County level mortality and morbidity associated with PM$_{2.5}$-related cancers in China based on satellite-derived PM$_{2.5}$ data from 1998 to 2016: a forecasting and spatial analysis

Ke Ju, Wei-Bin Liao, Qian Zhou, Ya-Min Gao, Jay Pan

Abstract

West China School of Public Health and West China Fourth Hospital (K Ju MSc, W-B Liao PhD, Q Zhou PhD, Prof J Pan PhD), **and West China Research Center for Rural Health Development** (Prof J Pan), **Sichuan University, Chengdu, China; and Medical College, Northwest Minzu University, Lanzhou, China** (Y-M Gao BSc)

Correspondence to:
Prof Jay Pan, West China School of Public Health, Sichuan University, Chengdu, Sichuan 610041, China
panjie.jay@scu.edu.cn

Background Ambient fine particulate matter (PM$_{2.5}$) pollution is becoming increasingly serious in China, and is a major risk factor for various cancers. Meanwhile, the regional transportation of air pollution is predicted to play an important role in terms of the effect of air pollution, against the background of massive internal migration. However, little study has focused on forecasting using long-term data and considering regional transportation. We aimed to predict spatial distribution of cancers related to PM$_{2.5}$, namely breast cancer, pancreatic cancer, and all-cause cancer, and their mortalities and morbidities, and draw a series of forecasting maps of these cancers.

Methods We included morbidity and mortality data from 1194 counties of breast cancer, pancreatic cancer, and all-cause cancer from 2006 to 2014. We also included the annual concentration of global surface PM$_{2.5}$ concentration derived from satellite $0 \cdot 01° \times 0 \cdot 01°$ spatial resolution. We used a spatial autocorrelation method to estimate the spatial relationship. A 1000-loops simulation was done to choose the optimal forecasting model between five alternative models: ridge regression, partial least square regression, regression tree, model tree, and the combined forecasting model. A kriging interpolation method was used to draw the distribution maps.

Findings The trend showed a gradual increase in the mortality and morbidity of breast cancer, pancreatic cancer, and all-cause cancer. We found a significant spatial autocorrelation between cancer incidence and PM$_{2.5}$. Our results from forecasting showed a constant growth in mortality and morbidity of all cancers, and the kriging method suggested a similar spatial pattern. High morbidity and mortality areas were mainly in central-east and south-east China.

Interpretation We found a similar distribution pattern between PM$_{2.5}$ concentration and mortality and morbidity associated with PM$_{2.5}$-related cancers. Our results serve as a valuable reference for the development of effective policies to reduce air pollution emissions, with the efforts from governments in high-risk areas.

www.manaraa.com