RSNA Radiological Society of North America
RADIOLOGICAL SOCIETY OF NORTH AMERICA
820 JORIE BLVD, OAK BROOK, IL 60523
TEL 1-630-571-2670 FAX 1-630-571-7837
RSNA.ORG
NEWS

AI-QUANTIFIED CHEST CT REVEALS FASTER VERTEBRAL BONE LOSS IN OLDER ADULTS EXPOSED TO TRAFFIC-RELATED AIR POLLUTION: MESA COHORT

PURPOSE

To determine whether long-term ambient air pollution exposure is associated with accelerated longitudinal decline in deep learning-quantified trabecular thoracic vertebral bone mineral density (vBMD) on chest CT in older adults, and whether the association is modified by sex or antiresorptive medication use.

METHODS AND MATERIALS

In this longitudinal MESA/MESA Air analysis at six U.S. centers, 3,019 adults underwent chest CT at Exam 5 (2010-2012), and 1,320 returned for repeat CT at Exam 6 (2016-2018). Trabecular T6-T10 vBMD was quantified using a validated deep learning pipeline (TotalSegmentator v2 / nnU-Net; axial Dice, 0.93 [IQR: 0.92, 0.95]) with phantom-calibrated HU-to vBMD conversion. Cumulative Exam 1-5 exposures to $PM_{2.5}$, nitrogen oxides (NO_2), and black carbon were derived from residence-based spatiotemporal models. Pollutant × time interactions for annualized vBMD change were estimated using linear mixed-effects models with random intercepts, adjusted for scanner × time and other covariates spanning demographics, socioeconomic factors, lifestyle, clinical and nutritional factors, bone-active medications, and CT scanner. Multiple imputation, inverse-probability-of attrition weights, and Benjamini-Hochberg FDR correction across six tests were applied.

RESULTS

Among 1,320 longitudinal participants (mean [SD] baseline age, 69.3 [9.2] years; 52.0% women; median follow-up, 6.3 [IQR: 6.0, 6.6] years), per IQR increment, cumulative NOx corresponded to an additional −0.45 mg/cm³ per year of T6-T10 vBMD decline (≈2.9 mg/cm³, ≈1.6% of baseline over follow-up; 95% CI: −0.74, −0.16; P = .003; FDR P = .009) and cumulative black carbon to −0.40 mg/cm³ per year (95% CI: −0.69, −0.10; P = .008; FDR P = .012); cumulative $PM_{2.5}$ was null (−0.02 [95% CI: −0.19, 0.14]; P = .80). Decline concentrated in men (NO_2: men, −0.80 [95% CI: −1.25, −0.35] vs women, −0.12 [95% CI: −0.50, 0.27]; P for interaction = .02) and was null in baseline antiresorptive users (P for interaction = .046. Findings persisted with 1-year prior NOx (FDR P = .009) but not ozone.

CONCLUSIONS

In this longitudinal cohort, higher long-term exposure to traffic related air pollution (NOx and black carbon) was associated with accelerated decline in deep learning-derived thoracic vBMD on chest CT, with effects concentrated in men and null among antiresorptive users; confirmation in independent cohorts is warranted.

CLINICAL RELEVANCE/APPLICATIONS

Opportunistic thoracic vBMD on routine chest CT may flag older adults — particularly men not on antiresorptive therapy — whose residential traffic-pollution exposure places them at risk of accelerated bone loss, enabling earlier targeted bone-health evaluation.