Turk J Public Health
Available online at: http://dergipark.org.tr/tjph/
Doi: 10.20518/tjph.1112614

NOTE/NOT

Descriptive epidemiological study of coronavirus disease distribution in specific geographic location: Unique public health practice in outbreak analysis

Spesifik coğrafi konumda coronavirüs hastalığı dağılımı için tanımlayıcı epidemiyolojik çalışma: Salgın analizinde benzersiz halk sağlığı uygulaması

Mostafa Essam Eissa[1] Engy Refaat Rashed[2]

[1]M. Sc., Pharmaceutical Research Facility, Cairo, Egypt
[2]Assoc. Prof., National Centre for Radiation Research and Technology, Biochemistry Department, Cairo, Egypt

Recieved: 05.05.2022 , **Accepted:** 23.02.2023

Abstract

Since the emergence of the Coronavirus disease outbreak, the world has witnessed great changes that have impacted humanity. A study of the pattern of the pandemic would be of great importance to understand the trending behavior for the spreading of the disease within any country. Visualization of the outbreak progression - through accumulated records in the datasets - using statistical tools showed that the initial fast increase rate of the affected cases in the original province in China was followed by a stability period till the end of the reporting date. Hong Kong - which was next to Hubei province in the cases – showed a different surge of slow growth curve with distinct major wave levels. The remaining territories showed a much smaller magnitude of morbidities. However, investigating the similarity levels for the daily kinetics of cases showed a clustering tendency between different political regions suggesting a significant correlation. The technique would be useful for public health authorities work.

Keywords: Coronavirus, Pandemic, Morbdities, Public Health

Correspondence: M. Sc., Mostafa Essam Eissa, Pharmaceutical Research Facility, Cairo, Egypt.
E mail: mostafaessamahmedeissa@gmail.com, **Phone:** +201006154853.
Cite This Article: Eissa ME, Rashed ER. Descriptive epidemiological study of coronavirus disease distribution in specific geographic location: unique public health practice in outbreak analysis. Turk J Public Health 2023;21(1):144-151.

Öz

Coronavirüs hastalığı salgınının ortaya çıkmasından bu yana dünya, insanlığı etkileyen büyük değişimlere tanık oldu. Salgının paterni üzerine bir araştırma, hastalığın herhangi bir ülkede yayılmasına yönelik eğilimi anlamak için büyük önem taşıyacaktır. Salgın ilerlemesinin veri kümelerinde biriken kayıtlar aracılığıyla istatistiksel araçlar kullanılarak görselleştirilmesi, Çin'deki orijinal eyalette etkilenen vakaların ilk hızlı artış oranının, raporlama tarihinin sonuna kadar bir istikrar dönemi izlediğini gösterdi. Vakalarda Hubei eyaletinin yanında yer alan Hong Kong, farklı ana dalga seviyeleri ile farklı bir yavaş büyüme eğrisi dalgalanması gösterdi. Kalan bölgeler çok daha küçük bir hastalık boyutu gösterdi. Bununla birlikte, vakaların günlük kinetiği için benzerlik düzeylerinin araştırılması, farklı siyasi bölgeler arasında önemli bir korelasyona işaret eden bir kümelenme eğilimi gösterdi. Teknik, halk sağlığı yetkililerinin çalışmaları için faydalı olacaktır.

Anahtar Kelimeler: Coronavirüs, Pandemi, Morbiditeler, Halk Sağlığı

INTRODUCTION

Since the dawn of history, the human being has been smashed with many microbial outbreaks that reaped the souls and devastated communities with huge consequences.[1]The impact of the infectious microbial outbreak on public health is a challenging problem that should not be underestimated, even if it shows a low level of mortality such as the recent Coronavirus Disease (COVID-19 or SARS-CoV-2 for Severe Acute Respiratory Syndrome Coronavirus 2).[2] This contagious viral disease was first identified and reported in December 2019 in Wuhan which is the capital of Hubei Province in the People's Republic of China.[2]

Being a public health concern, cases of SARS-CoV-2 will be studied herein as the kinetics of the epidemic in the country based on the morbidities in the affected territories in China using statistical tools involving unique methods.

MATERIAL AND METHOD

Data base gathering and processing were performed through Microsoft Excel 365. The current investigation involved a database from the HUMANITARIAN DATA EXCHANGE version 1.61.3 site https://data.humdata.org/dataset/novel-coronavirus-2019-ncov-cases/resource/00fa0e37-961b-4767-a5ce-e7ab4e2c921c. The work herein demonstrated the implementation of Contour plot, Pareto chart, cluster graph, tree diagram, time-series visualization, distribution fitting analysis, three-dimensional and surface plot using Excel add-in XLSTAT version 2022.1.2 and Minitab version 17.1.0 programs. The electronic built-in Minitab statistical manual was used as a guide for the use and selection of the statistical tools.

RESULTS AND DISCUSSION

Study of the kinetics of the morbidity incident trend**:** A brief view of the morbidity distribution through the country based on the coordinates at three distinct time frames yielded Contour plots in Figure 1 (A, B and C). The growth of the cases was prominent in the first year but declined in the second year suggesting an apparent stabilization in the cumulative illness.[3] Nevertheless, there was evidence of an initial rapid excursion of the infected population that could be seen in a limited area before it seized to escalate. This could be viewed as a good indicator of the effectiveness of the controlling measures after the initial surge that started in Hubei province. On the same line, the Pareto diagram (Figure 1 (D)) showed the descending order of the major contributing territories and provinces for COVID-19 cases till January 2022. More than half of morbidities stemmed from Hubei province followed by Hong Kong with a cumulative contribution from the total country by about 0.7 fractions suggesting the main public health risk regions with intense efforts were required by the authorities in these zones. The two territories were a major public health concern.

Three-dimensional visualization of the geographical distribution pattern of the Coronavirus epidemic showed a low level of the total reported morbidity across most territories within the country as could be observed in Figures 2 (A and B). However, a spiking could be detected in the middle southeastern region (Hubei) followed by a significantly lower level of the magnitude of cases in the southeast coastal region that could be attributed to Hong Kong which suffered from a recent new surge of cases.[4] Unfortunately, a new wave started to be evident in 2022 affecting Hong Kong as the major source of the emerging number of infected cases, indicating a major change in the redistribution of the cases in the emerging new wave of COVID-19 in the country which mandates reprioritization and reallocation of the control measure resources to the recently emerged devastated zones.[5] The time series plot in Figure 2 (C) showed that the province with the major surge (i.e. Hubei) was controlled swiftly and stabilized for the rest of the monitoring time. However, some of the low-impacted provinces demonstrated a minor level of cases growth over time and appeared as waves as could be seen in Hong Kong.

The distribution fitting showed empirically the mathematical description of the pattern of dispersion of the outbreak based on the provinces of China. The overall spreading pattern of the total cases data till the date of the study showed behavior that appeared to be close to following a negative binomial distribution (2) at a 95% confidence interval (CI) with a p-value of 0.05 using distribution fitting analysis. The two parameters k and p had estimated parameters of 0.251 and 39240.372 with standard error (SE) of 0.008 and 0.007, respectively. The census of the morbidity in the most affected territories tended to show a low number of accumulated cases. The statistics of (data, parameters) for the mean, variance, skewness and Kurtosis were (3471.471, 9847.354), (136225267.105, 386423678.867), (5.049, 3.992) and (25.044, 23.909), respectively. The aggregation of data on the left side had led to the right skewness behavior of the cases record database. In general, few provinces in the country showed

a tendency toward a high number of cases suggesting a public health issue of concern to address and act upon. But low dispersion level of the epidemic would be a suggestion that might lead to the conclusion of the effectiveness of the prevention measures, including the lockdown during this study period.

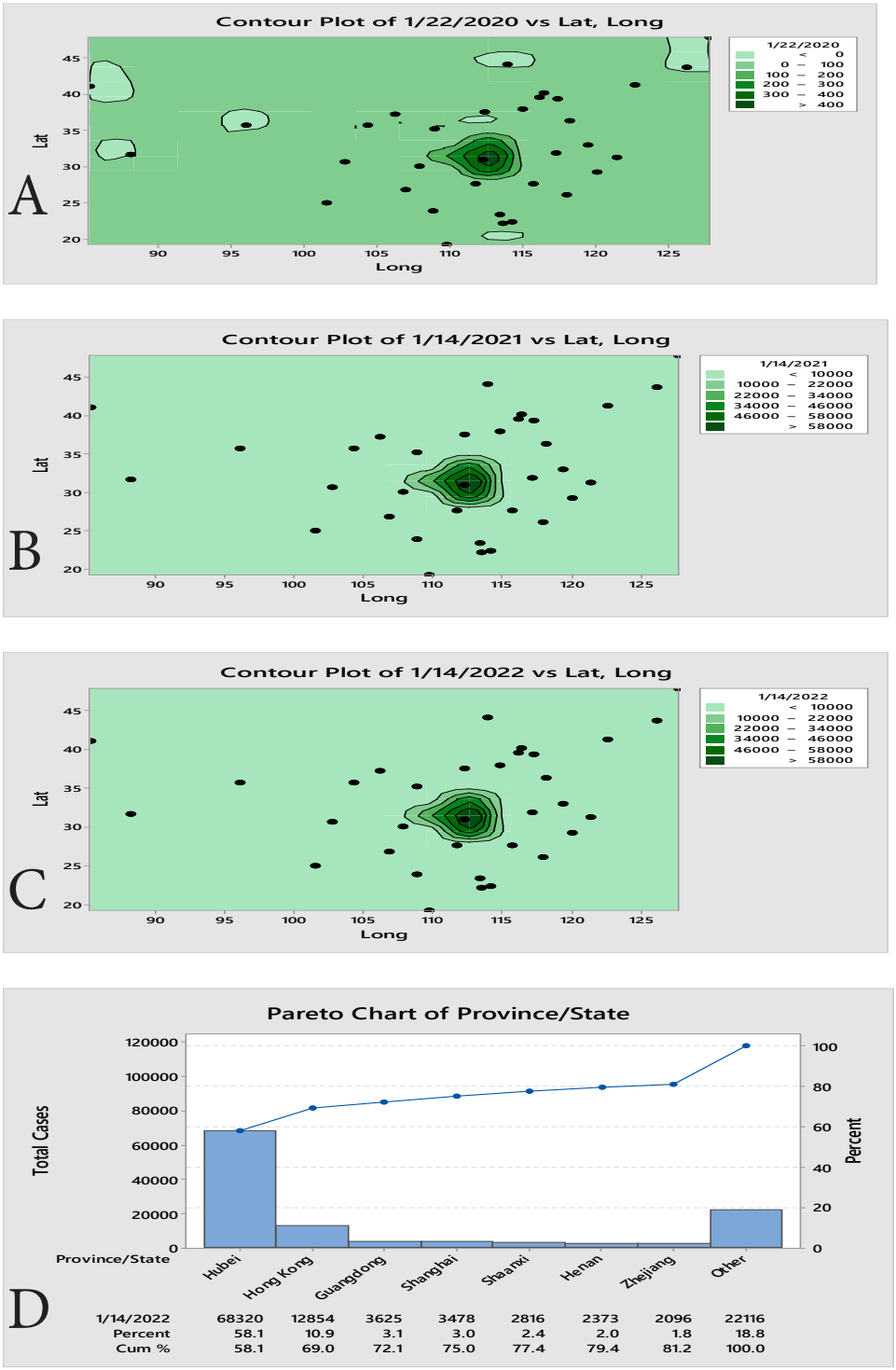
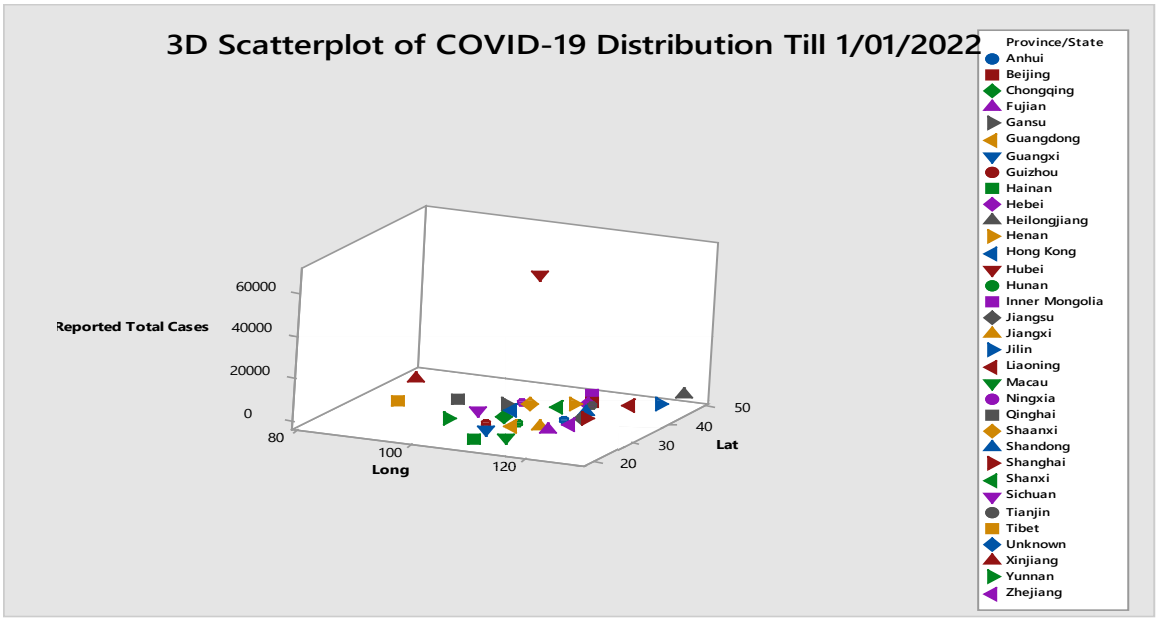
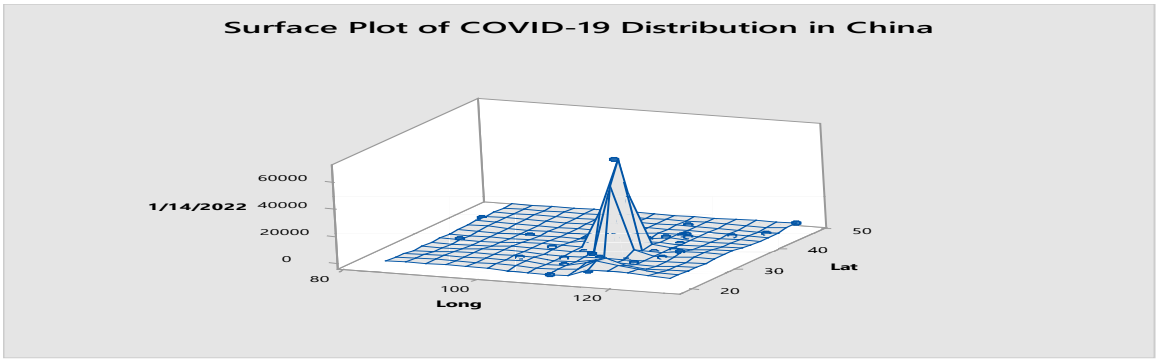


Figure 1: Time-bound contour plot series (A, B and C). Pareto diagram showing the descending order of the total reported cases of Coronavirus disease across Chinese territories (D)





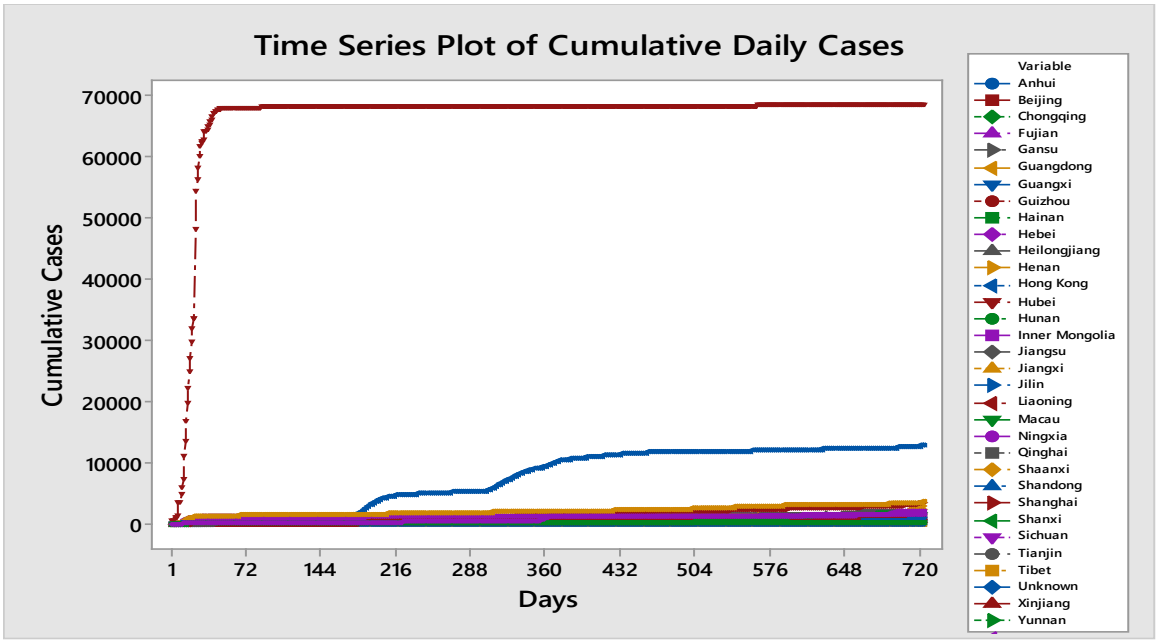


Figure 2: Three-dimensional plots (A and B) demonstrating the total reported cases of Coronavirus disease across Chinese territories until 14 January 2022. Time series diagram showing the daily dynamic pattern of COVID-19 waves in the country with Hubei and Hong Kong showing the predominance in the number of daily incidences

When viewing the cumulative cases based on the location, most reported morbidities tended to show homogenous grouping in the provinces, except for Hubei (an abnormally high number of cases) and Xinjiang (an exceptionally remote northwest territory with respect to the longitude only but with a relatively low number of cases within the normal range). Figure 3 (A and B) demonstrates this pattern of clustering. On the other hand, Figure 3C shows a tree diagram (dendrogram) that demonstrates the level of similarity between the provinces on the daily basis for cumulative dynamic morbidity. At the three major joints viz (Number of Cluster 2, Similarity 54.92), (Number of Cluster 3, Similarity 65.01) and (Number of Cluster 4, Similarity 76.16), three miniaturized political maps were illustrated showing the correlated territories at each selected similarity level. The recent surge that affected 90% of the provinces could be correlated with the significant degree of similarity between different provinces in the country. Notably, Jilin province which is in the same cluster as the Hong Kong similarity group was observed also as the second affected region – next to Hong Kong with the recent striking Coronavirus wave.

Limitations and Conclusions: The paper brings a unique statistical insight and quantitative perspective view into the COVID-19 outbreak from the morbidity kinetics standpoint. The present analysis was conducted using cost-effective, simple and fast commercially available statistical programs that are handy for those who work in the public health industry sector. Future research should assess the impacts of the scale of other parameters on the pandemic globally. The findings of this work are pertinent for the workers in public health, societies and the providers of the health service, as well as decision-makers. Since time work is time-bound, further study would be needed to be extended to cover a new period with the recent wave of the Coronavirus disease to elucidate the new geographical pattern and the similarity level change in trend. Similarly, another investigation might be used complementary to cover the recovery rate and mortalities which could light the path over the whole situation that would support public health professionals and authorities in policy, decision making and possibly management of the control and protective measures to control the outbreak by resources prioritization and allocation. The current analysis provided an assessment of the quality of public health control measures for the epidemic, in addition to the classification of the country as remarkable groups based on the daily case kinetics. The change in the geographical distribution of the disease has exposed other contributing factors involving the new variants of the Coronavirus in the disease spreading.

Figure 3: Aggregation pattern showing the reported cases of Coronavirus outbreak cases in relation to coordinates (A and B). Dendrogram plot showing similarity level of COVID-19 case kinetics between Chinese territories (C)

ACKNOWLEDGEMENT

Conflicts of Interest: None

Financal Support: The whole work was supported by the contributing authors

Ethical Declaration: Not applicable

Consent for publication: All authors consented.

Availability of data and material: No data in the article

Code availability: Not applicable

Authorship Contributions: Concept: ER, Design: ME, Supervision: ER, Financing and equipment: ER, Data collection and entry: ME, Analysis and interpretation: ME, Literature search: ME, Writing: ME, Critical review: ER.

REFERENCES

1. Piret J, Boivin G. Pandemics throughout history. Frontiers in microbiology. 2021:3594.

2. Sharma A, Tiwari S, Deb MK, Marty JL. Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2): a global pandemic and treatment strategies. International journal of antimicrobial agents. 2020;56(2):106054.

3. Wu S, Neill R, De Foo C, Chua AQ, Jung AS, Haldane V, Abdalla SM, Guan WJ, Singh S, Nordström A, Legido-Quigley H. Aggressive containment, suppression, and mitigation of covid-19: lessons learnt from eight countries. bmj. 2021 Nov 29;375.

4. Hung KK, Walline JH, Chan EY, Huang Z, Lo ES, Yeoh EK, Graham CA. Health service utilization in Hong Kong during the COVID-19 pandemic–a cross-sectional public survey. International Journal of Health Policy and Management. 2022 Apr 1;11(4):508-13.

5. World Health Organization. Western Pacific regional framework to end TB: 2021-2030.