A retrospective study: meteorological factors and COVID-19

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Abstract

Background: With the outbreak of novel coronavirus, the global epidemic prevention form is severe. Purpose: This paper aimed to investigate the association between meteorological factors (temperature, precipitation and relative humidity) and the daily new cases in Wuhan.

Methods: generalized linear model was built to evaluate the link between daily average temperature and the new cases COVID-19. Spearman rank correlation coefficient was used to investigate the association between temperature, relative humidity, precipitation and the daily new cases COVID-19.

Result: The correlation coefficient for daily average temperature, relative humidity, precipitation and NCP were 0.11, -0.083 and 0.17, respectively. The maximal effect of temperature on the new cases NCP appeared on Lag0.

Conclusion: The variation of temperature had an effect on the daily new cases.

Introduction

At the end of 2019, the novel coronavirus-infected pneumonia (NCP) was firstly discovered in Wuhan, China and then broke out successively around the world, which has aroused widespread concern and panic [1,2]. About the survival and transmission conditions of 2019-nCoV, many scholars have carried out research investigate [3,4]. It was reported that the 2019-novel-coronavirus (2019-nCoV) was detected in the self-collected saliva of 91.7% [5], in addition, Chinese government announced that 2019-nCoV can be transmitted through aerosols, specifically saliva mixed in the air, forming aerosols that can cause infection when inhaled. However, the spread of 2019-nCov among human was uncontrolled and it has been not figured out that how 2019-nCov spread until now.

It’s considered that 2019-nCov is one of coronavirus, it might be able to have the similar characteristics with SARS virus. Previous researches have suggested that the SARS outbreaks were significantly associated with the temperature and its variations [6,7]. Reported findings also showed that there were an association between relative humidity and SARS outbreak [8-10]. One ecologic study conducted in China illustrated that SARS patients from regions with high-level air pollution were twice as likely to die from SARS compared to those from regions with low-level air pollution [11]. Several researches pointed out that ambient temperature and relative humidity had an adverse effect on respiratory symptom [12-14]. Wuhan city belongs to the north sub-tropical monsoon (humid) climate, with abundant perennial rainfall, sufficient heat, rain and heat in the same season, light and heat in the same season, cold in winter and hot in summer.

Considering these factors, we think that there might be the association between the spread of 2019-nCov and temperature, relative humidity and precipitation. The purpose of this study was to explore the relationship between the spread of 2019-nCov and temperature, relative humidity.

Method

The daily new cases were obtained from China official report from January to February in 2020, particulate matter ($PM_{2.5}$ and PM_{10}), sulfur dioxide, nitrogen dioxide, carbon monoxide and ozone at this stage was attained from the website http://www.tianqihoubao.com/. The datasets during research period about precipitation, daily average temperature, daily largest temperature, daily lowest temperature, horizontal pressure was collected from the website https://en.tutiempo.net/climate. The reason for that this period was select was based on which on the start of outbreak there was little government intervenes, so that it might be able to find the factor that influenced it spread.

In this paper, description statistical analysis including minimum, maximum, the first quartile, the second quartile, the third quartile, average, and interquartile range was utilized to describe the dispersion of daily average temperature, the daily largest temperature, the daily lowest temperature, relative humidity, precipitation, pressure, air pollution (sulfur dioxide, carbon monoxide, nitrogen dioxide, particulate matter). The time-series variation of these factors was illustrated in line chart. Generalized linear model (GLM) was built to evaluate the effect of temperature on the changes of daily new case.

Result

The descriptive result of meteorological factors were presented in Table 1. Figure 1 presented the changes in the number of new cases of NCP from January to February in 2020. It can be found that until 3rd Feb, the number of new infected cases were increasing, however in fact, it started decreasing after February 13. The time-series changes of daily average temperature the daily largest temperature, the daily lowest temperature, relative humidity, precipitation, pressure was illustrated in Figure2-6 respectively. The correlation coefficient between meteorological factors and NCP was displayed in figure 7. The correlation coefficient for daily average temperature, relative humidity, precipitation and NCP were 0.11, -0.083 and 0.17, respectively, while there was no statistical significance. The effect of temperature on the new cases NCP was shown in Figure 8. It was obvious that the maximal effect of temperature on the new cases NCP appeared on Lag0.

Discussion

Generalized linear model was set up when controlling compound factors including daily relative humidity, precipitation. Our finding confirmed the previous research [15]. Richard A Neher thought there was an association between seasonal reason and a SARS-CoV-2 pandemic. As mentioned in this paper, it was noticed that there was common characteristic between SARS-CoV and SARS-CoV-2. Epidemics occurred in cold dry winter seasons celebrated with major holidays, especially in Chinese Spring Festival [16]. Based on this, it could be helpful for other country to guide local prevention and policy development according to local climate factors. The limitation of this paper was that the research area was set up in Wuhan, China, for which here was the first outbreak area hence it might provide some precious experience. In addition, early outbreak data was used in this paper, considering it was close to

propagation in a natural state without official prevention so that it could reveal the link between meteorological factors and the spread of COVID-2019.

Conclusion

Until now, it has been under control in China narrowly, also including Wuhan, the first outbreak city, however the situation is not optimistic in the world except China. In this paper, we found that there was weak link between precipitation and the daily new cases according spearman correlation and the variation of temperature could influence its spread.

Acknowledgement

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Table

Table 1. The descriptive result of meteorological factors

	Min	Q_{25}	Q_{50}	Q_{75}	Max	IQR	Ave
T	1	5	8	9	15	10	7
TM	5	9	14	15	19	10	13
Tm	-3	-2	0	3	8	10	1
SLP	1017	1025	1027	1028	1034	9	1027
H	46	63	78	86	93	30	75
PP	0	0	0	4	20	20	3

T, average temperature; TM, maximum temperature; Tm, minimum temperature; SLP, pressure; H, humidity; PP, precipitation

Declaration

Competing interests: The authors declare no competing interests.

Figures

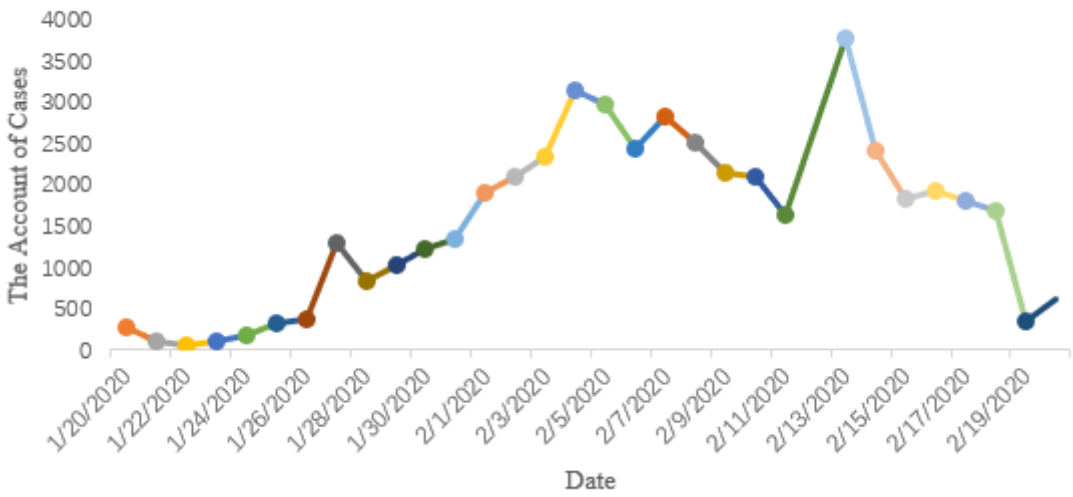

Figure 1

The changes in the number of new cases of NCP

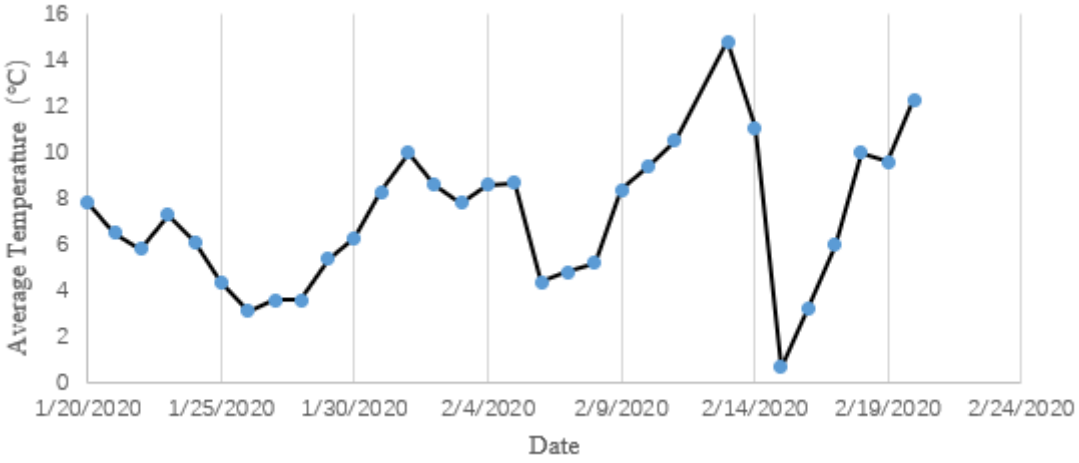

Figure 2

The time-series changes of daily average temperature in Wuhan

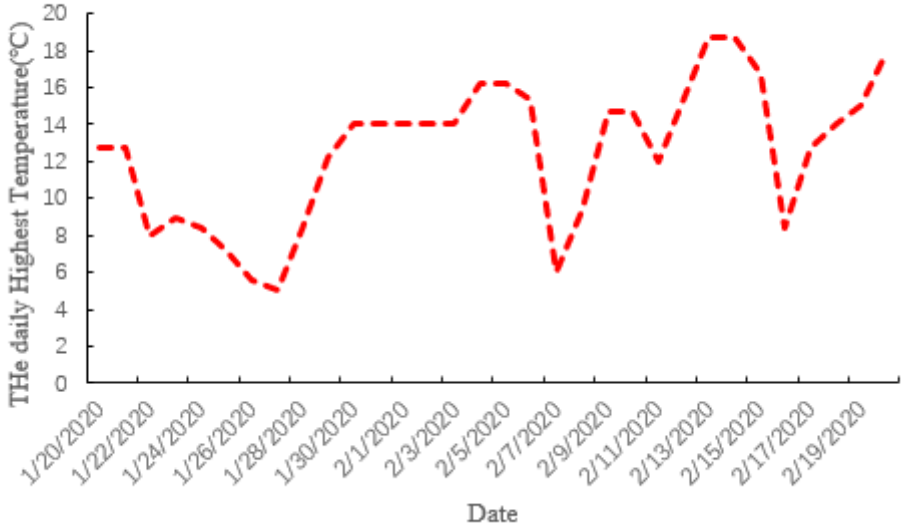

Figure 3

The time-series changes of daily highest temperature in Wuhan

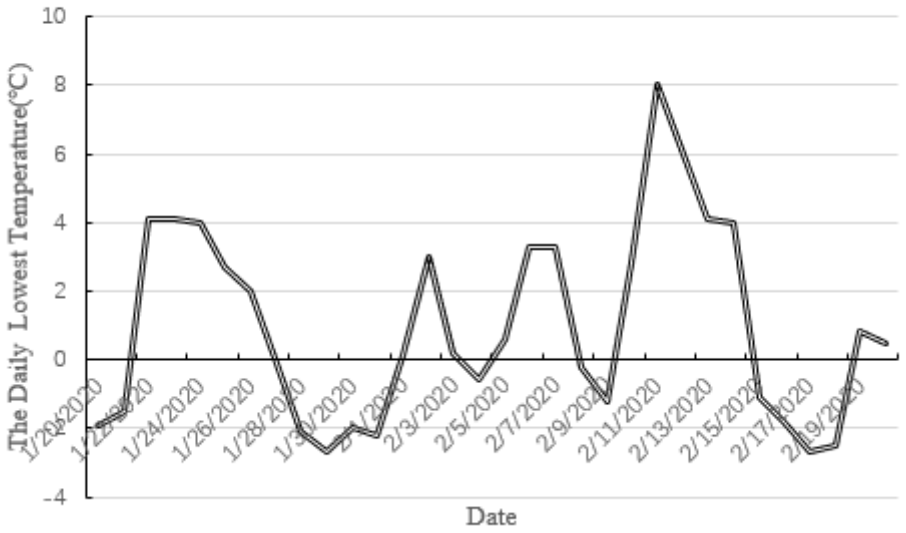

Figure 4

The time-series changes of daily lowest temperature in Wuhan

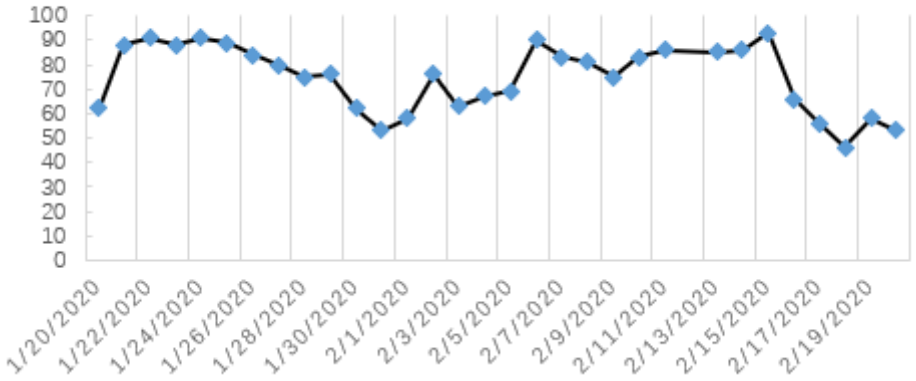

Figure 5

The time-series changes of daily relative humidity in Wuhan

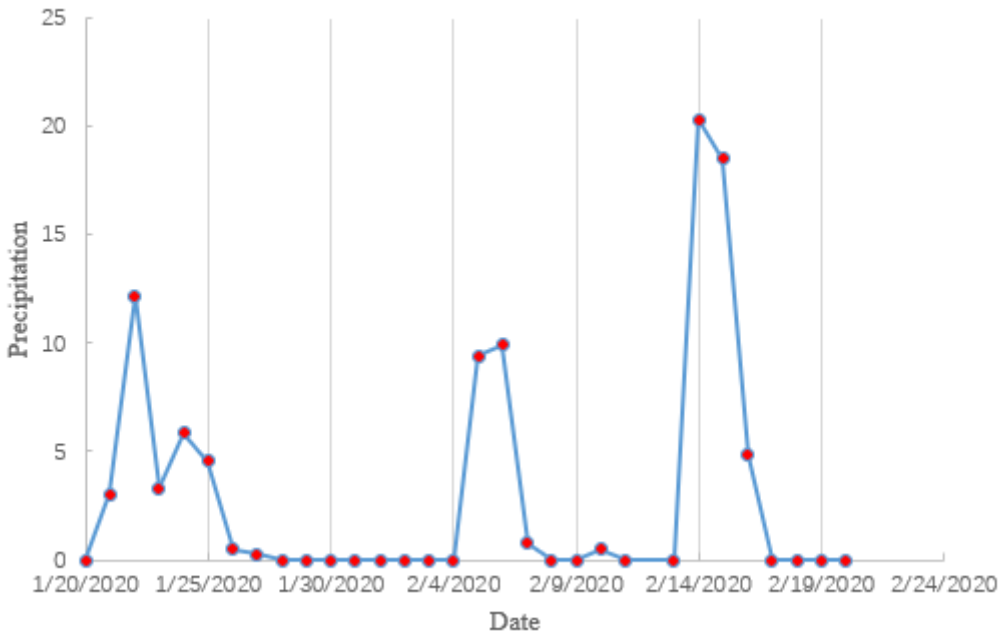

Figure 6

The time-series changes of daily precipitation in Wuhan

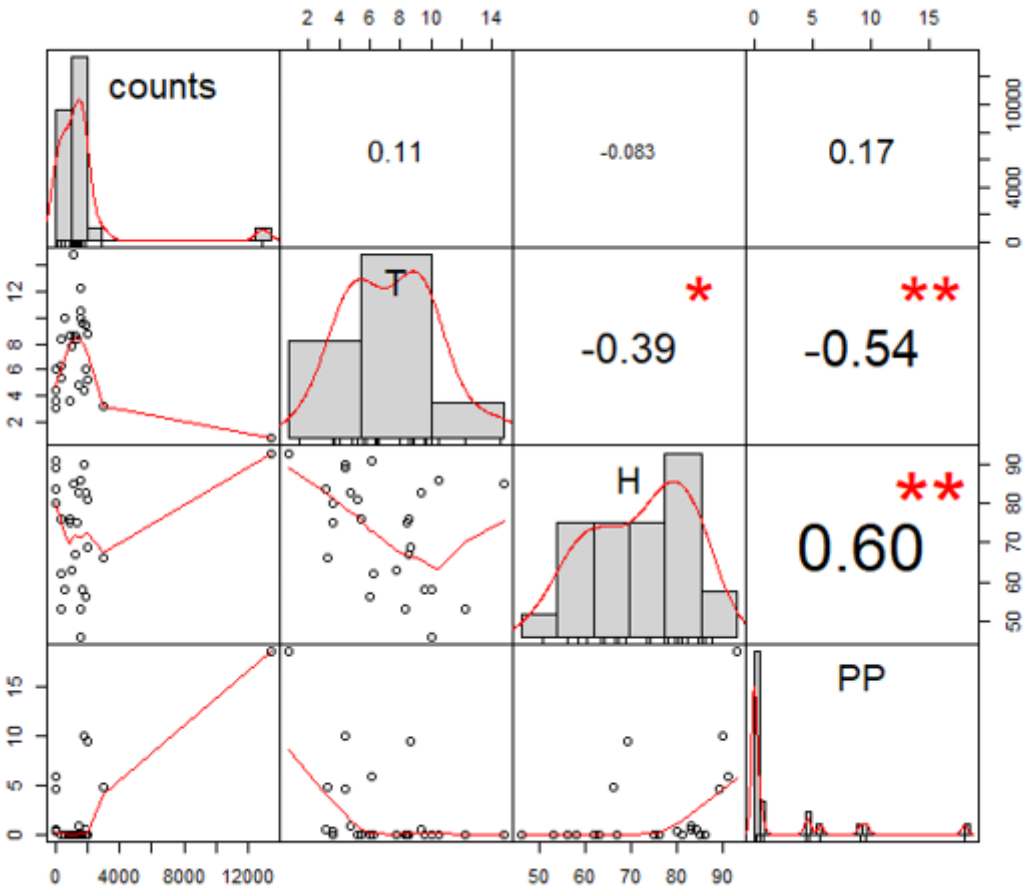

Figure 7

The correlation coefficient between meteorological factors and NCP

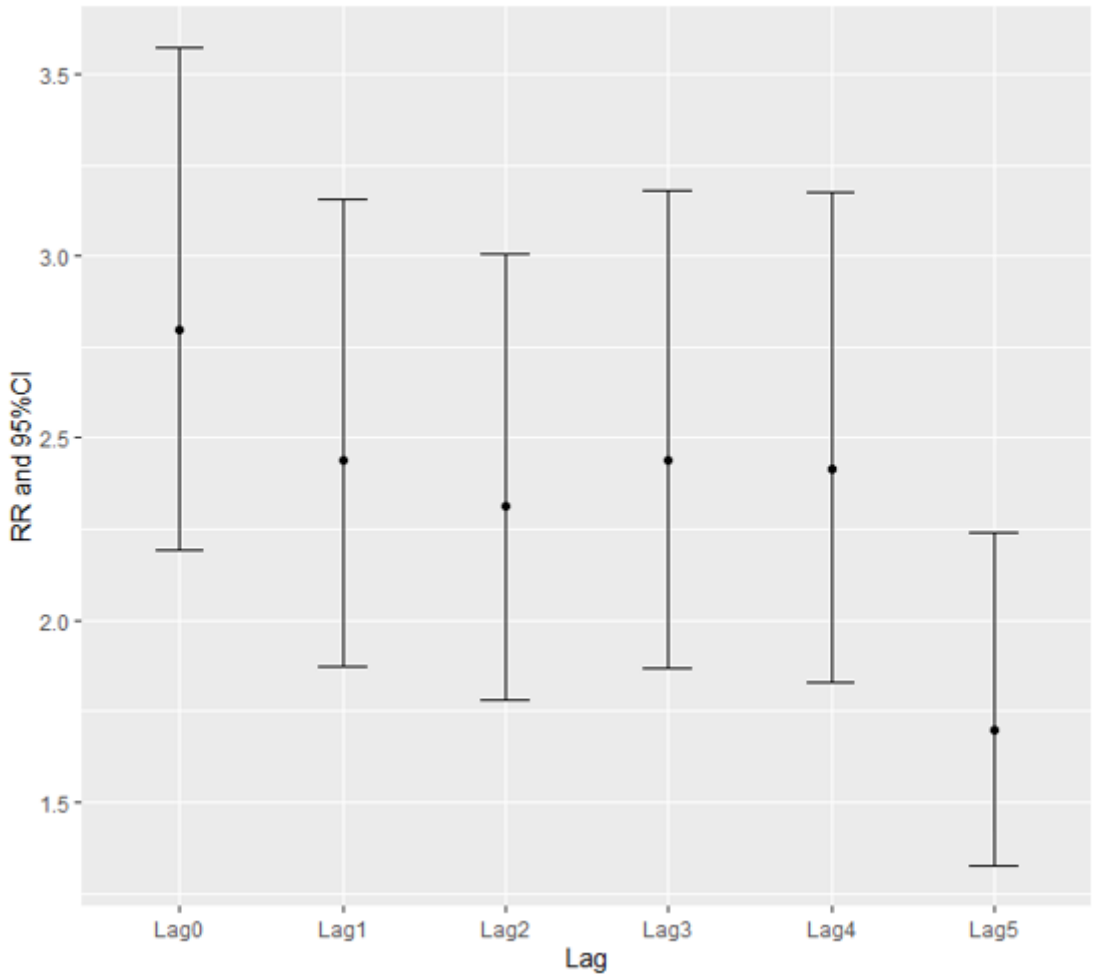

Figure 8

The effect of temperature on the new cases NCP