

COVID-19 CADTH REFERENCE LIST

Temperature, Humidity, and COVID-19: Evidence

This report was published on October 14, 2020

To produce this report, CADTH used a modified approach to the selection, appraisal, and synthesis of the evidence to meet decision-making needs during the COVID-19 pandemic. Care has been taken to ensure the information is accurate and complete, but it should be noted that international scientific evidence about COVID-19 is changing and growing rapidly.

Version: 1.0
Publication Date: October 2020
Report Length: 8 Pages

Authors: Shannon Hill, Charlene Argáez

Cite As: *Temperature, Humidity, and COVID-19: Evidence*. Ottawa: CADTH; 2020 Oct. (CADTH Reference list).

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Funding: CADTH receives funding from Canada's federal, provincial, and territorial governments, with the exception of Quebec.

Questions or requests for information about this report can be directed to requests@cadth.ca.

Research Question

What is the evidence regarding the weather (i.e., temperature, humidity) and COVID-19 transmission and incidence?

Key Findings

One systematic review and 30 non-randomized studies were identified related to evidence regarding the weather and COVID-19 transmission and incidence.

Methods

Literature Search Methods

A limited literature search was conducted by an information specialist on key resources including Ovid Medline, PubMed, the Cochrane Library, the University of York Centre for Reviews and Dissemination (CRD) databases, the websites of Canadian and major international health technology agencies, as well as a focused internet search. The search strategy was comprised of both controlled vocabulary, such as the National Library of Medicine's MeSH (Medical Subject Headings), and keywords. The main search concepts were COVID-19 and weather or temperature. No filters were applied to limit retrieval by study type. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2018 and October 7, 2020. Internet links were provided, where available.

Selection Criteria

One reviewer screened literature search results (titles and abstracts) and selected publications according to the inclusion criteria presented in Table 1. Full texts of study publications were not reviewed. Open access full-text versions of evidence-based guidelines were reviewed when abstracts were not available.

Table 1: Selection Criteria

Population	People without COVID-19
Exposure	Weather (i.e., temperature, humidity)
Comparator	Other temperatures or humidity levels; no comparator
Outcomes	COVID-19 infection (i.e., incidence, transmission)
Study Designs	Health technology assessments, systematic reviews, randomized controlled trials, non-randomized studies

Results

One systematic review¹ and 30 non-randomized studies²⁻³⁰ were identified related to evidence regarding the weather and COVID-19 transmission and incidence. No health technology assessments or randomized controlled trials were identified.

Additional references of potential interest that did not meet the inclusion criteria are provided in the appendix.

Health Technology Assessments

No literature identified.

Systematic Reviews and Meta-analyses

1. Mecenas P, Bastos R, Vallinoto ACR, Normando D. Effects of temperature and humidity on the spread of COVID-19: a systematic review. *PLoS ONE*. 2020 Sep;15(9):e0238339.
[PubMed: PM32946453](#)

Randomized Controlled Trials

No literature identified.

Non-Randomized Studies

Canadian Studies

2. Juni P, Rothenbuhler M, Bobos P, et al. Impact of climate and public health interventions on the COVID-19 pandemic: a prospective cohort study. *CMAJ*. 2020 May;192(21):E566-E573.
[PubMed: PM32385067](#)
3. To T, Zhang K, Maguire B, et al. Correlation of ambient temperature and COVID-19 incidence in Canada. *Sci Total Environ*. 2020 Aug 4;750:141484.
[PubMed: PM32829260](#)

Non-Canadian Specific Studies

4. Alkhowailed M, Shariq A, Alqossayir F, Alzahrani OA, Rasheed Z, Al Abdulmonem W. Impact of meteorological parameters on COVID-19 pandemic: a comprehensive study from Saudi Arabia. *Inform Med Unlocked*. 2020;20:100418.
[PubMed: PM32875061](#)
5. Bolano-Ortiz TR, Camargo-Cacedo Y, Puliafito SE, et al. Spread of SARS-CoV-2 through Latin America and the Caribbean region: a look from its economic conditions, climate and air pollution indicators. *Environ Res*. 2020 Jul 15;191:109938.
[PubMed: PM32858479](#)
6. Chien LC, Chen LW. Meteorological impacts on the incidence of COVID-19 in the U.S. *Stoch Environ Res Risk Assess*. 2020 Jul 4:1-6.
[PubMed: PM32837311](#)
7. Del Rio C, Camacho-Ortiz A. Will environmental changes in temperature affect the course of COVID-19? *Braz J Infect Dis*. 2020 May-Jun;24(3):261-263.
[PubMed: PM32380010](#)
8. Dogan B, Ben Jebli M, Shahzad K, Farooq TH, Shahzad U. Investigating the effects of meteorological parameters on COVID-19: case study of New Jersey, United States. *Environ Res*. 2020 Aug 30:110148.
[PubMed: PM32877703](#)

9. Goswami K, Bharali S, Hazarika J. Projections for COVID-19 pandemic in India and effect of temperature and humidity. *Diabetes Metab Syndr*. 2020 Sep-Oct;14(5):801-805.
[PubMed: PM32540732](#)
10. Iqbal MM, Abid I, Hussain S, Shahzad N, Waqas MS, Iqbal MJ. The effects of regional climatic condition on the spread of COVID-19 at global scale. *Sci Total Environ*. 2020 Oct 15;739:140101.
[PubMed: PM32531684](#)
11. Jahangiri M, Jahangiri M, Najafgholipour M. The sensitivity and specificity analyses of ambient temperature and population size on the transmission rate of the novel coronavirus (COVID-19) in different provinces of Iran. *Sci Total Environ*. 2020 Aug 1;728:138872.
[PubMed: PM32335407](#)
12. Lin J, Huang W, Wen M, et al. Containing the spread of coronavirus disease 2019 (COVID-19): meteorological factors and control strategies. *Sci Total Environ*. 2020 Nov 20;744:140935.
[PubMed: PM32688005](#)
13. Liu J, Zhou J, Yao J, et al. Impact of meteorological factors on the COVID-19 transmission: a multi-city study in China. *Sci Total Environ*. 2020 Jul 15;726:138513.
[PubMed: PM32304942](#)
14. Mandal CC, Panwar MS. Can the summer temperatures reduce COVID-19 cases? *Public Health*. 2020 Aug;185:72-79.
[PubMed: PM32574871](#)
15. Menebo MM. Temperature and precipitation associate with Covid-19 new daily cases: a correlation study between weather and Covid-19 pandemic in Oslo, Norway. *Sci Total Environ*. 2020 Oct 1;737:139659.
[PubMed: PM32492607](#)
16. Meo SA, Abukhalaf AA, Alomar AA, et al. Climate and COVID-19 pandemic: effect of heat and humidity on the incidence and mortality in world's top ten hottest and top ten coldest countries. *Eur Rev Med Pharmacol Sci*. 2020 Aug;24(15):8232-8238.
[PubMed: PM32767355](#)
17. Meo SA, Abukhalaf AA, Alomar AA, et al. Impact of weather conditions on incidence and mortality of COVID-19 pandemic in Africa. *Eur Rev Med Pharmacol Sci*. 2020 Sep;24(18):9753-9759.
[PubMed: PM33015822](#)
18. Meo SA, Abukhalaf AA, Alomar AA, Alsalam NM, Al-Khlaiwi T, Usmani AM. Effect of temperature and humidity on the dynamics of daily new cases and deaths due to COVID-19 outbreak in Gulf countries in Middle East Region. *Eur Rev Med Pharmacol Sci*. 2020 Jul;24(13):7524-7533.
[PubMed: PM32706095](#)
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[PubMed: PM32965017](#)

20. Ogaugwu C, Mogaji H, Ogaugwu E, et al. Effect of weather on COVID-19 transmission and mortality in Lagos, Nigeria. *Scientifica (Cairo)*. 2020 Aug;20:2562641.
[PubMed: PM32855836](#)
21. Pani SK, Lin NH, RavindraBabu S. Association of COVID-19 pandemic with meteorological parameters over Singapore. *Sci Total Environ*. 2020 Oct 20;740:140112.
[PubMed: PM32544735](#)
22. Pequeno P, Mendel B, Rosa C, et al. Air transportation, population density and temperature predict the spread of COVID-19 in Brazil. *PeerJ*. 2020 Jun;8:e9322.
[PubMed: PM32547889](#)
23. Prata DN, Rodrigues W, Bermejo PH. Temperature significantly changes COVID-19 transmission in (sub)tropical cities of Brazil. *Sci Total Environ*. 2020 Aug 10;729:138862.
[PubMed: PM32361443](#)
24. Qi H, Xiao S, Shi R, et al. COVID-19 transmission in Mainland China is associated with temperature and humidity: a time-series analysis. *Sci Total Environ*. 2020 Aug 1;728:138778.
[PubMed: PM32335405](#)
25. Raina SK, Kumar R, Bhota S, et al. Does temperature and humidity influence the spread of Covid-19?: a preliminary report. *J*. 2020 Apr;9(4):1811-1814.
[PubMed: PM32670923](#)
26. Sehra ST, Saliccioli JD, Wiebe DJ, Fundin S, Baker JF. Maximum daily temperature, precipitation, ultra-violet light and rates of transmission of SARS-Cov-2 in the United States. *Clin Infect Dis*. 2020 May 30;ciaa681.
[PubMed: PM32472936](#)
27. Sharma P, Singh AK, Agrawal B, Sharma A. Correlation between weather and COVID-19 pandemic in India: an empirical investigation. *J Public Aff*. 2020 Jul 21:e2222.
[PubMed: PM32837322](#)
28. Shi P, Dong Y, Yan H, et al. Impact of temperature on the dynamics of the COVID-19 outbreak in China. *Sci Total Environ*. 2020 Aug 1;728:138890.
[PubMed: PM32339844](#)
29. Sobral MFF, Duarte GB, da Penha Sobral AIG, Marinho MLM, de Souza Melo A. Association between climate variables and global transmission of SARS-CoV-2. *Sci Total Environ*. 2020 Aug 10;729:138997.
[PubMed: PM32353724](#)
30. Wu Y, Jing W, Liu J, et al. Effects of temperature and humidity on the daily new cases and new deaths of COVID-19 in 166 countries. *Sci Total Environ*. 2020 Aug 10;729:139051.
[PubMed: PM32361460](#)
31. Xie J, Zhu Y. Association between ambient temperature and COVID-19 infection in 122 cities from China. *Sci Total Environ*. 2020 Jul 1;724:138201.
[PubMed: PM32408450](#)

Appendix — Further Information

Preprint Articles – Not Peer Reviewed

Warning: Preprints are reports that have not been formally published or peer-reviewed. They should not be relied on to guide clinical practice or health-related behaviour.

32. Bannister-Tyrrell M, Meyer A, Faverjon C, et al. Preliminary evidence that higher temperatures are associated with lower incidence of COVID-19, for cases reported globally up to 29th February 2020 **[non-peer-reviewed preprint]**. medRxiv; 2020 Mar: doi: <https://doi.org/10.1101/2020.03.18.20036731> Accessed 2020 Oct 13.
33. Chaudury AP, Nelson AK, Harish S, et al. Effect of temperature and precipitation on the daily new cases and daily new death in seven cities around the globe **[non-peer-reviewed preprint]**. medRxiv; 2020 Oct: doi: <https://doi.org/10.1101/2020.10.03.20206227> Accessed 2020 Oct 13.
34. Chen B, Liang H, Yuan X, et al. Roles of meteorological conditions in COVID-19 transmission on a worldwide scale **[non-peer-reviewed preprint]**. medRxiv; 2020 Mar: doi: <https://doi.org/10.1101/2020.03.16.20037168> Accessed 2020 Oct 13.
35. Fang L, Wang D, Pan C. Effects of temperature and humidity on COVID-19 transmission in California, US: a time-series study **[non-peer-reviewed preprint]**. Europe PMC Preprints; 2020 Sep: <https://europepmc.org/article/PPR/PPR210575> Accessed 2020 Oct 13.
36. Gupta A, Pradhan B. Impact of daily weather on COVID-19 outbreak in India **[non-peer-reviewed preprint]**. medRxiv; 2020 Jun: doi: <https://doi.org/10.1101/2020.06.15.20131490> Accessed 2020 Oct 13.
37. Singh K, Agarwal A. Impact of weather indicators on the COVID-19 outbreak: a multi-state study in India **[non-peer-reviewed preprint]**. medRxiv; 2020 Jun: doi: <https://doi.org/10.1101/2020.06.14.20130666> Accessed 2020 Oct 13.
38. Wang J, Tang KE, Feng K, et al. High temperature and high humidity reduce the transmission of COVID-19 **[non-peer-reviewed preprint]**. SSRN Preprint Papers; 2020 Mar: <http://dx.doi.org/10.2139/ssrn.3551767> Accessed 2020 Oct 13.
39. Zhang C, Liao H, Strol E, et al. Beware that COVID-19 would be worse in winter: a study of a global panel of 1236 regions **[non-peer-reviewed preprint]**. medRxiv; 2020 Jul: doi: <https://doi.org/10.1101/2020.07.29.20164152> Accessed 2020 Oct 13.

Review Articles

40. Aboubakr HA, Sharafeldin TA, Goyal SM. Stability of SARS-CoV-2 and other coronaviruses in the environment and on common touch surfaces and the influence of climatic conditions: a review. *Transbound Emerg Dis*. 2020 Jun 30;10.1111/tbed.13707.
[PubMed: PM32603505](https://pubmed.ncbi.nlm.nih.gov/32603505/)

41. Adedokun KA, Olarinmoye AO, Mustapha JO, Kamorudeen RT. A close look at the biology of SARS-CoV-2, and the potential influence of weather conditions and seasons on COVID-19 case spread. *Infect Dis Poverty*. 2020 Jun 26;9(1):77.
[PubMed: PM32586369](#)
42. Babin S. Use of weather variables in SARS-CoV-2 transmission studies. *Int J Infect Dis*. 2020 Sep 17;100:333-336.
[PubMed: PM32950732](#)
43. Smit AJ, Fitchett JM, Engelbrecht FA, Scholes RJ, Dzihvhuho G, Sweijid NA. Winter is coming: a southern hemisphere perspective of the environmental drivers of SARS-CoV-2 and the potential seasonality of COVID-19. *Int J Environ Res Public Health*. 2020 Aug 5;17(16):5634.
[PubMed: PM32764257](#)

Additional References

44. Brassey J, Heneghan C, Mahtani KR, et al. Do weather conditions influence the transmission of the coronavirus (SARS-CoV-2)? Oxford, England: Centre for Evidence-Based Medicine, Oxford University; 2020 Mar: <https://www.cebm.net/covid-19/do-weather-conditions-influence-the-transmission-of-the-coronavirus-sars-cov-2/> Accessed 2020 Oct 13.
45. National Academies of Sciences, Engineering, and Medicine. Rapid expert consultation on SARS-CoV-2 survival in relation to temperature and humidity and potential for seasonality for the COVID-19 pandemic. Washington (DC): National Academies Press; 2020 Apr: <https://www.nap.edu/catalog/25771/rapid-expert-consultation-on-sars-cov-2-survival-in-relation-to-temperature-and-humidity-and-potential-for-seasonality-for-the-covid-19-pandemic-april-7-2020> Accessed 2020 Oct 13.
46. Agency for Clinical Innovation. Winter and COVID-19 transmission [evidence check]. St Leonards, NSW: COVID-19 Critical Intelligence Unit, Agency for Clinical Innovation; 2020 Apr: https://www.aci.health.nsw.gov.au/_data/assets/pdf_file/0004/578470/20200401-Evidence-Check-Seasonal-Changes-and-COVID-19.pdf Accessed 2020 Oct 13.
47. Spencer EA, Brassey J, Jefferson T, et al. Environmental weather conditions and influence on transmission of SARS-CoV-2 [open evidence review]. Oxford, England: Centre for Evidence-Based Medicine, Oxford University; 2020 Jul: <http://www.cebm.net/covid-19/weather-conditions-sars-cov-2/> Accessed 2020 Oct 13.