Early-life Exposure to Ambient Air Pollutants and Kidney Function in Adolescents: A Cohort Study Based on the "Children of 1997" Hong Kong Birth Cohort

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Background

- Air pollution is increasingly recognized as a potential risk factor for CKD and impaired kidney function in adults.

- Children are comparatively more vulnerable to air pollution due to their immature lungs and immune system.

- Little is known about the effects of early-life exposure to air pollution on kidney function in children and adolescents.

Objectives

- To investigate the association of early-life exposure to ambient air pollutants with kidney function in adolescence in Hong Kong.

- To indentify the critical time windows of air pollution exposure during early life on kidney function.

Methods

Study design and population

- "Children of 1997" Birth cohort.

- A total of 8327 participants were originally recruited shortly after birth in April and May 1997 at all the 49 Maternal and Child Health Centers (MCHCs) in Hong Kong.

- During 2013-2016, we conducted questionnaires/ telephone surveys and an in-person Biobank Clinical follow-up at age ~17.6 years (n=3618).

- To identify the critical windows, we classified early life into developmental periods: 1) in utero; 2) infancy (aged < 2 years), 3) childhood (aged 2- < 8 years), and also the overall period

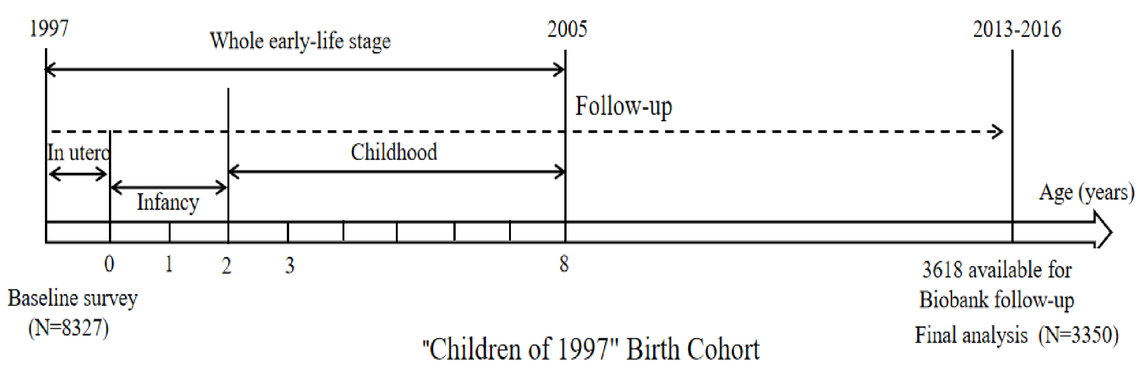

Figure 1. Timeline of the early-life stages in the "Children of 1997" birth cohort.

Kidney function assessment

- During the Biobank Clinical Follow-up at ~17.6 years, fasting venous blood samples were collected with serum creatinine (Scr) and blood urea nitrogen (BUN) measured.

- The estimated glomerular filtration rate (eGFR) was calculated using age-adjusted equations for children and adolescents as the main indicator

Ambient air pollutants exposure

- Pollutans: PM_{10}, SO_2, NO_2, and NO

- Residential exposure to ambient average levels of PM_{10}, SO_2, NO_2, and NO during in utero, infancy and childhood were estimated using the inverse distance weighting method, with a good validation (cross-validated R^2 ranged 0.75 to 0.85.

Covariates

maternal education, mother's birthplace and household annual average income per head, meteorological factors (ambient monthly average temperature and relative humidity (RH), sex, age, parity, maternal age, maternal smoking during/ after pregnancy and second-hand smoking (SHS) exposure during pregnancy.

Results

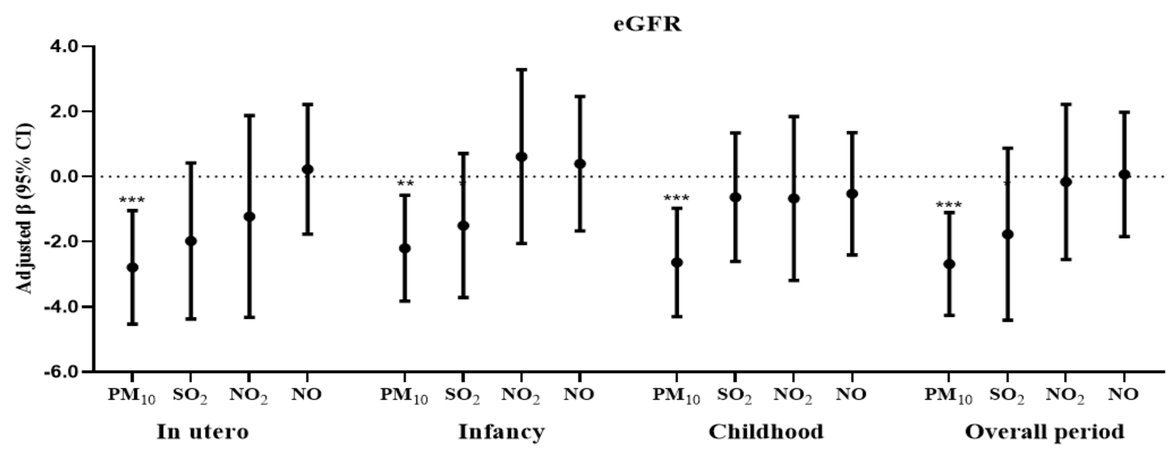

Figure 2. Association of ambient air pollutants exposure during each period in early life with the eGFR in adolescents[#].
[#]Single pollutant analysis after multiple imputation and inverse probability weighting.

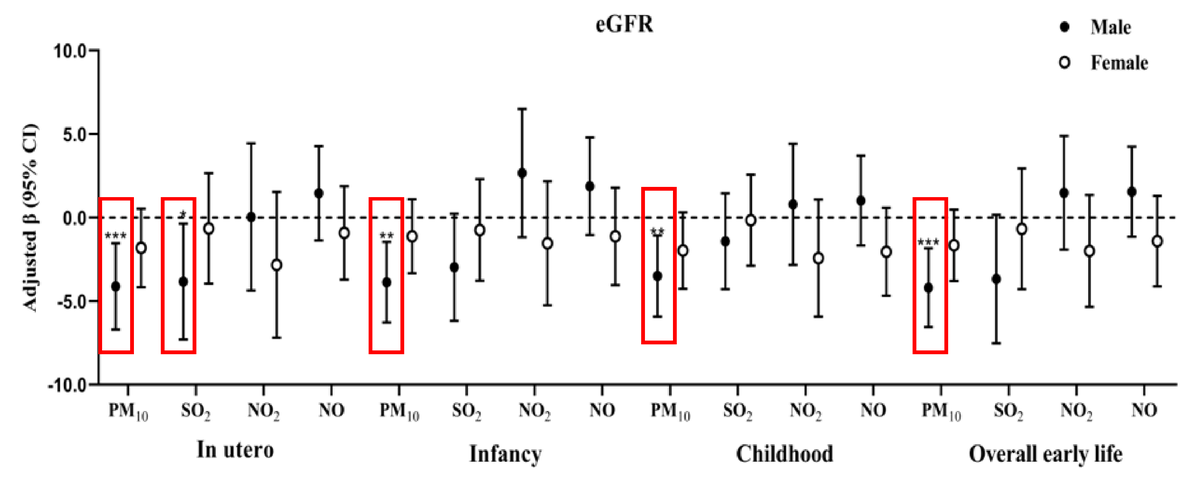

Figure 3. Association between ambient air pollutants with reduced kidney function during each period in early-life stratified by sex[#].
[#]Single pollutant analysis after multiple imputation and inverse probability weighting.

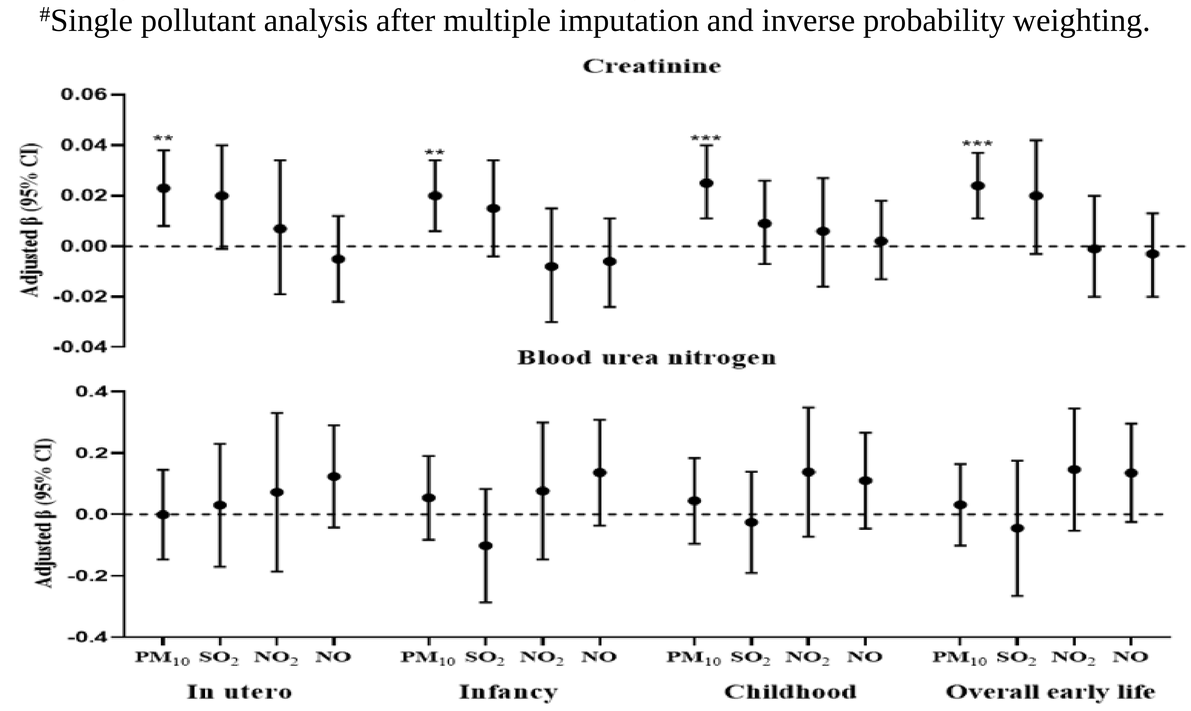

Figure 4. Sensitivity analysis for the association between air pollutants exposure with Scr and BUN during the early life period.

Conclusion

- Long-term exposure to outdoor air pollution is associated with a higher risk of impaired kidney function in adolescents in HK, especially for PM_{10}.

- Boys seem more vulnerable to PM_{10} and SO_2 in early-life than girls.

- We found that early life, especially for *in utero* period, may be a critical window of air pollutants exposure with subsequent kidney function.

References

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