
ROLES OF HUMIDITY AND TEMPERATURE IN COVID-19 INFECTION DYNAMICS

KEYWORDS: CLIMATE CHANGE, COVID-19, PUBLIC HEALTH, TEMPERATURE, HUMIDITY, GLOBAL
EPIDEMIC AND MOBILITY MODEL

MSc COMPUTATIONAL METHODS IN ECOLOGY AND EVOLUTION
YUAN ZHANG

SUPERVISED BY

SAMRAAT PAWAR

*Life Science Department
Imperial College London*

2 APRIL
2020

Contents

1	Introduction	2
2	Proposed Methods	2
2.1	Data and preparation	2
2.2	Analysis	3
2.2.1	Environmental impact	3
2.2.2	Fitting model and Modified model	3
3	Anticipated outputs and outcomes	3
4	Project feasibility supported by a timeline of tasks	3
5	The itemized budget	3

1 Introduction

Corona Virus Disease 2019 (COVID-19), a new type of Coronavirus, accompanied as human-to-human transmission, has become as a serious public health threat. Although similar to SARS-CoV and MERS-CoV, the COVID-19 is quite different (Wu 2020, Yan 2020, Ying Liu 2020). The rapidly increasing evidence of human-to-human transmission suggest that the virus is more contagious than SARS-CoV and MERS-CoV (Paules 2020). Based on statistic by WHO(2020), the number of confirmed cases worldwide has exceeded 200 000. Besides, it also can be deadly for massive alveolar damage and progressive respiratory failure (Paules 2020). Although it has been found that 96% COVID-19 matched at whole genome level to a bat coronavirus(Zhou et al. 2020), other aspects such as transmission methods and affecting factors of this Coronavirus are unknown. In short, it is essential to study this Coronavirus by suitable modeling.

Environmental factors (Temperature, humidity) have proven to be important influencing factors on epidemic disease (Chin et al. 2020). Some literature indicates that a high temperature and high humidity climate can reduce virus transmission (Lowen et al. 2014) . However,in fact, there are still many confirmed diagnoses in tropical countries such as Singapore and Malaysia. Therefore, the influence of environmental factors is complex and unclear. Few literatures has investigate this aspect and one fit empirical data seems not well (Chin et al. 2020).

This study aims to investigate roles of Humidity and Temperature in COVID-19 infection dynamics. The proposed questions are:

(1) Are Coronavirus infections phenomenological data in most cities showing similar trends in global scale?

(2) Whether environmental factors (focus on Temperature, humidity) have correlations with the number of diagnoses ?

(3) If the temperature and humidity factors are added to the existing model to modified the model, will it be more suitable for a large number of sample data?

2 Proposed Methods

2.1 Data and preparation

Infections in different countries and regions; Different temperature and humidity around the world

2.2 Analysis

2.2.1 Environmental impact

First analyze the correlation between environmental factors and the number of infected people to see if you can find a rule from them (focus on the inflection point, minimum infection corresponding temperature and humidity). Some former researches has considered SARS and Environmental factors (Casanova et al. 2010, K. H. Chan & Seto 2011).

2.2.2 Fitting model and Modified model

Fitting empirical data based on existing models:

(1) Weibull distribution using the Maximum Likelihood Estimation (MLE) method (Wang et al. 2020) This is linear regression, not true and the fit is macroscopically bad.

(2) Microsimulation model to two countries: the UK and the US (Ferguson 2020)

(3) A model based on aggregation of individuals according to disease status (Magdon-Ismail 2020)

Try to change the existing model through adding environmental factors, and then look at the degree of fit.

3 Anticipated outputs and outcomes

The improved model with the environmental factor model is more suitable for global data.

4 Project feasibility supported by a timeline of tasks

#	Task	Date																											
		Mar 23	Apr 30	Apr 6	Apr 13	Apr 20	Apr 27	May 4	May 11	May 18	May 25	Jun 1	Jun 8	Jun 15	Jun 22	Jun 29	Jul 6	Jul 13	Jul 20	Jul 27	Aug 3	Aug 10	Aug 17	Aug 24	Aug 31				
1	Choose topic																												
2	Research literature review																												
3	Write literature review																												
4	Data collection																												
5	Plan data analysis																												
6	Conduct sumulation																												
7	Data analysis																												
8	Research literature																												
9	Interpret data and fit																												
10	Write first draft																												
11	See supervisor																												
12	Finalise & Submit																												

5 The itemized budget

Noun

References

- Casanova, L. M., Jeon, S., Rutala, W. A., Weber, D. J. & Sobsey, M. D. (2010), 'Effects of air temperature and relative humidity on coronavirus survival on surfaces', *Applied and Environmental Microbiology* **76**(9), 2712.
URL: <http://aem.asm.org/content/76/9/2712.abstract>
- Chin, A., Chu, J., Perera, M., Hui, K., Yen, H.-L., Chan, M., Peiris, M. & Poon, L. (2020), 'Stability of sars-cov-2 in different environmental conditions', *medRxiv* p. 2020.03.15.20036673.
URL: <http://medrxiv.org/content/early/2020/03/27/2020.03.15.20036673.abstract>
- Ferguson, N. e. a. (2020), 'Impact of non-pharmaceutical interventions (npis) to reduce covid19 mortality and healthcare demand'.
URL: <https://spiral.imperial.ac.uk/handle/10044/1/77482>
- K. H. Chan, J. S. Malik Peiris, S. Y. L. L. L. M. P. K. Y. Y. & Seto, W. H. (2011), 'The effects of temperature and relative humidity on the viability of the sars coronavirus', *Advances in Virology* .
- Lowen, A. C., Steel, J. & Schultz-Cherry, S. (2014), 'Roles of humidity and temperature in shaping influenza seasonality', *Journal of Virology* **88**(14), 7692.
URL: <http://jvi.asm.org/content/88/14/7692.abstract>
- Magdon-Ismail, M. (2020), Machine learning the phenomenology of covid-19 from early infection dynamics.
- Paules, C. I., M. H. D. F. A. S. (2020), 'Coronavirus infections—more than just the common cold', *JAMA* **328**(8), 707–708.
- Wang, J., Tang, K., Feng, K. & Lv, W. (2020), 'High temperature and high humidity reduce the transmission of covid-19'.
URL: <https://ssrn.com/abstract=3551767>
- Wu, Z., M. J. M. (2020), 'Characteristics of and important lessons from the coronavirus disease 2019 (covid-19) outbreak in china', *JAMA* .
- Yan, Bai; Lingsheng, Y. T. W. e. a. (2020), 'Presumed asymptomatic carrier transmission of covid-19', *JAMA* .
- Ying Liu, Albert A Gayle, A. W.-S. J. R. (2020), 'The reproductive number of covid-19 is higher compared to sars coronavirus', *Journal of Travel Medicine* **27**(2).
- Zhou, P., Yang, X.-L., Wang, X.-G., Hu, B., Zhang, L., Zhang, W., Si, H.-R., Zhu, Y., Li, B., Huang, C.-L., Chen, H.-D., Chen, J., Luo, Y., Guo, H., Jiang, R.-D., Liu, M.-Q., Chen, Y., Shen, X.-R., Wang,

80 X., Zheng, X.-S., Zhao, K., Chen, Q.-J., Deng, F., Liu, L.-L., Yan, B., Zhan, F.-X., Wang, Y.-Y., Xiao,
81 G. & Shi, Z.-L. (2020), 'Discovery of a novel coronavirus associated with the recent pneumonia
82 outbreak in humans and its potential bat origin', *bioRxiv* p. 2020.01.22.914952.

83 **URL:** <http://biorxiv.org/content/early/2020/01/23/2020.01.22.914952.1.abstract>