Associations between modeled residential outdoor and measured personal exposure to ultrafine particles in four European study areas

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Author(s) van Nunen, E.; Vermeulen, R.; Tsai, M. Y.; Probst-Hensch, N.; Ineichen, A.; Imboden, M.; Naccarati, A.; Tarallo, S.; Raffaele, D.; Ranzi, A.; Nieuwenhuijsen, M.; Jarvis, D.; Amaral, A. F.; Vlaanderen, J.; Meliefste, K.; Brunekreef, B.; Vineis, P.; Gulliver, J.; Hoek, G.
Author(s) at UniBasel Probst Hensch, Nicole ; Tsai, Ming-Yi ; Ineichen, Alex ; Imboden, Medea ;
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Land use regression (LUR) models for Ultrafine Particles (UFP) have been developed to assess health effects of long-term average UFP exposure in epidemiological studies. Associations between LUR modeled residential outdoor and measured long-term personal exposure to UFP have never been evaluated, adding uncertainty in interpretation of epidemiological studies of UFP. Our aim was to assess how predictions of recently developed LUR models for UFP compared to measured average personal UFP exposure in four European areas. Personal UFP exposure was measured in 154 adults from Basel (Switzerland), Amsterdam and Utrecht (the Netherlands), Norwich (United Kingdom), and Turin (Italy). Subjects performed three 24-h exposure measurements by carrying a real-time monitor measuring particles between 10 and 300 nm (MiniDisc). Subjects reported whereabouts and indoor sources of UFP in questionnaires. In Basel and the Netherlands contemporaneously residential outdoor UFP concentrations were monitored. Area-specific LUR models were applied to model residential outdoor UFP concentrations. Associations between modeled and measured UFP concentrations were assessed with linear regression. LUR model predictions were significantly associated with median but not mean personal UFP exposures, likely because of the high impact of indoor peaks on mean personal exposures. Regression slopes (śse) combined for the four areas were 0.12 ś 0.04 for median and −0.06 ś 0.17 for mean personal exposure. The LUR model explained variance of the median personal exposure less than variance of residential outdoor measurements. Associations did not change when personal exposure was calculated for the time spent at home or when presence of indoor sources was incorporated in the regression models. Regression slopes for measured residential outdoor versus personal exposure were smaller for UFP (0.16 ś 0.04) than for simultaneously measured PM2.5 and soot (0.32 ś 0.10 and 0.43 ś 0.06). Our findings provide some support for the use of LUR models to estimate long-term exposure to ambient generated UFP in epidemiological studies.
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