Personal ultrafine particle dose–response relationship for school children

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This works aims to examine the relationship between ultrafine particle (UFP) dose and respiratory health in school children, aged 8-11 years old.

This paper utilises the collected data on children's personal UFP doses (based on the measurement with Philips Aerasense Nanotracer), personal daily activity diaries, respiratory health and questionnaires on the home environments in the Brisbane Metropolitan Area, as part of a large epidemiological project; Ultrafine Particles from Traffic Emissions and Children's Health (UPTECH): http://www.qut.edu.au/research/research-projects/uptech/. The health measures used in this work are spirometry (FEV_1, FVC and FEV_1/FVC), forced exhaled nitric oxide concentration (FeNO in ppm: marker of airway inflammation, and atopy (students' predisposition to inflammation) (Ezz et al. 2015).

Inhaled particle surface area (IPSA) doses were calculated for 89 students with a full 24-hr activity diary and personal exposure data (Mazaheri et al. 2014).

Bayesian linear models were fit to model the variation in the respiratory health outcomes, as log FEV_1, logit FEV_1/FVC, and log FeNO, transformed to be Normal. For each model, the explanatory variables were 24-hr IPSA dose (the main effect), and the following covariates: age (in years, centred at 10), sex, height (cm, centred at 130), atopy and the presence or absence of the following home environment factors: air conditioning, carpet, gas cooking, gas heating, an attached garage, a pet, flooding and mould within the last 12 months. An interaction term for 24 hr IPSA dose by atopy was also included to test for effect modification. Weakly informative priors were employed, and 30000 posterior samples were drawn in rjags (Plummer 2015) for inference after discarding 5000 burn-in samples.

Table 1 presents the estimated effect (posterior means and 95% credible intervals, CrIs) of 24-hr IPSA dose on lung function.

For a covariate to be considered to play a role in explaining variation in the health outcomes, its associated parameter 95% posterior CrIs should not contain zero. 24-hr IPSA doses were not found to be associated with changes in FEV_1, FEV_1/FVC ratio or FeNO for either atopic or non-atopic students (Table 1).

Table 1 Effect of UFP dose on lung function by atopic status. Posterior means and 95% CrIs from the Bayesian modelling.

Outcome	Atopic status	2.5%	Mean	97.5%
FEV_1	atopic	-0.017	-0.008	0.001
	non-atopic	-0.021	-0.005	0.012
FEV_1/ FVC	atopic	-0.076	-0.003	0.102
	non-atopic	-0.107	-0.036	0.033
FeNO	atopic	-0.051	0.012	0.073
	non-atopic	-0.100	0.020	0.141

In conclusion, no effect of dose was observed (at a 95% credibility level) for each health outcome, regardless of the atopic status of the students.

This is a very small cohort for an epidemiological study and the authors recommend more comprehensive personal monitoring in future studies seeking to establish a link between personal doses and respiratory health outcomes.

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