Publication

Long-term exposure to fine particle elemental components and natural and cause-specific mortality-a pooled analysis of eight European cohorts within the ELAPSE project

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BACKGROUND: Inconsistent associations between long-term exposure to particles with an aerodynamic diameter </=2.5 mum [fine particulate matter (PM2.5)] components and mortality have been reported, partly related to challenges in exposure assessment. OBJECTIVES: We investigated the associations between long-term exposure to PM2.5 elemental components and mortality in a large pooled European cohort; to compare health effects of PM2.5 components estimated with two exposure modeling approaches, namely, supervised linear regression (SLR) and random forest (RF) algorithms. METHODS: We pooled data from eight European cohorts with 323,782 participants, average age 49 y at baseline (1985-2005). Residential exposure to 2010 annual average concentration of eight PM2.5 components [copper (Cu), iron (Fe), potassium (K), nickel (Ni), sulfur (S), silicon (Si), vanadium (V), and zinc (Zn)] was estimated with Europe-wide SLR and RF models at a 100x100 m scale. We applied Cox proportional hazards models to investigate the associations between components and natural and cause-specific mortality. In addition, two-pollutant analyses were conducted by adjusting each component for PM2.5 mass and nitrogen dioxide (NO2) separately. RESULTS: We observed 46,640 natural-cause deaths with 6,317,235 person-years and an average follow-up of 19.5 y. All SLR-modeled components were statistically significantly associated with natural-cause mortality in single-pollutant models with hazard ratios (HRs) from 1.05 to 1.27. Similar HRs were observed for RF-modeled Cu, Fe, K, S, V, and Zn with wider confidence intervals (CIs). HRs for SLR-modeled Ni, S, Si, V, and Zn remained above unity and (almost) significant after adjustment for both PM2.5 and NO2. HRs only remained (almost) significant for RF-modeled K and V in two-pollutant models. The HRs for V were 1.03 (95% CI: 1.02, 1.05) and 1.06 (95% CI: 1.02, 1.10) for SLR- and RF-modeled exposures, respectively, per 2 ng/m3, adjusting for PM2.5 mass. Associations with cause-specific mortality were less consistent in two-pollutant models. CONCLUSION: Long-term exposure to V in PM2.5 was most consistently associated with increased

mortality. Associations for the other components were weaker for exposure modeled with RF than SLR in two-pollutant models. https://doi.org/10.1289/EHP8368.
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