Effects of Major Emission Sources on PM2.5 Concentration and Health Impacts in Korea

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The Korean government is currently exerting significant effort in developing policies to improve PM2.5. After recognizing PM2.5 as a societal issue, the government has identified thermal power plants, especially coal-fired power plants, as a primary target for management. It is a known fact that thermal power plants, particularly coal-fired ones, have a substantial impact on PM2.5 production. However, considering the narrow territory of Korea, emissions from large-scale petrochemical complexes and industrial zones, as well as from ships at well-developed ports due to the peninsula's characteristics, are also expected to have a significant impact on PM2.5 generation. According to the results of national emission Inventory, industrial complexes rank first as the source of precursors to PM2.5, followed by ships at second, and power plants at third.

This study evaluates the contributions of major air pollutant emission sources within Korea, namely thermal power plants, industrial complexes, and ship emissions, to the generation of PM2.5 and their respective health impacts. To analyze the contributions of PM2.5, the CMAQ photochemical model was utilized, applying the Brute Force Method (BFM). The assessment of the health impacts, based on PM2.5 contribution concentrations, was conducted using the BenMAP, which employs premature death estimation methods.

For industrial complexes, the annual average PM2.5 contribution from major complexes is calculated to be 1.25 μ g/m³. Emissions from domestic shipping contribute 0.57 μ g/m³, approximately 2% of Korea's annual mean PM2.5 level. Notably, the impact of shipping emissions is comparable to, if not less than, that from coal-fired power plants, which is 0.51 µg/m³ of PM2.5. The number of premature deaths estimated from the PM2.5 contribution concentrations of major industrial complexes, coal-fired power plants, and ship emissions were respectively calculated to be 1472, 796, and 863. In this study, we estimated the PM2.5 contributions from LNG power plants in addition to coal-fired power plants and calculated the conversion rates of PM2.5 concentration due to power plants, major industrial complexes, and ship emissions for each local government. These data are expected to serve as a scientific basis for the setup of PM2.5 improvement policy by the national and local governments.