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ReviewOnCovidDataAnalysisUsingSpatialTemporalData

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Abstract

Coronavirus (Covid) is a severe acute respiratory syndrome infectious disease, spreads mainly between humanbeingsduringclosecontact,most symptomsarecoughing, sneezing, andspeakingsmalldroplets. The outbreak of COVID has led to a worldwide socio-economic crisis, with major impacts on developing countries. Understanding the dynamics of the disease and its driving factors, on a smallspatial scale, might support strategies to control infections. It explores the impact of the COVID-19 on neighborhoodsof Recife, Brazil, for which we examine a set of drivers that combines socio-economic factors and the presence of non-stop services.Athree-stage methodology was conducted by conducting a statistical and spatial analysis, including clusters and regression models. COVID-19 data were investigatedconcerningtendatesbetweenAprilandJuly2020.Hotspotsofthemostaffectedregionsand their determinant effects were highlighted. We have identified that clusters of confirmed cases were carried from a well-developed neighborhood to socially deprived areas, along with the emergence of hotspotsofthecase-fatalityrate.Theinfluenceofage-groups,income,levelofeducation,andtheaccess to essential services on the spread of COVID-19 was also verified. The recognition of variables that influence the spatial spread of the disease becomes vital for pinpointing the most vulnerable areas.
Consequently,specificpreventionactionscanbedevelopedfortheseplaces,especiallyinheterogeneouscities.

Keywords

Covid-19,Spatial-Temporalanalysis,VariableImportanceanalysis,Pandemic,MedicalRiskFactors, Neighborhood

Introduction

The World Health Organization (WHO) declared the coronavirus disease 2019 (COVID-19) pandemic in March 2020 . It is a vascular disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV2)virus..Intheearlystagesofthepandemic,thespreadofthediseasewasprimarilyreduced by non-pharmaceutical interventions, which were then complemented with vaccination programs as technology evolved. However, changes of intervention measuresalong with the emergence of highly infectiousvariants of the virus have affected the rates and the patterns of the spread of COVID-19.Countries are grappling withmany tactics inorder tominimizethe spread of Covid: collection, close schools, stop transportation,lock towns, enforce curfew, and seal places, but unable to contain it effectively . The time is required to locate the risk assessment on a site basis to take prompt preventive measures.Globally,thereare48,93,195casesofcoronavirus,whilethedeathtollis3,22,861.Takinginto account the updates of the Ministry of Health on Wednesday (May 20, 2020), India received a total of 1,06,750 COVIDcases whichinclude61,149activecases, 42,298cureand3303deaths[3]. Inthelast 24h, there have been 5611 new cases and 140 deaths. The rate of recovery is 39.62%.

Spatial-temporalanalysismightbeavaluabletooltocapturethedynamicbehaviorofthepandemic.One of the most regularly applied approaches in this context is spatial analysis, in which cluster and hotspot analysis, interpolation, and space–time scan statistics have been the main techniques used . For instance,inChina,spatialclusteringpatterns,overtime,ofcumulativecasesofCOVID-19atthecityand county-levelsshowed a shift from hotspots of larger coverage to few specific places. In global terms, evidence suggests that there is a sort of spread of COVID-19 cases from developed countries to less affluent countries .

SouthAmerica saw its geographic centroid for COVID-19 cases generally shifting from west to east in Brazilianareas,uptoJanuary2021.InBrazil,thenumberofcasesanddeathsstartedinSãoPaulostate(Southeast region), then progressivelymovednorth until earlyMay2020 . The COVID-19epidemicincreased rapidly acrossnortheasternBrazil uptoMay 2020, atwhichtimeit wasthemetropolitanareasthat werereported as having clusters of cases, even though there was an already relevant spread towards the countryside . Understanding the transmission dynamics within local communities is important in order to develop strategies to combat the spread of the disease**.**

METHODOLOGY

A7-day moving average was applied to the data on daily infections at the city-level, thereby seeking to reduce sudden variability due to reporting biases such as the lack of testing and the delay in recording cases and deaths .The impact of restricting and relaxation measures imposed by the State Government of Pernambuco and the City Council of Recife on the variability of the rate of new infections was also discussed. These government actions include the following: closing of non-essential commercial activities; mandatory use of masks; strict quarantine; reopening of building supply stores, beauty salons, suburban retailers, malls, and places of worship.n order to comprehend disparities in the spread of COVID-19 on a small scale, neighborhoods were explored using a spatial cluster analysis as appliedfor otherdiseases.Georeferenceddataobtainedfromtenspecificdaysbetween16Apriland3July2020at intervals of roughly one week were considered. Nevertheless, we were able to represent the ascending, peaking and descending behaviors of the curve of infections.

LocalMoran'swasimplementedforcumulativeconfirmedcasesandthecase-fatalityrate—whichmeansthetotalnumberofdeathsdividedbythetotalnumberofcases.Thisstatisticassessedthespatial autocorrelationassociatedwitheachneighborhoodofthestudyregionintermsofafewsurrounding spatial units. It was calculated for each area i = 1,…,n in:

$$I_i = \frac{\sum_{j=1}^{n} W_{ij}(y_i - \bar{y})(y_j - \bar{y})}{\frac{1}{n}\sum_{j=1}^{n}(y_j - \bar{y})}$$

where*y*meanstheCOVID-19reportedcasesorcase-fatalityratesforthe*i*thareaorits*j*th neighborinareas,and*Wij*meansaweightthatrepresentsproximityforthepairofareas*i*and

Inthismethod,akernelfunctionwithabandwidthparameterisusedtocalculatealocalweightsmatrixin terms of the distance between each pair of spatial units. Considering *i*= 1,…,*n* aseach samplelocation, GWRis mathematically denoted by :

$$y_i = \beta_{i0} + \sum_{k=1}^{p-1} \beta_{ik} x_{ik} + \varepsilon_i$$

(2)

where*yi*isthedependentvariableofCOVID-19confirmedcasesatneighborhood*i*,*xik*isthevalueofthe kth explanatoryvariable at location *i*, *βi*0 isthe intercept, *βik* is the regression coefficientfor the kth explanatory variable, *p* is the number of regression terms, and *εi* is the random error at location *i*.
Cumulativecountdatahasbeenappliedinstudiesof COVID-19,especiallyatasmall-scalelevelsuchasneighborhood or county-level and grid .

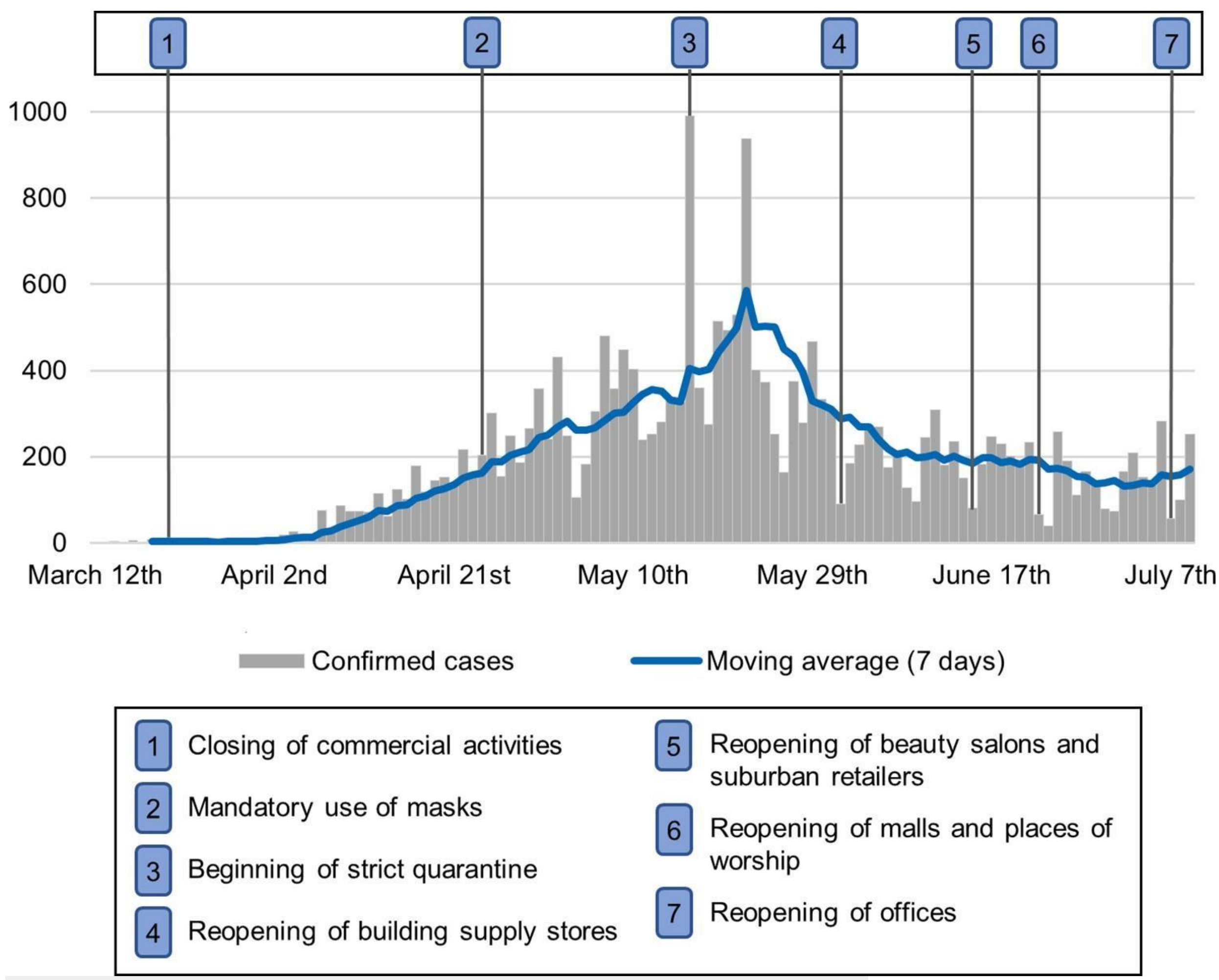

Fig1.EvolutionofdailyCOVID-19casesinRecifefromMarch12thtoJuly8th,2020.

CONCLUSION

This study combined spatial clusters and statistical analysis to evaluate the influence of socio-economic factors and essential services on the spread of COVID-19 in the city of Recife, Brazil. Our findings reveal that an increased risk of transmissions was associated with children and the elderly, the size of the population, household income, the level of education, and the presence of some facilities that have remainedopenthroughoutthepandemic.Moreover,thespatialspreadofthediseaseoccurredbymoving from well-developed todeprived neighborhoodsduring theinitial stagesof the pandemic.What wasalso found was for there to have been a tendency for there to have been harsh impacts on socially vulnerable and densely populated communities, specially those with many everyday places that are prone to overcrowding(e.g.bakeries,grocerystores).Brazilmanagesapublichealthsystemthatiswidespreadin all federative units, even though the country has continental dimensions and faces complex challenges. However,currently,publicagencieshavebeengoingthroughmanagementdifficulties.Inthissense,this studycansupportstrategicdecisionstohelpmitigatethespreadofCOVID-19notonlyinBrazil,butalsoinother developing and economically emerging countries. Furthermore, in the long term, knowledge produceddduringtheCOVID-19pandemicinthisheterogeneouscontext,regardinglocalcharacteristicsand spatiotemporal patterns, can be used to structure policies for tackling new epidemics of viral infectiousdiseases.

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