

FINAL COMMUNICATION OF THE WMO COVID-19 TASK TEAM

In May of 2022, the World Meteorological Organization Research Board's COVID-19 Task Team released a set of lessons learned regarding Meteorological and Air Quality Services for COVID-19 Risk Reduction and Management. These findings were based in part on the Task Team's March 2021 Review on Meteorological and Air Quality Factors Affecting the COVID-19 Pandemic and were further informed by evidence published after that Review.

In order to provide a formal update on the Review, the Task Team commissioned and accepted an updated umbrella review that summarized the evidence of meteorological and air quality influences on the pandemic provided in review articles published through April 2022.

The Task Team thanks Dr Mabel Carabali (Department of Epidemiology, Biostatistics and Occupational Health, McGill University), Ms Elsurry Perez (School of Public Health, University of Montreal), and Ms Priya Shreedhar (Heidelberg Institute of Global Health, Heidelberg University) for preparing this review and for their inventory of peer reviewed publications published after the Task Team's first report that were not covered by published review papers.

The commissioned review updates and confirms the evidence basis for the Key Findings that the Task Team issued in May 2022. The main findings of the commissioned review include the following:

- Studies from the first two and a half years of the COVID-19 pandemic indicate that the influence of meteorology and air quality on disease transmission have been secondary compared to the influence of non-pharmaceutical interventions, vaccination campaigns, changing immunity profiles, introduction of variants, and behavioural dynamics. There has been no evidence that certain weather conditions (e.g., warm and humid conditions) absolutely precludes transmission, as had been suggested by some commentators early in the pandemic.



- Overall, the literature provided evidence for possible associations between temperature and humidity and COVID-19 incidence, and poor air quality and severe COVID-19 outcomes. The findings suggest that associations between weather and COVID-19 incidence (via impacts on transmission) and severe outcomes are complex and likely non-linear. This complexity likely means that impacts of weather are dependent on the contexts of the studies in terms of geography, season, stage of pandemic etc. However, the relative contributions of possible mechanisms of impact (e.g. impacts on virus survival versus impacts on person-to-person contact rates) need further elucidation.
- The context, complexity, and possible non-linearity of these associations have contributed to mixed results regarding the sign of association between meteorological variables and COVID-19 incidence. Different studies have also employed a diversity of analysis methods, predictor and response variables, and data sources, and this has further contributed to the diversity of results. As indicated in most reviews, a pattern has emerged in high quality studies that indicates a generally negative association between temperature and COVID-19 transmission (lower temperatures favour transmission) and between humidity and COVID-19 transmission (drier conditions favour transmission) within the range of prevailing conditions. Plausible associations with other meteorological variables have also been identified but have not been studied as widely as temperature and humidity or shown the same emerging consistency.
- Several reviews and meta-analyses consolidated in this review suggest an association between exposure to pollutants affecting air quality and severe COVID-19 outcomes. A high level of heterogeneity in measurement and methodologies across studies precludes quantification of impacts, however, and further studies are needed to ascribe causality of severe outcomes to poor air quality.
- Process-based modelling studies anticipate that COVID-19 transmission may become seasonal over time, suggesting MAQ factors may support monitoring and forecasting of COVID-19. This expectation is consistent with knowledge of many other respiratory viral infections, particularly in temperate climates. Continued data collection and analysis will be critical for risk assessment and communication as COVID-19 transitions from epidemic to endemic dynamics.
- While meteorology and air quality factors may have been secondary to other influences in the first years of the pandemic, it must be noted that the number of infections and deaths from COVID-19 was very large, such that even secondary factors can have large total impact. For this reason, it is critical that researchers continue to study the role of MAQ factors in COVID-19 and the potential to apply such knowledge to pandemic preparedness and response.
- Similarly, as a new globally endemic disease, COVID-19 retains the possibility of causing severe outcomes. Even small percentage changes in COVID-19 incidence and severity will result in large impacts in terms of cases and deaths. Consequently, understanding the role of MAQ in transmission and outcomes of infection remains an important research endeavor to allow development of accurate forecasting and effective interventions.
- MAQ information has also proven to be useful in COVID-19 preparedness and response beyond the specific question of transmission sensitivities. For example, meteorological forecasts that inform preparedness for extreme storms, heat events, and other hazards have supported actions to mitigate the impacts of those events in a manner that is consistent with COVID-19 precautions. We encourage the National Meteorological Services and the meteorological academic community to closely collaborate with health experts in order to further incorporate MAQ into COVID-19-related services, products and activities.
- Reviews assessed in the umbrella review indicated the use of a variety of data sources, showing increased data availability. However, linkage between data sources could be improved to favor the robustness of the temporal association between MAQ exposures and COVID-19 outcomes. The relative brevity of the COVID-19 record, combined with data collection challenges throughout the pandemic, continue to limit the conclusiveness of published analyses.
- Just as importantly, clear, and active communication between researchers, the media, and decision makers is required to ensure that scientific findings are applied to policy in an appropriate, objective, transparent and responsible manner.

With this updated literature review and the reinforcement of the [May 2022 Key Findings](#), the WMO Research Board's COVID-19 Task Team has concluded its work.