Effects of particulate matter on respiratory disease and the impact of meteorological factors in Busan, Korea

Eun-Jung Jo, Woo-Seop Lee, Hyun-Young Jo, Chang-Hoon Kim, Jung-Seop Eom, Jeong-Ha Mok, Mi-Hyun Kim, Kwangha Lee, Ki-Uk Kim, Min-Ki Lee, Hye-Kyung Park

A R T I C L E   I N F O

Article history:
Received 28 October 2016
Received in revised form 28 January 2017
Accepted 12 February 2017
Available online 17 February 2017

Keywords:
Particulate matter
Hospitalization
Respiratory diseases
Temperature
Relative humidity

A B S T R A C T

Background: Both air pollution and weather impact hospitalization for respiratory diseases. However, few studies have investigated the contribution of weather to hospitalization related to the adverse effects of air pollution. This study analyzed the effects of particulate matter (PM) on daily respiratory-related hospital admissions, taking into account meteorological factors.

Methods: Daily hospital admissions for respiratory diseases (acute bronchitis, allergic rhinitis, and asthma) between 2007 and 2010 were extracted from the National Health Insurance Corporation, Korea. Patients were divided into three age-based groups (0-15, 16-64, and ≥65 years). PM levels were obtained from 19 monitoring stations in Busan.

Results: The mean number of patients admitted for acute bronchitis, allergic rhinitis, and asthma was 5.8 ± 11.9, 4.4 ± 6.1, and 3.3 ± 3.3, respectively. During that time, the daily mean PM10 and PM2.5 concentrations were 49.6 ± 20.5 and 24.2 ± 10.9 μg/m³, respectively. The mean temperature anomaly was 7.0 ± 2.3°C; the relative humidity was 62.0 ± 18.0%. Hospital admission rates for respiratory diseases increased with increasing PM and temperature, and with decreasing relative humidity. A multivariate analysis including PM, temperature anomaly, relative humidity, and age showed a significant increase in respiratory-related admissions with increasing PM levels and a decreasing relative humidity. Higher PM2.5 levels had a greater effect on respiratory-related hospital admission than did PM10 levels. Children and the elderly were the most susceptible to hospital admission for respiratory disease.

Conclusions: PM levels and meteorological factors impacted hospitalization for respiratory diseases, especially in children and the elderly. The effect of PM on respiratory diseases increased as the relative humidity decreased.

1. Introduction

Air pollution is increasing as urbanization and industrialization processes expand worldwide. The adverse effects of air pollution on health, especially that of the cardiovascular and respiratory systems, have been confirmed in several studies [1–3]. In children, air pollution increases the prevalence and incidence of asthma [4–6]; in all age groups, it is associated with acute exacerbations of asthma, bronchitis, chronic obstructive pulmonary disease (COPD), and hospital admissions for respiratory diseases [7–10].
Climate factors can also affect the development and severity of respiratory diseases. Both hyperthermia and hypothermia have been linked to respiratory morbidity and mortality, and relative humidity have been related to aggravation of respiratory diseases [11–14]. Relative humidity is thought to reduce the number of total suspended particulates contained in air [15]. Particulate matter (PM), a major component of air pollution, consists of a mixture of solid and liquid particles suspended in air [16,17]. Among the major sources of PM release are traffic, industry, biomass burning, and long-range transport. However, whether the effects of PM on health vary in response to climate has not been investigated, except in a few recent studies [13,18,19].

Busan is the second largest city in the Republic of Korea. Its high concentration of PM is due to automobile exhaust and the presence of mid-to small-level industries, such as chemical and shipbuilding industries, and to its active ports [20]. Because the southern end of Busan meets the sea and the northern end is surrounded by mountains, the city’s weather is relatively warm and humid. In this Busan-based study we investigated the effect of PM on hospital admission rates for respiratory diseases and asked whether they varied depending on meteorological factors.

2. Materials and methods

2.1. Hospital admissions for respiratory disease

Data on daily hospital admissions for respiratory diseases in Busan were extracted from the National Health Insurance Corporation, Republic of Korea, for the period 2007–2010. The data included the admission date, diagnostic code (International Classification of Diseases, ICD–10) of each admission, and the age and sex of the patient. Respiratory diseases analyzed in this study were acute laryngotraechobronchitis (J01), influenza (J10–11), pneumonia (J18), acute bronchitis (J20–21), allergic rhinitis (J30), chronic bronchitis (J40–42), chronic obstructive pulmonary disease (COPD, J44), asthma (J45–46), and hypersensitivity pneumonitis (J67). Patients were categorized in three age-based groups, I (0–15 years), II (16–64 years), and III (≥65 years), to assess the relative frequency of respiratory diseases with respect to age. Hospital admission rates were calculated as:

\[
\text{Rate}_{c,d} = \frac{\text{Hospitalization}_{c,d}}{\text{Freq}_{c,d} \times \text{POP}_d} \times 1,000,000
\]

where hospitalization\(c,d\) is the number of patients with respiratory disease by age group, Freq\(c,d\) is the frequency of hospital admission by age group, and POP\(d\) is the size of the population in Busan.

This study was approved by the Institutional Review Board of Pusan National University Hospital (H-1508-007-033).

2.2. Air pollution and meteorological data

Hourly levels of PM with aerodynamic diameters <10 \(\mu\)m (PM\(_{10}\)) and <2.5 \(\mu\)m (PM\(_{2.5}\)) were obtained from 19 monitoring stations in Busan (Fig. 1). The data were collected and made available by the Korean Ministry of Environment. Meteorological observation data were provided by the Korean Meteorological Administration and included temperature and relative humidity.

2.3. Statistical analysis

Descriptive data are presented as the means ± standard deviation (SD), minimum, lower quartile, median, upper quartile, and maximum. The relative risk of hospitalization was estimated using Poisson regression analysis, which is appropriate for analyzing rare events in subjects followed for variable lengths of time. Hospitalization for respiratory diseases as a function of PM\(_{10}\) and PM\(_{2.5}\) levels, temperature anomalies, and relative humidity were estimated respectively with a decrease in relative humidity. An analysis adjusting for the effects of temperature anomaly, relative humidity, and age group showed that PM\(_{10}\) levels greatly affected hospital
دریافت فوری
متن کامل مقاله

امکان دانلود نسخه تمام متن مقالات انگلیسی
امکان دانلود نسخه ترجمه شده مقالات
پذیرش سفارش ترجمه تخصصی
امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
امکان دانلود رایگان ۲ صفحه اول هر مقاله
امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
دانلود فوری مقاله پس از پرداخت آنلاین
پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات