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## Potential influence of meteorological conditions on early COVID-19 transmission dynamics in 409 cities across 26 countries

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More than a year since its emergence, there is conflicting evidence on the potential influence of weather conditions on COVID-19 transmission dynamics. Respiratory viral infections often show seasonality, with influenza and other coronaviruses peaking in winter, yet the underlying mechanisms are poorly understood. As SARS-CoV-2 is a new virus to humans, it is difficult to ascertain if seasonal climate variations might have enhanced or reduced transmission in the first pandemic wave given the high proportion of susceptible people and the potential confounding role of different types of non-pharmaceutical interventions adopted at different times after the onset of local outbreaks. We used a two-stage ecological modelling approach to estimate weather-dependent signatures in COVID-19 transmission in the early phase of the pandemic, using a dataset of 3 million COVID-19 cases reported until 31 May 2020, spanning 409 locations in 26 countries. We calculated the effective reproduction number ( $R_e$ ) over a city-specific early-phase time-window of 10-20 days, for which local transmission had been established but before non-pharmaceutical interventions had intensified, as measured by the OxCGRT Government Response Index. We calculated mean levels of meteorological factors, including temperature and humidity observed in the same time window used to calculate  $R_e$ . Using a multilevel meta-regression approach, we modelled nonlinear effects of meteorological factors, while accounting for government interventions and socio-demographic factors. A weak non-monotonic association between temperature and  $R_e$  was identified, with a decrease of 0.087 (95% CI: 0.025; 0.148) for an increase in temperature between 10-20°C. Non-pharmaceutical interventions had a greater effect on  $R_e$  with a decrease of 0.285 (95% CI 0.223; 0.347) for a 5th - 95th percentile increase in the government response index. The variation in the effective reproduction number explained by early government interventions was 6 times greater than for mean temperature. We find little evidence of meteorological conditions having influenced the early stages of local epidemics and conclude that population behaviour and governmental intervention are more important drivers of transmission.

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