Occupational Dust Exposure and Airways Disease by Computed Tomography

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Abstract

Background: Computed tomography (CT) has become a diagnostic method to quantitatively measure airways disease, providing more accurate and detailed diagnosis than pulmonary function tests. The goal of this project was to determine if occupational dust-exposures cause airways disease as measured by CT.
Methods: Using participants from a population-based study in Bergen, Norway, the extent of emphysema on CT was measured by the percent of lung low attenuation areas of 950 Hounsfield units or less (LAA950) and chronic bronchitis by airway wall thickness standardized at an internal airway perimeter of 10 mm (AWT-Pi10). Participants provided data on occupational exposures from a self-reported respiratory questionnaire that included questions on duration and severity of exposure. To quantitatively define occupational dust exposure, a "dust-year" exposure measure was created by combining duration and severity of exposure ("dust-years" = years of exposure*severity of exposure) where severity of dust exposure was classified as 0=never, 0.5=mild, 0.75=moderate, and 1.0=severe dust-exposure. Other defined occupational exposures included: (1) gas/fume-years; (2) asbestos-years; (3) quartz-dust-years; (4) aluminum-dust-years; (5) wood-dust-years.
Results: Dust-years were associated with greater LAA950 (more emphysema), even after adjusting for age, sex, and pack-years. Dust-years were also associated with greater AWT-Pi10 (thicker airways), but the association was not robust to adjustment for age, sex and pack-years (specifically, the association was confounded by sex). A sensitivity analysis was performed to determine how each of the dust-year components, duration and severity, was associated with LAA950 and AWT-Pi10. Adjusting for age, sex and pack-years, both duration and severity contributed to differences in LAA950, but only severity contributed to AWT-Pi10. Gas/fume-, asbestos-, and quartz-years were also associated with greater LAA950, but only because of their association with dust exposure.
Conclusion: Reported occupational exposure to dust as measured in "duration-severity-years" was associated with more low lung attenuation but not with more airway wall thickening, suggesting a causal effect on emphysema but not chronic bronchitis.

Background

- Formerly, respiratory symptoms and pulmonary function tests were used to diagnose airways disease
- Computed tomography (CT) now quantitatively measures airways disease
- CT measures have never been used as an endpoint for occupational dust exposure

Aim: To determine if occupational dust-exposures cause airways disease as measured by CT

Methods

Participants: Study sample from a population-based cohort in Bergen, Norway, supplemented with a hospital case series of patients with COPD defined by spirometry

Respiratory questionnaire: (self-completed)

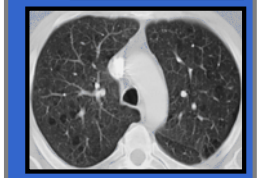
Have you ever worked for one year or more in any dusty job? If YES, please specify:

Total years worked:____

Was dust exposure: □ Mild □ Moderate □ Severe

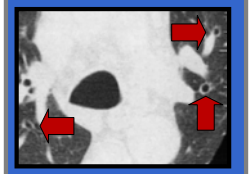
LAA950:

% of lung low attenuation areas



CT endpoint measures:

- Extent of emphysema on CT was measured by the percent of lung low attenuation areas of 950 Hounsfield units or less (LAA950), **n=914**
- Airway wall thickness was standardized at an internal airway perimeter of 10 mm (AWT-Pi10), **n=862**



AWT-Pi10:

standardized airway wall thickness

Exposure measures: Dust exposure quantitatively defined by combining duration and severity of exposure:
(years of exposure) x (severity of exposure)
= "dust-years"

- Severity of dust exposure classified as: 0=never, 0.5=mild, 0.75=moderate, & 1.0=severe
- Other defined occupational exposures:
(1) gas/fume-years, (2) asbestos-years, (3) quartz-dust-years, (4) aluminum-dust-years, (5) wood-dust-years

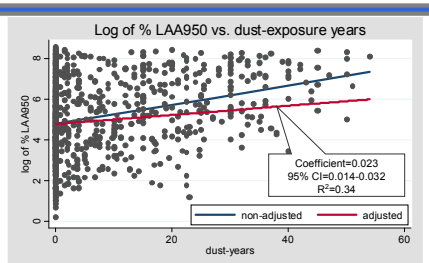
Statistical analysis: Multiple linear regression controlling for age, sex and pack-years of smoking

Results

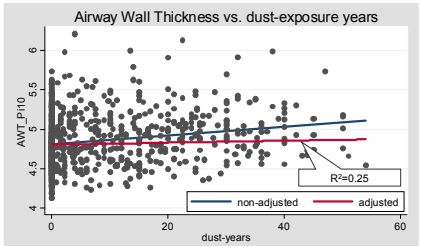
Covariate effects on LAA & AWT:

LAA950	Coefficient	95% CI	p-value
Age	0.080	0.070-0.090	<0.001
Sex	0.529	0.328-0.729	<0.001
Pack-years	0.017	0.011-0.023	<0.001

AWT-Pi10	Coefficient	95% CI	p-value
Age	-0.001	-0.003-0.001	0.561
Sex	0.279	0.237-0.318	<0.001
Pack-years	0.003	0.002-0.004	<0.001



- Dust-years associated with greater LAA with smaller (but still statistically significant) effect after covariate adjustment



- Dust-years associated with AWT-Pi10 but entirely confounded by sex in adjusted model (p=0.20)
- Gas/fume-, asbestos-, and quartz-years were associated with greater LAA950 but only because of their association with dust exposure.

Conclusion

- Higher age, male sex, and more pack-years are associated with more low lung attenuation, and male sex and more pack-years with thicker airway walls.
- More dust-years are associated with more low lung attenuation.
- More dust-years are associated with thicker airway walls, but not after adjusting for covariates due to confounding by sex.
- Gas/fume-, asbestos-, and quartz-years have no independent effects on lung attenuation or airway wall thickness.

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