COVID-19 GEO-SPATIAL BIG DATA ANALYSIS OF POPULATION MORTALITY FOR COUNTRIES SITUATED AT LATITUDES BETWEEN 64°N AND 35°S

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ABSTRACT: The outbreak of the Covid-19 emerged from Wuhan, Hubei province of China, spread geo-spatially in more than 210 countries causing more than 96.7 million people of the global population infected and 2.06 million deaths (as on 20th January 2021) from 25.416 million people infected and 0.851 million deaths (as on 30th August 2020), which is still spreading in geo-spatiotemporal way to the new geographical locations. There are marked variations in the spectrum of daily new cases of covid-19 between different countries. People do not receive sufficient sunlight to retain adequate vitamin D levels during winter in countries situated at the latitude beyond 35°N. Vitamin D is important in preventing the cytokine storm and subsequent acute respiratory distress syndrome that is commonly the cause of mortality. The global spreading of covid-19 caused marked variations in population mortality between different countries situated at different latitudes, which suggest establishing the correlation between latitude and the severity of the covid-19 outbreak. In this paper, geo-spatial big data analysis has been carried out for determining the impact of latitude and the role of vitamin-D on population mortality for 52 countries situated between the latitude 64°N and 35°S, based on population mortality data from 15th April 2020 to 30th June 2021, which shows relatively lower population mortality in countries that lie below the latitude 38°N. This paper explains the variability factor of population mortality from 3rd May 2020 to 30th January 2021 with respect to population mortality on 15th April 2020 for determining the severity of the covid-19, which shows the significant severity of the covid-19 outbreak in the country such as South Africa, Colombia, Russia, Kuwait, India, Mexico and Ukraine during 30th September 2020 to 30th January 2021 and sudden rise of variability factor for Romania, Serbia, Slovenia, Austria and Poland.

1. INTRODUCTION

The outbreak of the 2019 novel corona virus disease (Covid-19) spread geo-spatially in more than 210 countries of the globe causing more than 96.7 million people of the global population infected and 2.06 million deaths (as on 20th January 2021). The spreading of corona virus spectrum in spatiotemporal way to the new geographical locations has seriously threatened the human health as well as posed the challenges for countries to control the severity of the outbreak (BBC, 2020; Corona virus, 2020). This posed the challenges to control the severity of the outbreak by creating a unique health response system to suppress the transmission of the virus to end the pandemic and control the severity of the outbreak. There are marked variations in the spectrum of daily new cases of covid-19 between different countries, which resulted into six different stages of the spectrum such as complete recoverable stage, recoverable stage, safe stage, stabilizing stage, critical stage and beyond the critical stage based on spatial big data analysis of daily new cases up to 10th June 2020 and spectrum models developed to predict the trend of the spectrum for different such stages (Verma A.K. et al, 2020). Further, higher population mortality from covid-19 observed in northern latitude exhibiting the population mortality with decreasing north south gradient based on mortality data of 2nd April 2020 (Panarese A. and Shahini E., 2020). Population mortality from covid-19 between different countries situated at latitudes below 64°N showed marked variations with relatively low population mortality at latitudes below 35°N based on mortality data of 15th April 2020, which supports vitamin D as a factor determining severity of the outbreak (Jonathan M.R. et al, 2020). Spatial big data analysis on population mortality carried out for 28 countries including southeast Asian region based on population mortality data from 15th April to 08 June 2020 showed relatively lower population mortality for countries situated at latitudes between 38°N and 35°S. Further, the temporal variability factor of population mortality with respect to population mortality observed on 15th April 2020 supports the significant variability factor as determining factor for the severity of the outbreak (Verma A.K. et al, 2020). Further, big data analysis carried out for 52 countries situated between the latitude 64°N and 35°S, based on population mortality data from 15th April to 30th August 2020 showed relatively lower population mortality for different countries situated between the latitude 38°N and 35°S, whereas relatively significant variability factor of population mortality observed for countries situated between the latitude 38°N and

35°S, and non-significant variability factor of population mortality for countries situated beyond the latitude 38°N. Thus, very significant variability of population mortality observed for India, South Africa, Peru, Columbia, Mexico, Brazil, Saudi Arabia, Kuwait, Egypt, Russia and Ukraine from 3rd May to 30th August 2020, whereas non-significant variability factor observed for Argentina, Indonesia, Singapore, Malaysia, Thailand, Philippines, Hong-Kong, Taiwan, Israel, Japan, Iran and South Korea (Verma A.K. et al, 2020).

In this paper, geo-spatial big data analysis has been carried out for determining the impact of latitude on population mortality for 52 countries situated between the latitude 64°N and 35°S, based on population mortality data from 15th April 2020 to 30th January 2021. This paper explains the temporal variability factor of population mortality from 3rd May 2020 to 30th January 2021 for these countries for determining the severity of the covid-19 outbreak. This present study of spatial big data analysis of population mortality based on population mortality data shows relatively low population mortality in countries that lie below the latitude 38°N. The spread of covid-19 outbreak has seriously attacked societies at their core posing global health crisis threatening the human health and life of the people. This stressed the importance of geo-spatial big data analysis for determining the impact of latitude on population mortality and its variability factor. The variability factor of population mortality from 30th September 2020 to 30th January 2021 estimates the significant severity of the covid-19 outbreak in the country such as South Africa, Colombia, Russia, Kuwait, India, Mexico and Ukraine, and sudden rise of variability factor for Romania, Serbia, Slovenia, Austria and Poland. The sudden rise of variability factor of population mortality for Malaysia, Myanmar, Hong-Kong and Taiwan observed during 30th September 2020 to 30th January 2021, whereas other countries controlled the variability factor for recovery of the outbreak in the Southeast Asian region.

2. IMPACT OF LATITUDE ON POPULTION MORTALITY

Higher population mortality from Covid-19 observed in northern latitude with highest in Italy and exhibiting the population mortality with decreasing north south gradient based on mortality data of 02 April 2020 for 108 countries (Panarese A. and Shahini E., 2020). Northern latitudes are associated with vitamin D deficiency for higher population mortality due to low ultraviolet exposure in the northern countries. When population mortality plotted against the latitude for 130 countries based on mortality data of 15 April 2020 showed marked variation in mortality for countries that lie below the latitude of 64°N (Jonathan M.R. et al, 2020). People do not receive adequate sunlight to maintain vitamin D levels during winter in countries situated beyond the latitude of 35°N. All countries that lie between the latitude of 35°N and 35°S showed relatively low population mortality due to adequate sunlight to maintain vitamin D levels (Jonathan M.R. et al, 2020). Further, big data analysis for 28 countries from 15 April to 08 June 2020 observed relatively low population mortality for countries situated at latitudes between 38°N and 35°S as depicted in Figure-1. Higher correlations of the impact of latitudes on population mortality observed due to continuance of multiple peaks at the same latitudes (Verma A.K. et al, 2020).

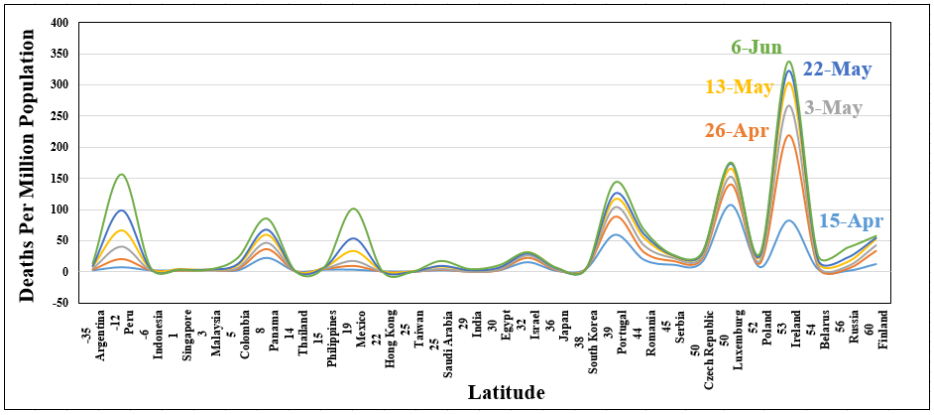
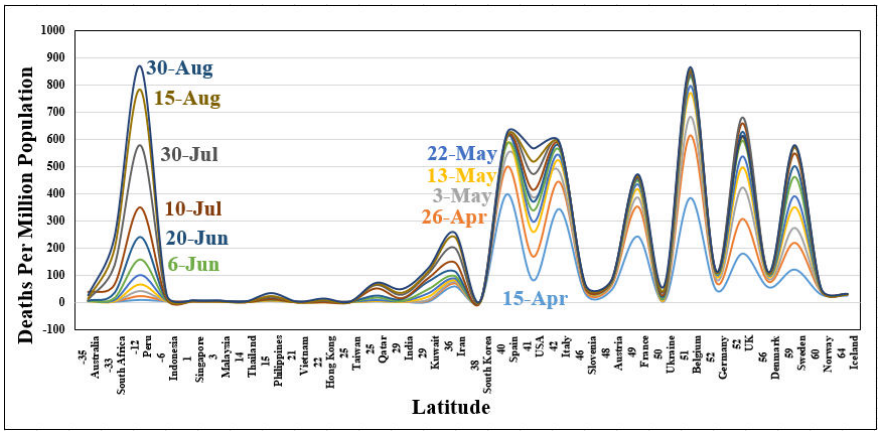


Figure 1: Variation of death per million for 28 countries between latitude 60 °N and 35 °S.

Figure-2 depicts Population mortality analysis of 28 countries from 15 April 2020 to 30 August 2021 further observed relatively lower population mortality for countries situated at latitudes between 38°N and 35°S as depicted in Figure-2 Verma A.K. et al, 2020; Panarese A. and Shahini E., 2020; Jonathan M.R. et al, 2020; Verma A.K. et al, 2020) [6].



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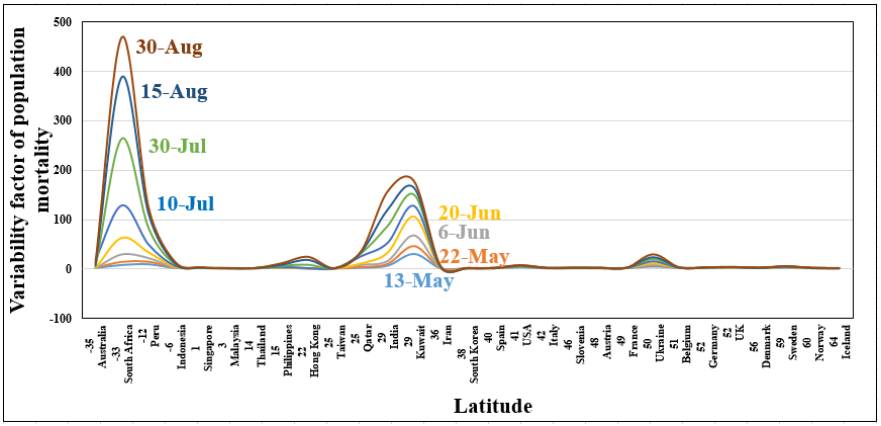
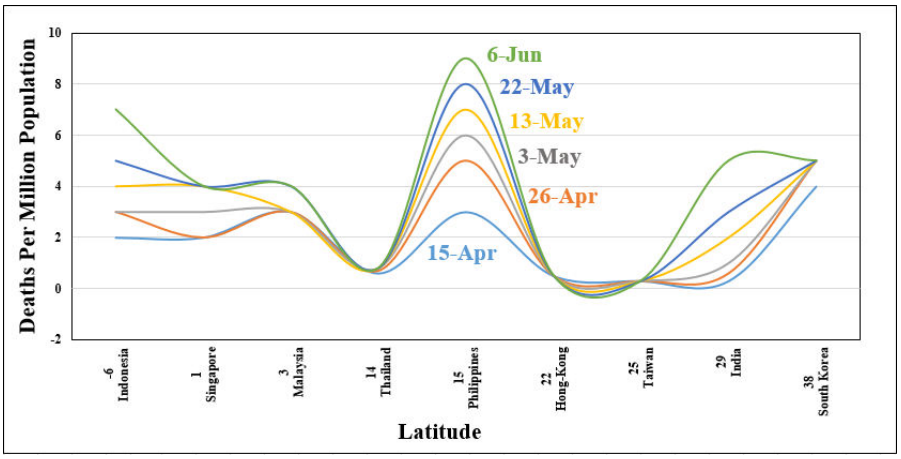


(b)

Figure 2: Variation of population mortality and variability for 28 countries between latitude 64 °N and 35 °S.



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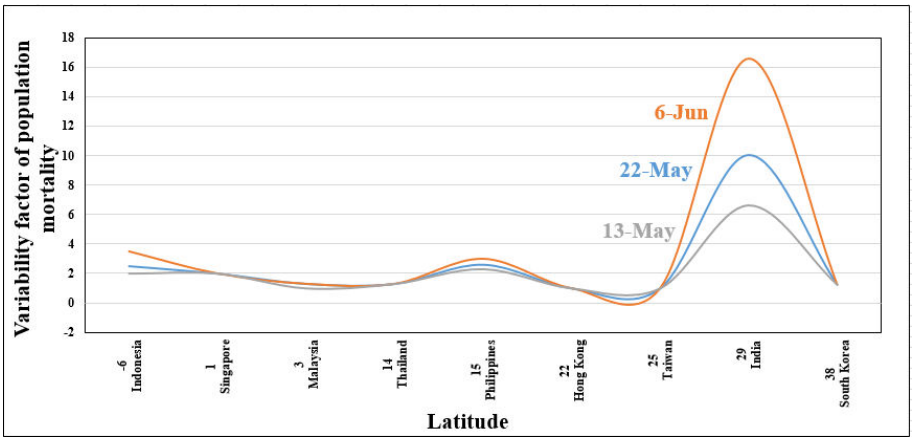

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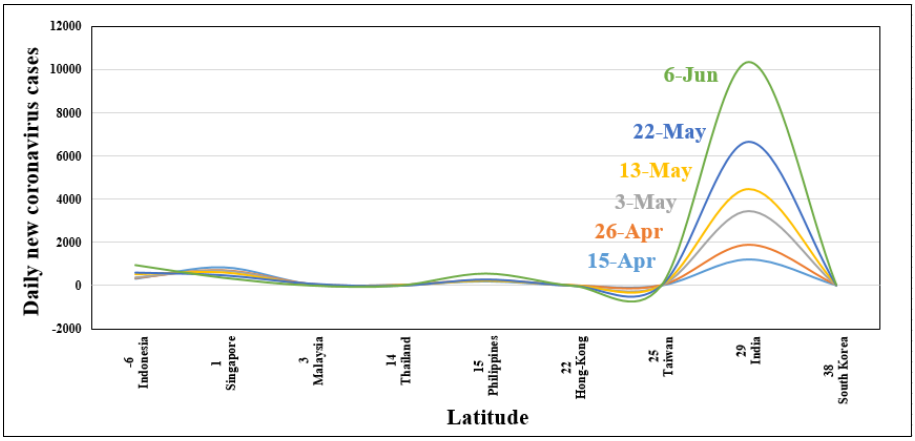


(c)

Figure 3: Variation of population mortality, variability factor of mortality and daily new cases with latitude for the Southeast Asian region.

2.1 POPULATION MORTALITY FOR THE SOUTHEAST ASIAN REGION

Figure 4 depicts the variation of population mortality from Covid-19 for 11 countries of the Southeast Asian region based on population mortality data from 15th April 2020 to 20 January 2021. There are significant rise in population mortality for India, Hong Kong, Philippines, Indonesia and Singapore, whereas South Korea, Taiwan, Vietnam, Myanmar, Thailand and Malaysia showed non-significant increase in population mortality from 15 April to 30 August 2020 (Verma A.K. et al, 2020). There is a sudden rise of population mortality for Myanmar, Malaysia, Hong-Kong and South Korea from 30 September 2020 to 20 January 2021, in addition to the increase of population mortality for Indonesia, Philippines and India, whereas Singapore, Thailand, Vietnam and Taiwan observed non-significant increase in population mortality.

Figure 5 depicts the variation of variability factor of population mortality from 13 May 2020 to 20 January 2020 with respect to population mortality on 15 April 2020. It shows maximum variability factor of population mortality for India in the Southeast Asian region, whereas other countries shows non-significant variations of variability factor till 30 August 2020. The sudden increase of variability factor of population mortality observed for Myanmar, Hong-Kong and Taiwan after 15 November 2020 as significant rise of severity of the covid-19 outbreak, whereas other countries controlled the severity in the Southeast Asian region.

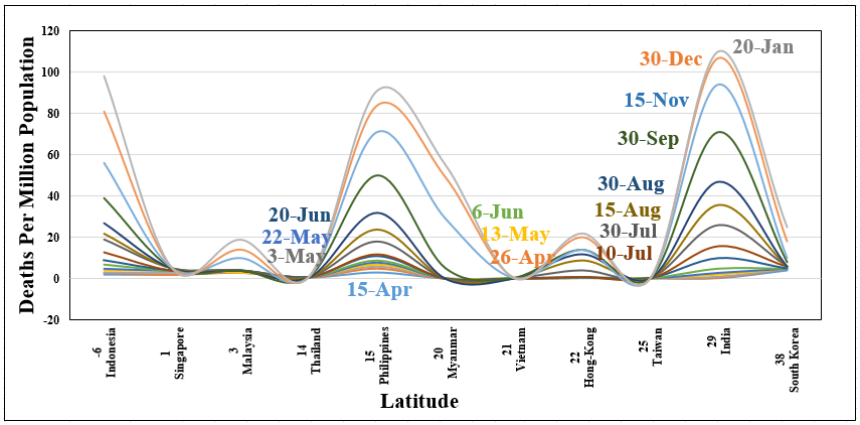


Figure 4: Variation of population mortality from 15 April 2020 to 20 January 2021 for Southeast Asian region.

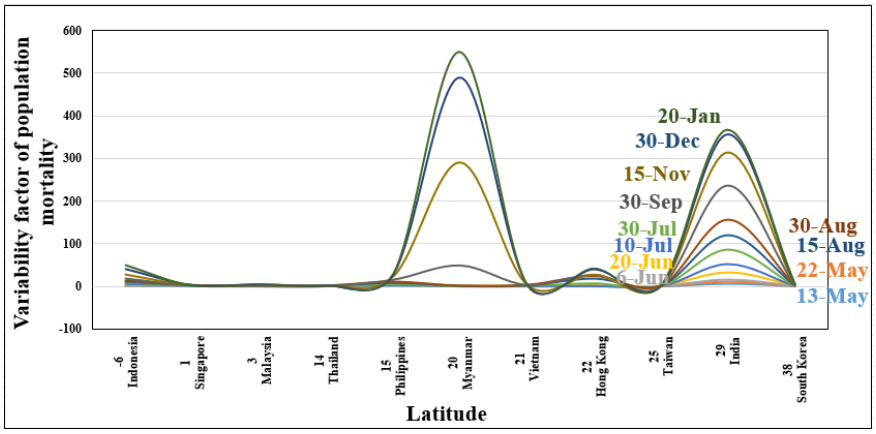


Figure 5: Variation of variability factor of population mortality in the Southeast Asian region.

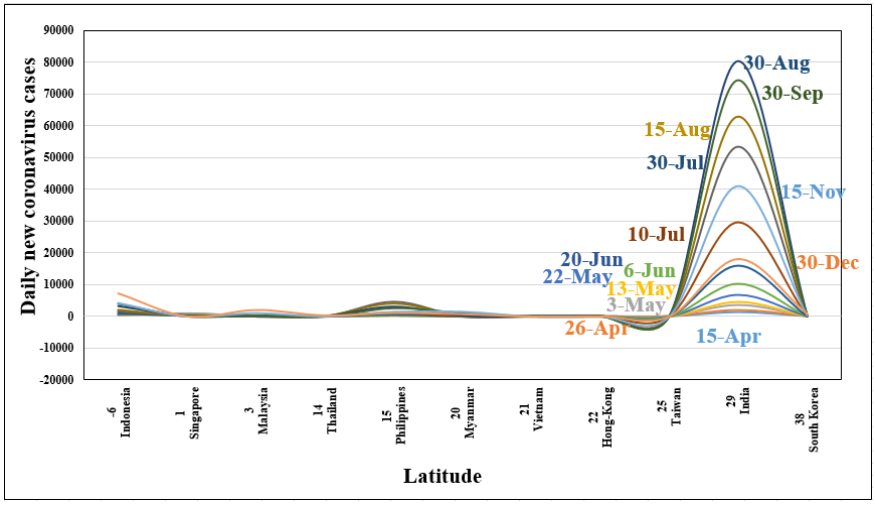
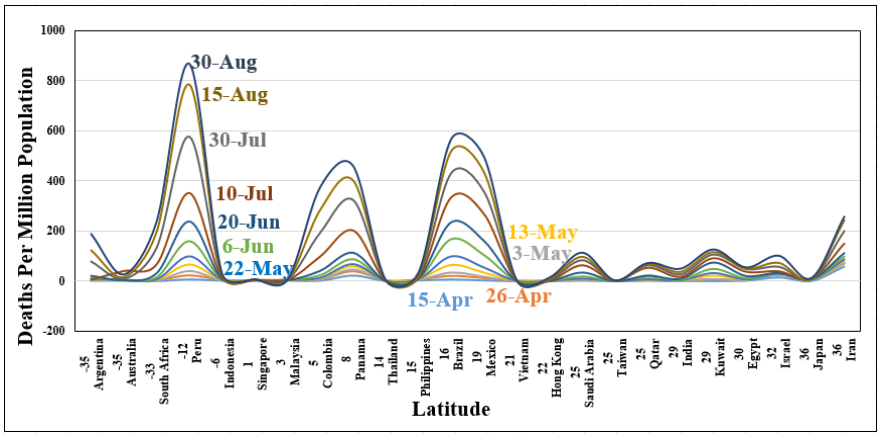


Figure 6: Variation of daily new Covid-19 cases.

The spectrum of daily new covid-19 cases depicted in Figure 6 shows very significant exponential increase for India during July and August 2020, which resulted into significant variability of population mortality. Further, daily new covid-19 cases for India increased sharply to more than 80,000 up to 30 August 2020, prior to decrease sharply to reach less than 20,000 daily new cases during December 2020, whereas sudden increase of daily new covid-19 cases observed for Indonesia, Malaysia, Thailand and Philippines during the same period.

3. POPULATION MORTALITY AND ITS VARIABILITY BETWEEN LATITUDES 64°N and 35°S

Figure 7 and Figure 8 shows the marked variations of population mortality for 52 countries situated below the latitude 64°N based on population mortality data from 15 April to 30 August 2020 and 15 April 2020 to 30 January 2021. Relatively low population mortality observed for countries situated at latitudes between 38° N and 6° S, whereas countries that lies beyond the latitude 38°N and below the latitude 6° S shows relatively higher population mortality. Further, the continuity of the higher peaks of population mortality observed based on the population mortality of 15 April, 26 April, 3 May, 13 May, 22 May, 6 June, 20 June, 10 July, 30 July, 15 August and 30 August 2020 as depicted in Figure 4, which confirms to higher correlation between population mortality and latitudes for countries, and confirming the impact of latitudes on population mortality (Verma A.K. et al, 2020; Panarese A. and Shahini E., 2020; Jonathan M.R. et al, 2020; Verma A.K. et al, 2020).



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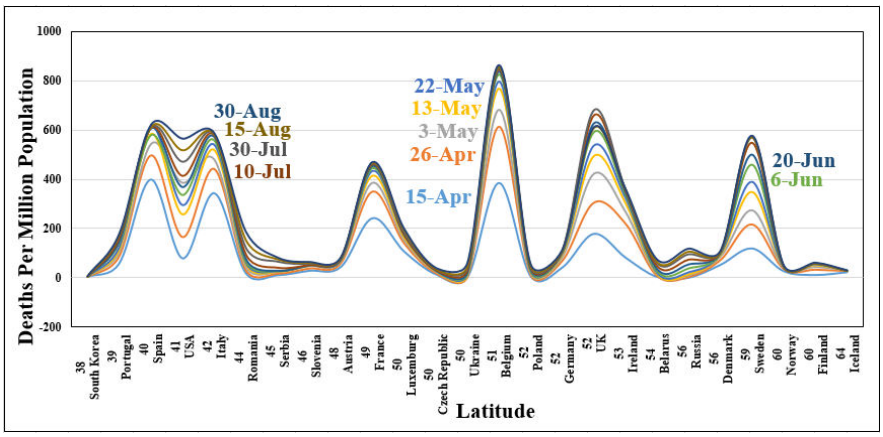
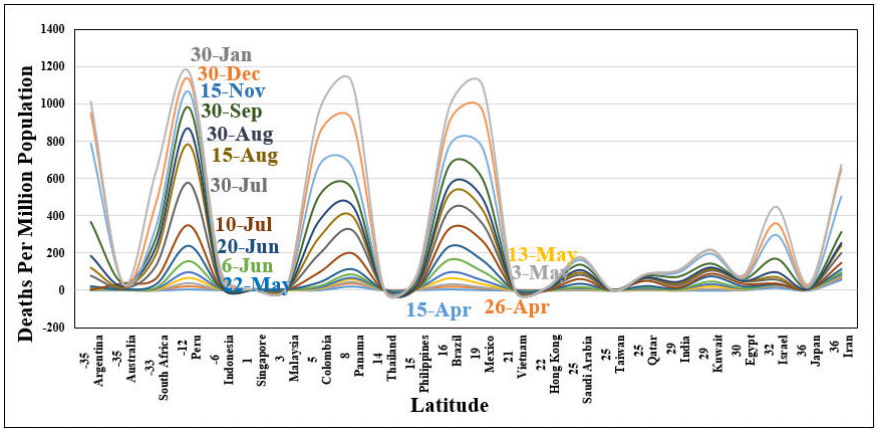


(b)

Figure 7: Variation of Population Mortality with Latitude.

Figure 8 (a) depicts sudden significant increase of population mortality for Argentina, Colombia, Brazil, Panama, Mexico, and Israel during 30 September 2020 to 30 January 2021, whereas non-significant rise of population mortality observed for South Africa, Peru, Indonesia, Saudi Arabia, India, Kuwait and Iran that lies between the latitude 35°S and 36°N. Figure 8 (b) shows a sudden significant increase of population mortality for Portugal, Serbia, Slovenia, Austria, Luxemburg, Czech Republic, Ukraine, Poland and Germany during the same period, whereas the increase of population mortality observed for Spain, Italy, France, Belgium, UK and Russia between the latitude 38°N and 64°N. Further, population mortality is observed higher than 400 for countries situated beyond the latitude 38°N from 15 November 2020 to 30 January 2021, compared to the countries situated between the latitude 38°N and 35°S, except Argentina, Peru, Colombia, Panama, Brazil and Mexico.



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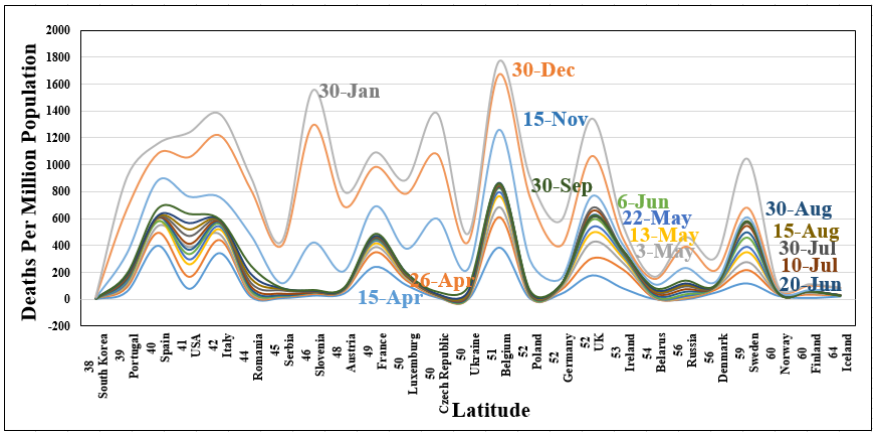

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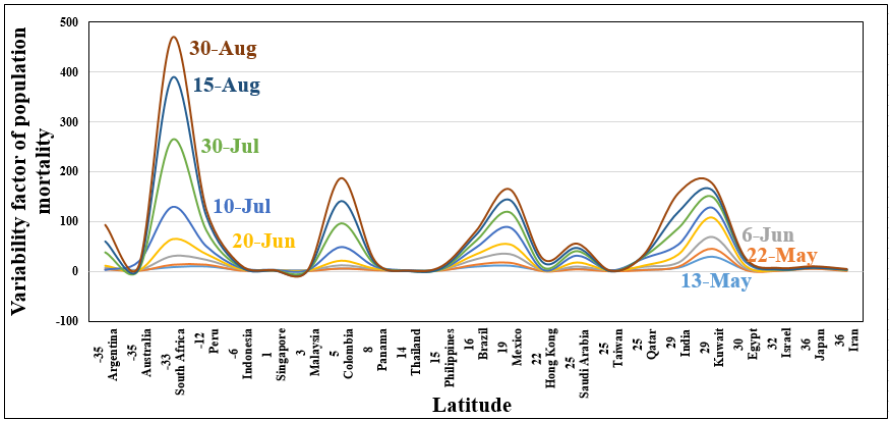
Figure 8: Variation of Variability factor of Population Mortality with Latitude.

Figure 9 depicts the variability factor of population mortality from 13 May to 30 August 2020 for countries that lies below the latitude 38°N, whereas, non-significant increase of variability factor observed for countries situated at the latitudes beyond 38°N, excluding Russia and Ukraine showing significant variability factor. The significant increase of variability factor of more than 100 observed for countries situated below the latitude 38°N such as South Africa, Peru, Columbia, Panama, Brazil, Mexico, India, Kuwait and Egypt, whereas non-significant variability factor observed for Argentina, Australia, Indonesia, Singapore, Malaysia, Thailand, Philippines, Hong-Kong, Saudi Arabia, Taiwan, Qatar, Israel, Japan, Iran and South Korea (Verma A.K. et al, 2020). Figure 10 (a) depicts the maximum variability factor of population mortality for South Africa during 15 November 2020 to 30 January 2021, which is followed by Colombia, Russia, Kuwait, India, Mexico and Ukraine above variability factor of 200. There is a sudden significant increase of variability factor of population mortality for countries such as Argentina, Romania, Serbia, Slovenia, Austria and Poland, whereas non-significant variation of variability factor observed for other countries between the latitude 64°N and 35°S as depicted in Figure 10(b). It confirms from the analysis that the variability factor of population mortality does not depend on the latitude of the country for determining the severity of the outbreak of covid-19, but depends on the design measures taken by these countries as well as quality of existing healthcare infrastructure to control the population mortality.



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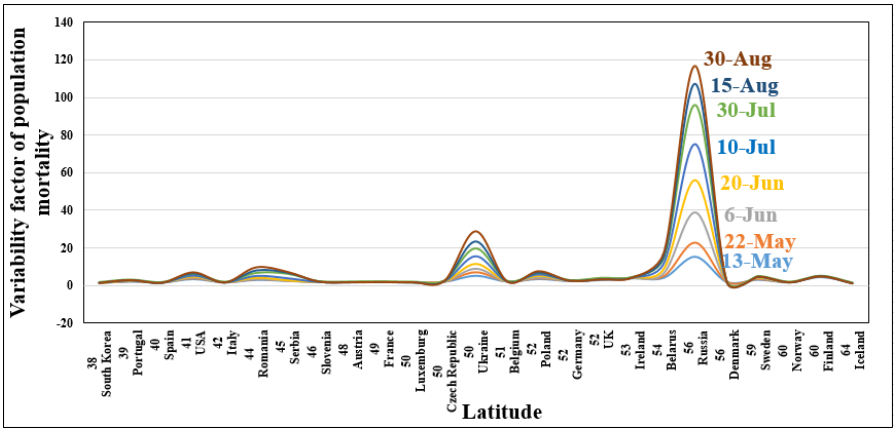

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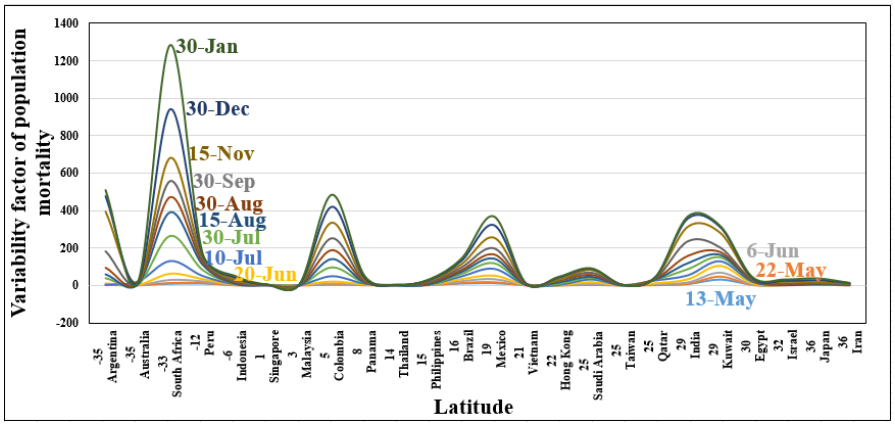
Figure 9: Variability factor of population mortality.



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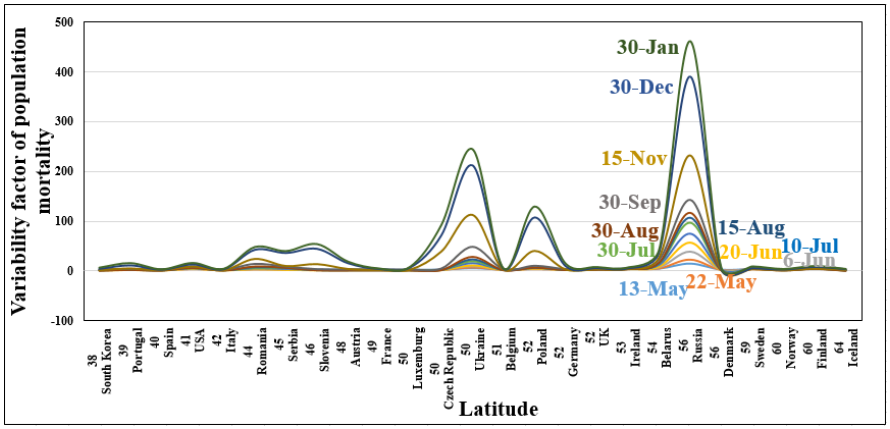

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Figure 10: Variability factor of population mortality.

5. CONCLUSIONS

This present study of spatial big data analysis of population mortality based on population mortality data from 15 April 2020 to 30 January 2021 shows relatively low population mortality in countries that lie below the latitude 38°N (Verma A.K. et al, 2020; Panarese A. and Shahini E., 2020; Jonathan M.R. et al, 2020; Verma A.K. et al, 2020). The variability factor of population mortality from 30 September 2020 to 30 January 2021 estimates the significant severity of the covid-19 outbreak in the country such as South Africa, Colombia, Russia, Kuwait, India, Mexico and Ukraine, and sudden rise of variability factor for Romania, Serbia, Slovenia, Austria and Poland, rather than considering only population mortality. The sudden rise of variability factor of population mortality for Malaysia, Myanmar, Hong-Kong and Taiwan observed during 30 September 2020 to 30 January 2021, whereas other countries controlled the variability factor for recovery of the outbreak in the Southeast Asian region

6. REFERENCES

1. BBC, 2020. Coronavirus: The World in Lockdown in Maps & Charts/ Source: Oxford Covid-19 Government Response Tracker /BBC Research, Available online at: https:// www.bbc.com/news/world-52103747 (Last access date: 10 July 2020).

2. Coronavirus, 2020. Global Covid-19 Data for All Countries, *Available online at:* https://www. worldmeters.info/coronavirus (Last access date: 10 July 2020).

3. Verma Arun Kumar, Verma Aditi & Verma Anjul, 2020. Coronavirus Spatial Big Data Predictive Analysis for the Southeast Asian Region, Defence Science & Technology Technical Bulletin, Ministry of Defence, Malaysia, **12,** 2, pp. 344- 366.

4. Panarese A. and Shahini E., 2020. Covid-19 and Vitamin D, Aliment. Pharm. Therap., 51, pp. 993- 995.

5. Jonathan M.R., Sreedar S. , Eamon L. and & Rose A.K., 2020. Low population mortality from COVID-19 in countries south of latitude 35 degree north supports vitamin D as a factor determining severity", Aliment. Pharm. Therap., 51, pp. 1438-1439.

6 Verma A.K., Verma Anjul and Verma Aditi, 2020. Covid-19 Geo-Spatial Big Data Analysis for the Impact of Latitude on Population Mortality for Countries Situated at Latitudes between 64°N and 35°S", **41st** Asian Conference on Remote Sensing (ACRS 2020), Organised by Asian Association of Remote Sensing (AARS), 09-11 November 2020, Deqing, China.