Exposure to moderate air pollution and associations with lung function at school-age: a birth cohort study

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Background

- Adverse effects of **higher air pollution levels** before and after birth on subsequent lung function are often reported in the literature.
- We assessed whether **low-to-moderate levels** of air pollution during preschool-age **impact on lung function** at **school-age**.

Methods

- In a **prospective birth cohort study** (Basel and Bern Infant Lung Development [BILD] cohort) of **304 healthy term-born infants**, 232 (79%) completed lung function at **follow-up at six years**.
- Using spatial-temporal models, **levels of individual air pollution** (nitrogen dioxide [NO_2] and ozone [O_3], particulate matter with a diameter <10 µm [PM_{10}]) were estimated for the **yearly time windows** pregnancy, first up to the sixth year of life, and birth until **follow-up at age six**.
- Time window means were compared to **World Health Organization (WHO) guideline** limits.
- **Associations of exposure windows with spirometry** (FEV_1, FVC, FEV_1/FVC) and **body plethysmography** (FRC_{pleth}) indices were analyzed using **regression models**, adjusting for potential confounders.
- For **subgroup analysis**, patients were categorized into **quartiles** based on individual pollution levels (four groups of 52 children each).

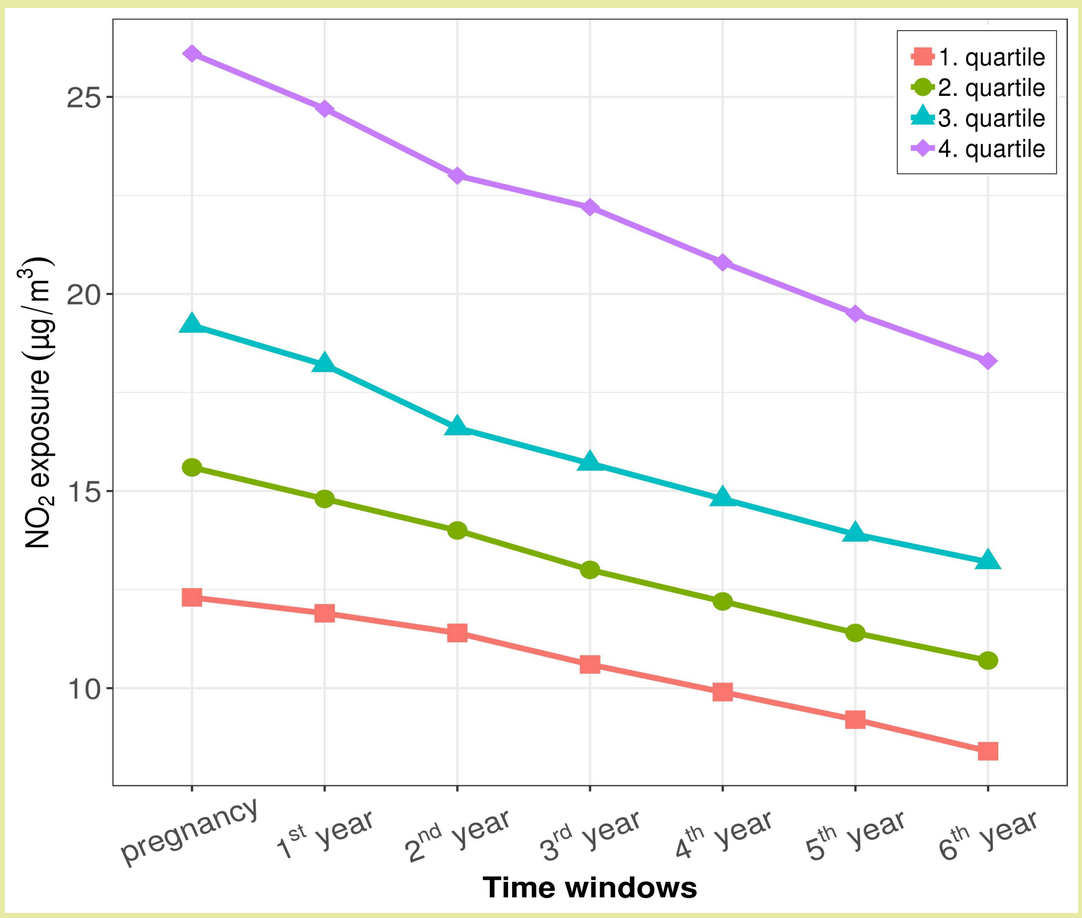

Figure 1 Temporal development of mean NO_2 (µg/m³) levels for each quartile. Temporal decrease over all investigated time windows (pregnancy, 1st year, 2nd year, 3rd year, 4th year, 5th year, 6th year). The population was divided into quartiles by individual NO_2 (µg/m³) levels; per quartile n=52.

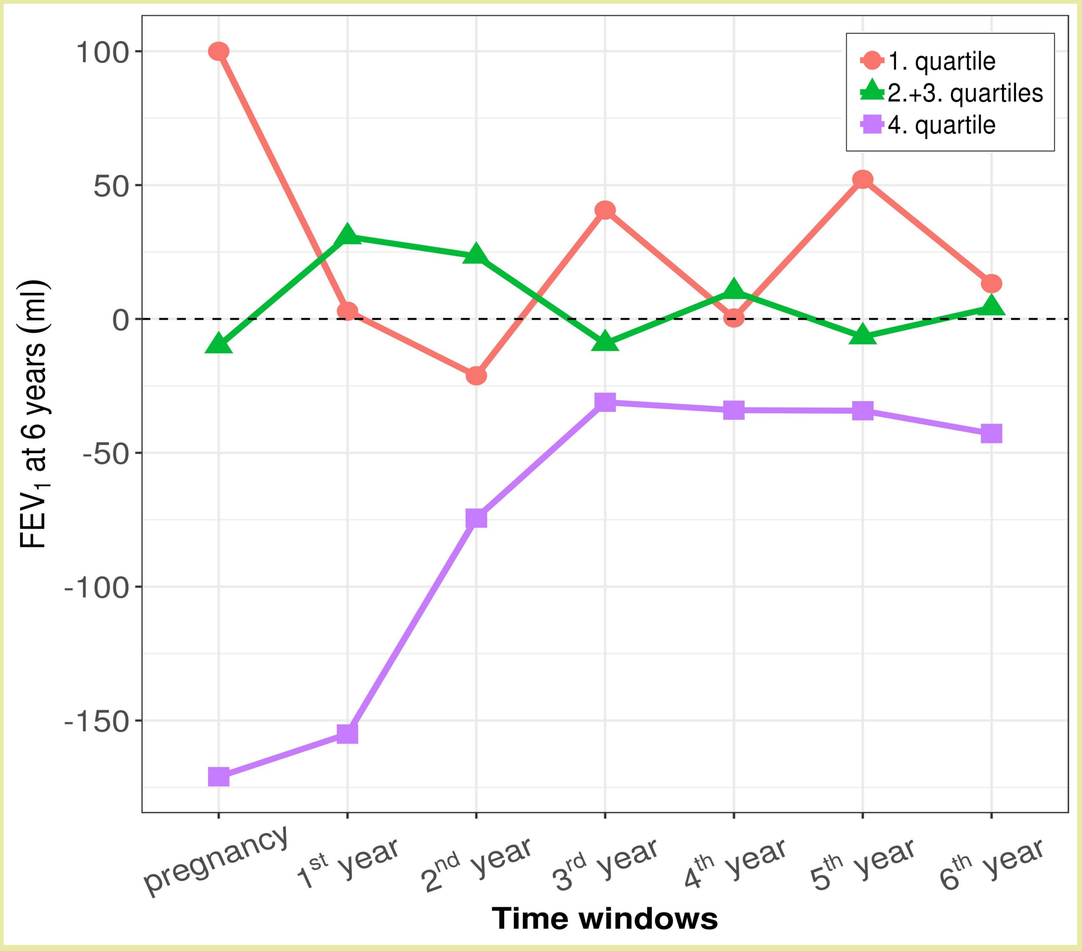

Figure 2 Effect of NO_2 (µg/m³) levels on FEV_1 (ml) at six years. The population was divided into quartiles by individual NO_2 levels (per quartile n=52). This resulted in low exposed (1st quartile), mid exposed (2nd and 3rd quartile) and highest exposed (4th quartile) subgroups. NO_2 (µg/m³) during different time windows (pregnancy, 1st year, 2nd year, 3rd year, 4th year, 5th year, 6th year) and its effects on FEV_1 (ml) at six years of age was calculated for 1st quartile, 2nd and 3rd quartile combined, and 4th quartile.

Results

- **Of the 232 children**, 44 (19%) were exposed to ETS during the study period, 17 (7%) had asthma at six years, and 89 (38%) had atopic mothers.
- **Mean NO_2 level** from birth until follow-up was (11.8 µg/m³, range 4.9 to 35.9 µg/m³), which is almost **4-times lower than the WHO suggested** limit of 40 µg/m³ (**Figure 1**).
- In the whole population, **increased air pollution levels** from birth until follow-up **were associated with reduced lung function at six years**. In the subgroup analysis, the 52 children exposed to NO_2 levels from the **highest quartile during pregnancy, the first and second year** of life and from birth until follow-up, had a **significant decrease in FEV_1** (**Figure 2**).
- Per interquartile range increase of NO_2, FEV_1 decreased by (change in ml [95% confidence interval]) (-171 [-267 to -75]), (-155 [-258 to 53]) and (-136 [-221 to -51]), respectively (**Figure 2**).

Conclusion

- Our results suggest that **exposure to higher NO_2 levels**, which are still much lower than WHO guideline limits, especially during the sensitive period of early lung development, **may be associated with reduced lung function at school-age**.
- These findings support the **concept of age and dose-dependent pollution effects** on lung function in healthy school-aged children and underline the **importance of further pollution reduction measures**.

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Funding

- Goldschmidt-Jacobson Foundation
- Swiss National Science Foundation
- Special Program Botnar Foundation