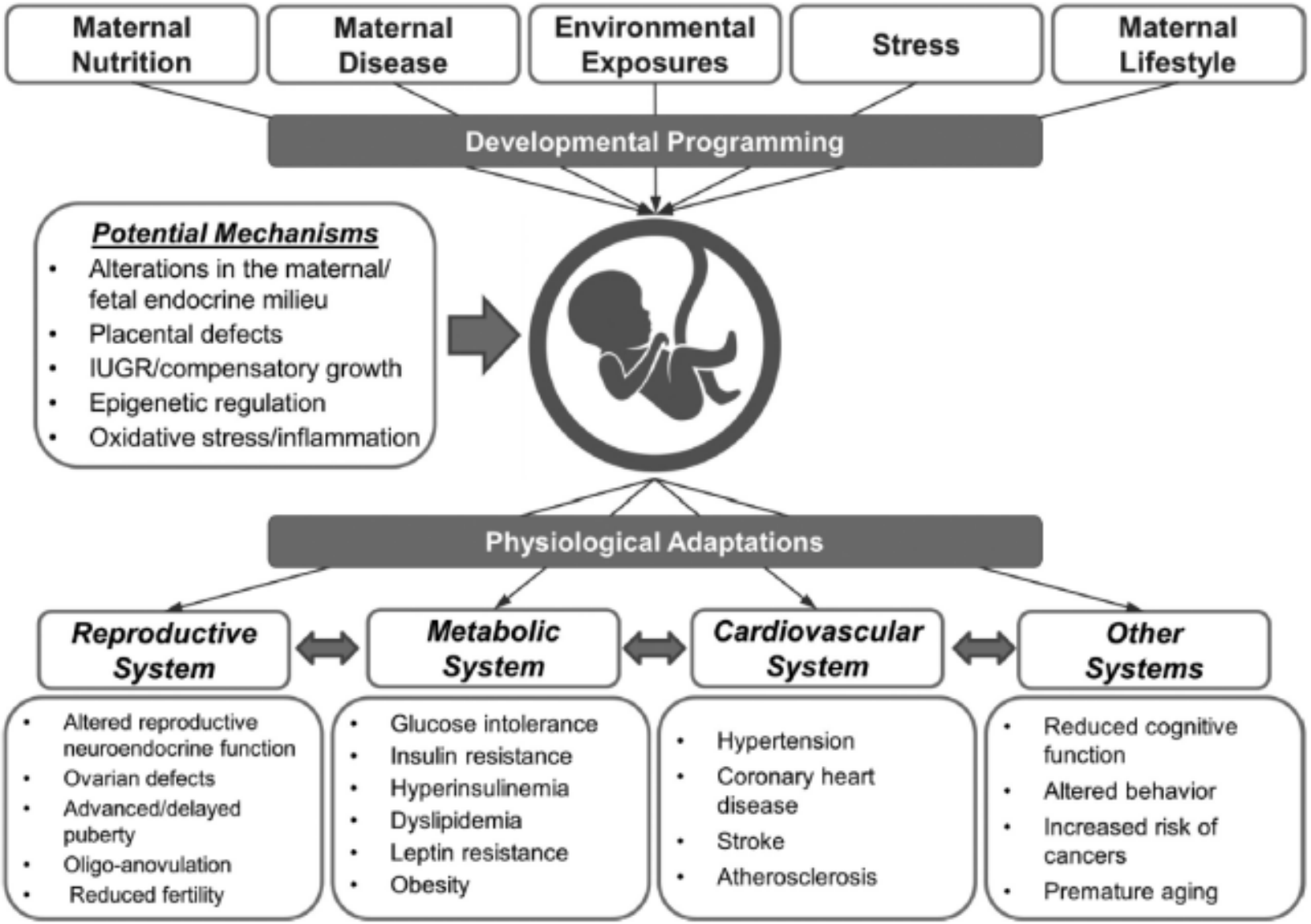
  49 grams

- Pooled effect of maternal nutrition interventions on mean birth weight in low-income countries:

  94 grams

Gresham, et al. 2014. Effects of dietary interventions on neonatal and infant outcomes: a systematic review and meta-analysis. *Am. J. Clin. Nutr.* 100, 1298–1321.

Developmental "Programming"



Padmanabhan et al., 2016

Developmental Effects?

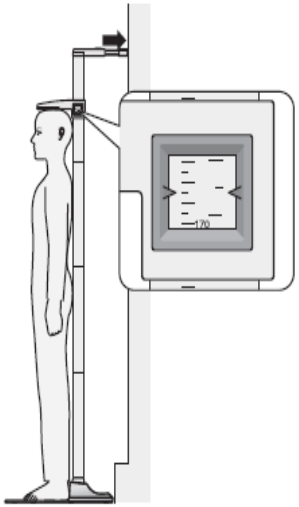
Parent-reported symptoms in first year

Outcome	Cases in Control (N = 187)	Cases in Intervention (N = 217)	Odds Ratio	95% Confidence Interval	
Wheeze	21 (11%)	12 (5.5%)	0.47	0.22	0.97
Eczema	96 (51%)	117 (54%)	1.12	0.76	1.66
Chest Infection	49 (26%)	54 (25%)	0.91	0.58	1.43
Otitis Media	32 (17%)	39 (18%)	1.07	0.64	1.76

Crista Bartolomeu, MSc thesis

Developmental Effects?

Body mass index at age 2



Estimated effects of air purifier intervention

	Effect Measure	Effect Estimate	Confidence Interval (95%)
BMI (kg/m^2)	Change in BMI	-0.23	-0.50, 0.03
Catch-Up Growth*	OR	0.49	0.30, 0.82

*Catch-Up Growth as defined as being born below the sex-specific median birth weight and having BMI above the sex-specific median at age two.

Kanlic et al., in preparation

Summary

- Considerable observational evidence that air pollution exposure during pregnancy affects birth weight
- Portable air purifiers reduced indoor $PM_{2.5}$ concentrations in UB by 29%
- Results suggest air purifier use improves fetal growth
  - Effect estimate comparable to results from trials of maternal nutrition interventions
- Preliminary results consistent with the hypothesis that prenatal exposure may affect development after birth

Acknowledgments

- UGAAR participants and their families
- UGAAR staff
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Thank you for your attention.

Questions? Comments?

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