The burden of disease attributable to ambient PM2.5-bound PAHs exposure in Nagpur, India

Tunde O. Etchie a, *, Saravanadevi Sivanesan b, Ayotunde T. Etchie c, Gregory O. Adewuyi d, Kannan Krishnamurthi b, K.V. George b, Padma S. Rao b

a Meteorology, Environment & Demographic Surveillance (MEDsurveillance) Ltd. Port Harcourt, Nigeria
b National Environmental Engineering Research Institute, Council of Scientific and Industrial Research (CSIR-NEERI), Nagpur, India
c Department of Chemistry, Covenant University, Otta, Nigeria
d Department of Chemistry, University of Ibadan, Ibadan, Nigeria

HIGHLIGHTS

- We assessed PM2.5-bound PAHs in urban, peri-urban and rural areas of Nagpur.
- We estimated the DALYs/year resulting from the PAHs exposure.
- Average annual levels of total PM2.5-bound PAHs in Nagpur was 458 ± 246 ng/m3.
- The PAHs exposure caused about 49500 DALYs, annually.
- PAH-related burden from developmental impairments was the largest.

ARTICLE INFO

Article history:
Received 19 January 2018
Received in revised form 7 April 2018
Accepted 10 April 2018
Available online 11 April 2018
Handling Editor: A. Gies

Keywords:
Disability-adjusted life years (DALYS)
Quantitative structure-activity relationships (QSAR)
Relative toxicity factor (RTF)
Developmental impairments
Reproductive abnormalities

ABSTRACT

Exposure to PM2.5-bound polycyclic aromatic hydrocarbons (PAHs) can elicit several types of cancer and non-cancer effects. Previous studies reported substantial burdens of PAH-induced lung cancer, but the burdens of other cancer types and non-cancer effects remain unknown. Thus, we estimate the cancer and non-cancer burden of disease, in disability-adjusted life years (DALYS), attributable to ambient PM2.5-bound PAHs exposure in Nagpur district, India, using risk-based approach. We measured thirteen PAHs in airborne PM2.5, sampled from nine sites covering urban, peri-urban and rural areas, from February 2013 to June 2014. We converted PAHs concentrations to benzo[a]pyrene equivalence (BaPeq) for cancer and non-cancer effects using relative potency factors, and relative toxicity factors derived from quantitative structure-activity relationships, respectively. We calculated time-weighted exposure to BaPeq, averaged over 30 years, and adjusted for early-life susceptibility to cancer. We estimated the DALYS/year using BaPeq exposure levels, published toxicity data, and severity of the diseases from Global Burden of Disease 2016 database. The annual average concentration of total PM2.5-bound PAHs was 458 ± 246 ng/m3 and resulted in 49,500 DALYS/year (0.011 DALYS/person/year). The PAH-related DALYS followed this order: developmental (mostly cardiovascular) impairments (55.1%) > cancer (26.3%) > lung cancer (23.1%) > immunological impairments (18.0%) > reproductive abnormalities (0.4%).

© 2018 Elsevier Ltd. All rights reserved.