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Association between COVID-19 lockdown policies and air pollution with associated mortality reduction in Europe

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Governments were enforced to respond to SARS-CoV-2 virus spread by taking a wide range of policy measures. Several studies have reported a decrease in air pollution following the enforcement of lockdown measures during the first wave of the COVID-19 pandemic. However, these investigations were mostly based on simple pre-post comparisons using past years as a reference, and did not assess the role of different policy interventions. These responses offered an unprecedented opportunity to assess the effectiveness of several interventions to reduce air pollution levels worldwide. Using an accurate representation of business-as-usual and lockdown air pollution scenarios, provided by Copernicus Atmosphere Monitoring Service (CAMS), we quantitatively evaluated the association between policies responses to the COVID-19 pandemic with changes in NO₂, O₃, PM_{2.5}, and PM₁₀ levels in 47 European cities. We also estimated the short-term mortality in the period of February-July 2020. An advanced spatio-temporal Bayesian non-linear mixed effect model was performed to determine the association between air pollutant levels and stringency indices as well as individual policy measures. The results indicate non-linear relationships, with a stronger decrease in NO₂ and to a lesser extent PM₁₀ and PM_{2.5} at very strict policy levels. Differences across interventions were also identified, actions linked to school/workplace closure, limitations on gatherings, and stay-at-home requirements had strong effects, while restrictions on internal movement and international travels showed little impact. The observed decrease in pollution potentially resulted in hundreds of avoided deaths across the European cities. This project provides information that can help inform future policies on air pollution reduction.