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Seasonal Short-Term Effect of Air Pollution on Cardiovascular Mortality in Belgium

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Abstract : It is currently proven that both extremes of temperature are associated with increased mortality and that air pollution is associated with temperature. This relationship is complex, and in countries with important seasonal variations in weather such as Belgium, some effects can appear as non-significant when the analysis is done over the entire year. We, therefore, analyzed the effect of short-term outdoor air pollution exposure on cardiovascular mortality during the warmer and colder months separately. We used daily cardiovascular deaths from acute cardiovascular diagnostics according to the International Classification of Diseases, 10th Revision (ICD-10: I20-I24, I44-I49, I50, I60-I66) during the period 2008-2013. The environmental data were population-weighted concentrations of particulates with an aerodynamic diameter less than 10 µm (PM_{10}) and less than 2.5 µm ($PM_{2.5}$) (daily average), nitrogen dioxide (NO_2) (daily maximum of the hourly average) and ozone (O_3) (daily maximum of the 8-hour running mean). A Generalized linear model was applied adjusting for the confounding effect of season, temperature, dew point temperature, the day of the week, public holidays and the incidence of influenza-like illness (ILI) per 100,000 inhabitants. The relative risks (RR) were calculated for an increase of one interquartile range (IQR) of the air pollutant (µg/m^3). These were presented for the four hottest months (June, July, August, September) and coldest months (November, December, January, February) in Belgium. We applied both individual lag model and unconstrained distributed lag model methods. The cumulative effect of a four-day exposure (day of exposure and three consecutive days) was calculated from the unconstrained distributed lag model. The IQR for PM_{10}, $PM_{2.5}$, NO_2, and O_3 were respectively 8.2, 6.9, 12.9 and 25.5 µg/m^3 during warm months and 18.8, 17.6, 18.4 and 27.8 µg/m^3 during cold months. The association with CV mortality was statistically significant for the four pollutants during warm months and only for NO_2 during cold months. During the warm months, the cumulative effect of an IQR increase of ozone for the age groups 25-64, 65-84 and 85+ was 1.066 (95%CI: 1.002-1.135), 1.041 (1.008-1.075) and 1.036 (1.013-1.058) respectively. The cumulative effect of an IQR increase of NO_2 for the age group 65-84 was 1.066 (1.020-1.114) during warm months and 1.096 (1.030-1.166) during cold months. The cumulative effect of an IQR increase of PM_{10} during warm months reached 1.046 (1.011-1.082) and 1.038 (1.015-1.063) for the age groups 65-84 and 85+ respectively. Similar results were observed for $PM_{2.5}$. The short-term effect of air pollution on cardiovascular mortality is greater during warm months for lower pollutant concentrations compared to cold months. Spending more time outside during warm months increases population exposure to air pollution and can, therefore, be a confounding factor for this association. Age can also affect the length of time spent outdoors and the type of physical activity exercised. This study supports the deleterious effect of air pollution on cardiovascular mortality (CV) which varies according to season and age groups in Belgium. Public health measures should, therefore, be adapted to seasonality.

Keywords : air pollution, cardiovascular, mortality, season
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