

## Effect of Temperature and Lockdown on Daily Growth of Active Cases of COVID-19 in Gujarat, western India- Statistical Analysis

DR.Bhavin Vasavada,  
Consultant hepatobiliary and liver transplant surgeon,  
Shalby Hospitals,  
Ahmedabad—380054.  
Email: [drbhavin.liversurgeon@gmail.com](mailto:drbhavin.liversurgeon@gmail.com)

Conflict of interests: none  
Funding: No funding obtained  
Ethical clearances: None required.

### ABSTRACT:

#### **Aim of the study:**

Aim of the study was to analyse correlation of daily maximum temperature on corona virus daily growth rate as well as effect of lockdown on daily growth rate of cases.

#### **Materials and Methods:**

All the data regarding new cases of covid 19 Pandemic in Gujarat was collected from Gujarat health department website., Temperature details were collected from [www.accuweather.com](http://www.accuweather.com). Growth rate was calculated as a percent increase of new cases daily compared to previous day active cases. Relations between trends were calculated from correlation and regression studies. MANNOVA analysis was performed.

#### **Results:**

Total 6625 cases, 4729 active cases and 380 deaths were reported as on 6th May 2020 in Gujarat. Daily maximum temperature was significantly correlated inversely with daily growth rate. (p value= 0.010) with Pearson correlation coefficient =-0.363. Correlation between time since lock down to daily case growth rate was non significant. (p=0.123). Phases of lockdown and growth rates showed significant inverse correlation. (p=0.002). Multivariate ANOVA showed there was statistical significant difference in case growth rate based on daily temperature [p= 0.006 F=4.71] and progression of phases of lockdown (p=0.018, F=3.55).

#### **Conclusion:**

Conclusion increase in temperature has inverse relationship in growth rate in covid 19 pandemic. Lockdown may be useful in decreasing growth.

**Keywords:** COVID19, PANDEMIC

## Background:

In December 2019, many cases of pneumonia due to unknown cause were identified in Wuhan province of China. A novel coronavirus now named as sever acute respiratory syndrome corona virus-2 (SARS COV-2) is now identified as the reason behind these cases of pneumonia. From Wuhan it has spread world wide, and now entire world is fighting against this pandemic.[1]

WHO has named this new virus as covid-19. Currently Covid-19 has spread to more than 70 countries, and at present it is the main healthcare issue world is facing. [2]. WHO has already declared it as pandemic and trying its best to curtail it.

Many countries responded to the challenge of ongoing pandemic by declaring nation wide lockdowns among various measures. India also responded by declaring it a nation wide lockdown on 25<sup>th</sup> march in phase-1, in phase-2 it extended its lockdown period up to 3 rd may and India is currently under its phase-3 of lock down until May 17. [5]

As on May 7 Th. India has already crossed more than 50000 total cases and more than 1700 deaths. ([www.mohfw.nic.in](http://www.mohfw.nic.in)).

Gujarat one of the major states in western India is at present number-2 in total cases in India. ([www.mohfw.nic.in](http://www.mohfw.nic.in)) . As on 7<sup>th</sup> may Gujarat has recorded more than 6000 COVID-19 cases and around 400 deaths due to novel corona virus. [6,7]. Effect of temperature on covid-19 infectivity and effect on spread due to lock down is largely unknown. [4,8]

## Aim of the study:

Aim of the study was to analyse correlation of daily maximum temperature on corona virus daily growth rate as well as effect of lockdown on daily growth rate of cases.

## Material and Methods:

All the data regarding new cases of covid 19 Pandemic in Gujarat was collected from Gujarat health department website. (<https://gujhealth.gujarat.gov.in>), Temperature details were collected from daily maximum temperature of Ahmedabad from [www.accuweather.com](http://www.accuweather.com). Ahmedabad was selected to collect data on temperature, as Ahmedabad is the main city of Gujarat as well as maximum cases of Gujarat also came from Ahmedabad. 25<sup>th</sup> march to 17<sup>th</sup> April was considered as first phase of pandemic. No lockdown phase was considered as phase 0 of pandemic, 17<sup>th</sup> April to 3<sup>rd</sup> may as phase 2 of pandemic and 3<sup>rd</sup> may to 6<sup>th</sup> may was considered as phase 3 of pandemic. Growth rate was calculated as a percent increase of new cases daily compared to previous day active cases.

Relations between trend of temperature as well as days from lockdown and phases of lockdown was calculated from correlation studies. Regression variable plots were prepared to show relation between two variables. Multivariate ANNOVA or MANNOVA analysis was performed. Statistical analysis was performed using SPSS version 23. P value less than 0.05 was considered statistically significant.

## Results:

Total 6625 cases were reported as on 6<sup>th</sup> May 2020 in Gujarat. Active cases were 4729. Total 380 deaths were reported as on 6<sup>th</sup> May 2020.

Daily maximum temperature was significantly correlated inversely with daily growth rate. (p value= 0.010) with Pearson correlation coefficient =-0.363. Regression variable plot suggested negative relationship. [Figure 1.] This suggest that as daily maximum temperature increased, growth rate tend to decrease.

We have also evaluated correlation between time since lock down to daily case growth rate which was non significant. (p=0.123) and Pearson coefficient-0.239. Regression plot also showed non linear relationship.

As days since lockdown showed no correlation with growth rates we look for correlation between phases of lockdown and growth rates. Which showed significant inverse correlation and growth rates which showed as the phases of lockdown progressed growth rate decreased. (p=0.002). Correlation coefficient -0.424.

We did multivariate ANOVA (MANOVA) to establish relationship between daily growth rate, phases of lockdown and daily temperature. Which showed there was statistical significant difference in case growth rate based on daily temperature (p= 0.006 F=4.71, R. Squared 0.948, Adjusted R squared 0.747). And progression of phases of lockdown (p=0.018, F=3.55 R squared 0.933, adjusted R squared 0.670).

## Discussion:

Purpose of lockdown in pandemic is to curtail the spread and flatten the curve and build up healthcare infrastrcture. During Covid 19 pandemic , reports from china has shown that lck down measures have helped them to curtail pandemic spread. [9] However effect of lockdown measures in other countries is being awaited.

India is a unique country due population density, socio economic conditions, lack of social awareness. Due to these factors to study effects of lockdown on virus spread.

SARS virus has been found to be temperature sensitive and its spread reduced by temperature. [10].However, very few studies are available for COVID 19. Xie et al. showed some relationship between COVID 19 infectivity and temperature. [11].

Aim of our study to see effect of daily maximum temperature and daily case growth rate. Junling et al showed study of growth rate of new cases is a very important tool for epidemiological study. [12] Daily growth rate is also an indirect marker of severity of spread. [13].

We found significant negative correlation between daily temperature and growth rate. In the month of March and April as temperature rose, growth rate significantly reduced. (p=0.01,Pearson coefficient — 0.363).It suggested some effect of temperature on disease spread. Regression chart also established inverse lineal relationship between daily growth of cases and maximum temperature. [Figure 1]

We , etc., tried to find correlation between time since lockdown and daily growth rate but we failed to find any relationship. ( $p=0.123$ ), population density, more members per household , etc., factors may be responsible for this finding. However there was significant inverse correlation ship between phases of lockdowns in India and daily growth rate, suggesting growth rate decrease in phase 3 compared to phase 2 compared to phase 1. ( $p= 0.002$ ,Pearson coefficient-0.424).

In multivariate ANNOVA analysis also there was statistical significant difference in case growth rate based on daily temperature ( $p= 0.006$   $F=4.71$ ,  $R$ . Squared  $0.948$ , Adjusted  $R$  squared  $0.747$ ). And progression of phases of lockdown ( $p=0.018$ ,  $F=3.55$   $R$  squared  $0.933$ , adjusted  $R$  squared  $0.670$ ). Suggesting increase temperature and progression in various phases of lockdown independently predicted decrease growth rate.

There are certain limitation of the study, as it is a statistical model study based on government published data, some data may be missing and also there can be many confounding factors not studies yet. More large scale studies needed to confirm these findings

In conclusion increase in temperature has inverse relationship in growth rate in covid 19 pandemic. Lockdown may be useful in decreasing growth.

#### Refermces:

1. Ge H, Wang X, Yuan X, et al. The epidemiology and clinical information about COVID-19 [published online ahead of print, 2020 Apr 14]. *Eur J Clin Microbiol Infect Dis*. 2020;1-9. doi:10.1007/s10096-020-03874-z.
2. Li H, Liu SM, Yu XH, Tang SL, Tang CK. Coronavirus disease 2019 (COVID-19): current status and future perspectives [published online ahead of print, 2020 Mar 29]. *Int J Antimicrob Agents*. 2020;105951.
3. El Zowalaty M.E., Järhult J.D. From SARS to COVID-19: A previously unknown SARS-CoV-2 virus of pandemic potential infecting humans—Call for a One Health approach. *One Health*. 2020
4. Barkur G, Vibha, Kamath GB. Sentiment analysis of nationwide lockdown due to COVID 19 outbreak: Evidence from India [published online ahead of print, 2020 Apr 12]. *Asian J Psychiatr*. 2020;51:102089. doi:10.1016/j.ajp.2020.102089
5. The Lancet. India under COVID-19 lockdown. *Lancet*. 2020;395(10233):1315.
6. [www.mohfw.nic.in](http://www.mohfw.nic.in)
7. <https://gujhealth.gujarat.gov.in>
8. Tobías A, Molina T. Is temperature reducing the transmission of COVID-19 ? [published online ahead of print, 2020 Apr 18]. *Environ Res*. 2020;186:109553.

9. Ji T, Chen HL, Xu J, et al. Lockdown contained the spread of 2019 novel coronavirus disease in Huangshi city, China: Early epidemiological findings [published online ahead of print, 2020 Apr 7]
10. Lin K, Yee-Tak Fong D, Zhu B, Karlberg J. Environmental factors on the SARS epidemic: air temperature, passage of time and multiplicative effect of hospital infection. *Epidemiol Infect.* 2006;134(2):223-230
11. Xie J, Zhu Y. Association between ambient temperature and COVID-19 infection in 122 cities from China. *Sci Total Environ.* 2020;724:138201. doi:10.1016/j.scitotenv.2020.138201
12. Junling Ma, Estimating epidemic exponential growth rate and basic reproduction number, *Infectious Disease Modelling*, Volume 5, 2020, Pages 129-141.
13. Nishiura H, Chowell G, Heesterbeek H, Wallinga J. The ideal reporting interval for an epidemic to objectively interpret the epidemiological time course. *J R Soc Interface.* 2010;7(43):297-307. doi:10.1098/rsif.2009.0153

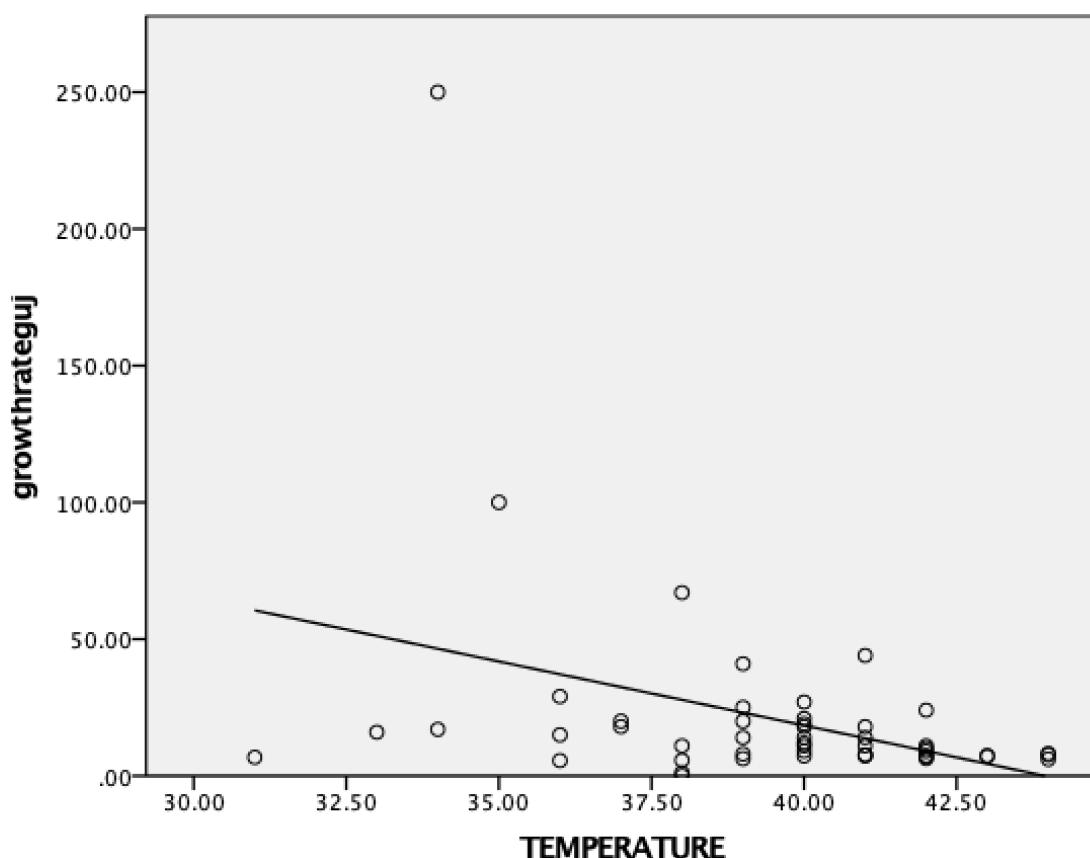


Figure:1 Regression plot showing inverse linear relationship between daily maximum temperature and case growth rate.

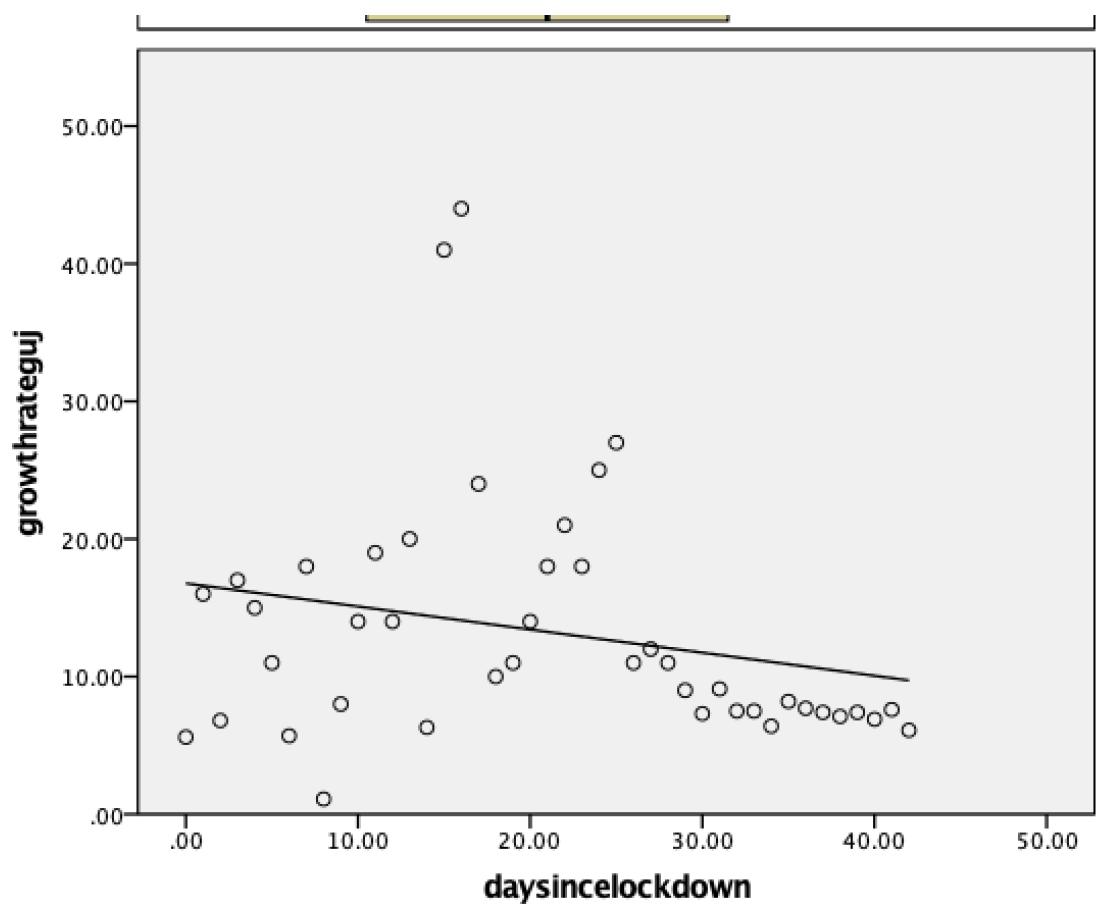


Figure:2 No significant inverse corelation with days since lockdown to daily growth rate.

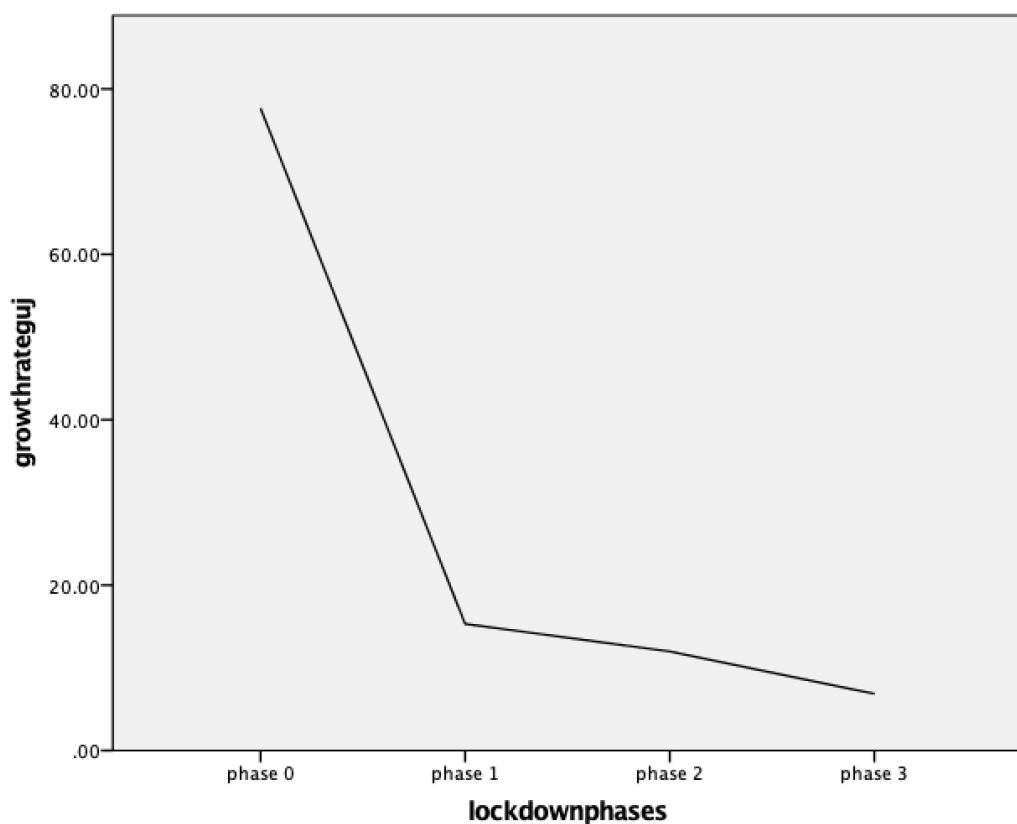


Figure: 3 Regression plot showed as Gujarat progressed from phase 1 to phase 2 to phase 3, growth rate significantly decreased.