Health impact assessment of traffic-related air pollution in Copenhagen Municipality

Brønnum-Hansen, Henrik; Bender, Anne Mette; Andersen, Zorana Jovanovic; Sørensen, Jan; Bønløkke, Jakob Hjort; Boshuizen, Hendrik; Becker, Thomas; Diderichsen, Finn; Loft, Steffen

Published in:
European Journal of Public Health

DOI:
10.1093/eurpub/cky213.204

Publication date:
2018

Document license:
CC BY

Citation for published version (APA):
Health impact assessment of traffic-related air pollution in Copenhagen Municipality

Henrik Brønnum-Hansen

H Brønnum-Hansen1, AM Bender1, ZJ Andersen1, J Sørensen2, J Banlakke3, H Boshuizer4, T Becker5, F Diderichsen1, S Loft1

1Department of Public Health, University of Copenhagen, Copenhagen, Denmark
2Healthcare Outcomes Research Centre, Royal College of Surgeons in Ireland, Dublin, Ireland
3Department of Public Health, Aarhus University, Aarhus, Denmark

Abstract

Traffic-related air pollution is one of the largest sources of ambient air pollution in cities. Copenhagen is the capital of Denmark and has a population of 618,000 inhabitants. It is situated on a peninsula with an area of 577 km². The city is surrounded by the Øresund strait to the west, the Baltic Sea to the north and the Øresund Bridge to the south. Copenhagen is the largest city in Denmark and a major hub for trade and transportation.

Methods

Traffic-related air pollution was estimated using the dispersion model SKY. The model was calibrated using measurements from monitoring stations in the study area. The model results were validated using measurements from an additional network of monitoring stations.

Results

Traffic-related air pollution was found to be the largest source of ambient air pollution in Copenhagen. The fine particles (PM2.5) and ozone (O3) concentrations were highest in the city center, where traffic is dense. The concentrations of PM2.5 and O3 were found to exceed the guideline values set by World Health Organization (WHO).

Conclusions

Traffic-related air pollution has a significant impact on public health in Copenhagen. The findings suggest that measures to reduce traffic-related air pollution should be prioritized in order to improve public health in the city.
Background:
High-resolution exposure to traffic-related air pollution can be assessed by modelling levels of nitrogen dioxide (NO2) which together with ultrafine particles mainly originate from diesel-powered vehicles in urban areas. The purpose of the study was to estimate the health benefits of reduced exposure to vehicle emissions assessed as NO2 among the citizens of Copenhagen Municipality, Denmark.

Methods:
We utilized residential NO2 concentrations modelled by use of chemistry transport models to calculate contributions from emission sources to air pollution. We used exposure-response functions linking NO2 concentration estimates with the risk of diabetes, cardiovascular diseases, and respiratory diseases derived from a large Danish study. The DYNAMO-HIA model was applied to the population of Copenhagen by using residential NO2 concentrations combined with demographic data and data from nationwide registers on incidence and prevalence of diseases associated with air pollution. Different scenarios were modelled to estimate the impact of NO2 exposure on related diseases and the potential health benefits of lowering the NO2 level in Copenhagen.

Results:
If NO2 exposure was restricted to the rural level life expectancy in 2040 would increase by two years for men and almost a half year for women. The greatest gain in disease-free life expectancy for men would be lifetime without ischemic heart disease (2.2 years), chronic obstructive pulmonary disease (2.1 years), and asthma (2.3 years). Among women the greatest increase would be lifetime without diabetes (1.2 years) and without stroke (1.1 years).

Conclusions:
Reducing the NO2 exposure by controlling traffic-related air pollution reduces the occurrence of some of the most prevalent diseases and increases life expectancy which can be quantified by DYNAMO-HIA with a high resolution exposure modelling. This tool has demonstrated how traffic planners can assess health benefits from reduced levels of traffic-related air pollution.

Key messages:
- Lowering NO2 exposure by reducing traffic-related air pollution would reduce occurrence of cardiovascular, respiratory and metabolic diseases, lung cancer, and increase disease-free life expectancy.
- The full potential of health gain by reducing NO2 exposure level to that of rural areas would increase life expectancy in Copenhagen by two years for men and almost a half year for women.