

Publication

Association of long-term exposure to ambient air pollution with retinal neurodegeneration: the prospective alienor study

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Chronic exposure to air pollution may have adverse effects on neurodegenerative diseases. Glaucoma, the second leading cause of blindness worldwide, is a neurodegenerative disease of the optic nerve, characterized by progressive thinning of the retinal nerve fiber layer (RNFL). We investigated the relationship of air pollution exposure with longitudinal changes of RNFL thickness in the Alienor study, a population-based cohort of residents of Bordeaux, France, aged 75 years or more. Peripapillary RNFL thickness was measured using optical coherence tomography imaging every 2 years from 2009 to 2020. Measurements were acquired and reviewed by specially trained technicians to control quality. Air pollution exposure (particulate matter ≤ 2.5 μm (PM(2.5)), black carbon (BC), nitrogen dioxide (NO₂)) was estimated at the participants' geocoded residential address using land-use regression models. For each pollutant, the 10-year average of past exposure at first RNFL thickness measurement was estimated. Associations of air pollution exposure with RNFL thickness longitudinal changes were assessed using linear mixed models adjusted for potential confounders, allowing for intra-eye and intra-individual correlation (repeated measurements). The study included 683 participants with at least one RNFL thickness measurement (62% female, mean age 82 years). The average RNFL was 90 μm (SD:14.4) at baseline. Exposure to higher levels of PM(2.5) and BC in the previous 10 years was significantly associated with a faster RNFL thinning during the 11-year follow-up (-0.28 $\mu\text{m}/\text{year}$ (95% confidence interval (CI) [-0.44;-0.13]) and -0.26 $\mu\text{m}/\text{year}$ (95% CI [-0.40;-0.12]) per interquartile range increment; $p < 0.001$ for both). The size of the effect was similar to one year of age in the fitted model (-0.36 $\mu\text{m}/\text{year}$). No statistically significant associations were found with NO₂ in the main models. This study evidenced a strong association of chronic exposure to fine particulate matter with retinal neurodegeneration, at air pollution levels below the current recommended thresholds in Europe.

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