Background
To date, sparse epidemiological evidence suggests associations of ultrafine particles (particulate matter with diameter < 0.1 µm; UFPs) with cardiovascular disease (CVD) yet no studies adjusted for road traffic noise.

There is lack of studies on long-term exposure to UFPs and all- and cause-specific mortality and morbidity due to diabetes, dementia, and respiratory diseases (RD), all of which have been linked so far to long-term exposure to particulate matter < 2.5 µm (PM2.5).

Objectives

Main objective: To examine the association between long-term exposure to UFPs and mortality and morbidity due to major cardio- and cerebrovascular, respiratory, metabolic, and neurodegenerative diseases.

Specific objective 1: To validate Google Air View-based model predictions for UFPs.

Specific objective 2: To determine if long-term exposure to UFPs is associated with total natural and cause-specific mortality (due to cardiovascular disease (CVD), respiratory disease (RD), diabetes, and dementia), independently of particular particulate matter of diameter < 2.5 µm (PM2.5), nitrogen dioxide (NO2), black carbon (BC), and road traffic noise.

Specific objective 3: To determine if long-term exposure to UFPs is associated with incidence of CVD, chronic RD (including lung cancer), diabetes, and dementia, independently of PM1, NO2, BC, and road traffic noise.

Methods

Population: People 30 years or older who were residing in Copenhagen, Frederiksborg, and Tårnby municipalities on January 01, 2010 (~400,000).

Exposure: Long-term estimates of UFPs (Figure 1), nitrogen dioxide (NO2), and black carbon (BC) from Google Air View-based land use regression models.

Health outcomes: Total natural and cause-specific mortality and morbidity due to CVD (myocardial infarction, heart failure, atrial fibrillation, and stroke), RD (asthma, COPD, and lung cancer), diabetes, and dementia.

Confounding covariates: Individual-level data on SES related variables in year 2010. Other air pollutants (PM1, NO2, and BC) from the European-wide hybrid ELAPSE LUR models, and road traffic noise from NORD2000 model.

Statistical analyses: Cox proportional hazard models, and Bayesian kernel machine regression (BKMR).

Preliminary results

External validation of Google model

• Completed UFP measurement for one year at reference site located at University of Copenhagen campus using a DiSCmini (Testo SE & Co., Germany)
• Completed two measurement campaigns (one in the colder season and one in the warmer season) at 37 volunteer locations (Figure 2), and calculated the annual mean at each site adjusted for temporal variability.
• Correlation was 0.03 for validation sites vs Google LUR for UFP (Figure 3).

Discussion

The Google LUR polyline data is transformed to gridded data with 15 m cell size using natural neighbor (Sibson) method. We are currently in the process of merging the exposure data with COUPH population.

Exposure merging with population

COUPH will use unique data and advanced methods to provide novel exposure-response functions for the effects of long-term exposure to UFPs, and will be useful in evaluation of a need of regulating UFPs.