The relationship between ambient particulate matter and respiratory mortality: a multi-city study in Italy

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ABSTRACT: The association of air pollutants with natural and respiratory mortality has been consistently reported. However, several aspects of the relationship between particulate matter with a 50% cut-off aerodynamic diameter of 10 μm (PM10) and respiratory mortality require further investigation. The aim of the present study was to assess the PM10–respiratory mortality association in Italy and examine potentially susceptible groups.

All deaths from natural (n=276,205) and respiratory (n=19,629) causes among subjects aged ≥35 yrs in 10 northern, central and southern Italian cities in 2001–2005 were included in the study. Pollution data for PM10, nitrogen dioxide and ozone were also obtained. A time-stratified case-crossover analysis was carried out. Different cumulative lags were selected to analyse immediate, delayed, prolonged and best-time effects of air pollution. The shape of the exposure–response curve was analysed. Age, sex, chronic conditions and death site were investigated as potential effect modifiers.

We found a 2.29% (95% CI 1.03–3.58%) increase in respiratory mortality at 0–3 days lag. The increase in respiratory mortality was higher in summer (7.57%). The exposure–response curve had a linear shape without any threshold. Sex and chronic diseases modified the relationship between particulate matter (PM) and respiratory mortality.

The effect of PM on respiratory mortality was stronger and more persistent than that on natural mortality. Females and chronic disease sufferers were more likely to die of a respiratory disease caused by air pollution than males and healthy people.

KEYWORDS: Case-crossover design, multi-city study, particulate matter, respiratory mortality

The effects of particulate air pollution on respiratory health are universally acknowledged, thanks to the results of various studies examining respiratory symptoms, exacerbation of respiratory diseases, decrease in pulmonary function and mortality in patients with chronic respiratory diseases or due to respiratory causes. The short-term effects of particulate matter with a 50% cut-off aerodynamic diameter 10 μm (PM10) on daily mortality have been estimated to be in the range of 0.3–1.5% per 10 μg·m⁻³ PM10 [1]. The effects on mortality caused by cardiovascular (CV) and respiratory diseases have been found to be generally stronger than for other conditions, and the findings contribute to our understanding of the damage mechanisms of air pollution in human health [2].

Although the association between air particles and respiratory mortality has been known for several years, many aspects of the PM10–respiratory mortality relationship, such as the specific shape of the exposure–response curve, the latency interval of the effect and the individual characteristics that can modify the particular matter (PM) effect [3, 4], deserve further investigation. The shape of the exposure–response curve has been evaluated for airborne particles and total mortality [5, 6], but very few studies have considered the relationship with specific-cause mortality [7, 8]; a variable latency interval ranging from 0–1 to 0–6 days has been studied and only a few susceptibility factors have been investigated. For instance, a stronger effect among the elderly has been found in three studies [9–11] and one study only [4]