Letter

The Spatial Analysis of COVID-19 Distribution Pattern in Central Iran Using the Local Indicators of Spatial Association (LISA): A Letter to the Editor

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Dear Editor,

In late 2019, a novel virus called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was identified in Wuhan, Hubei Province, China, which was reported to be the cause of cases of pneumonia. The disease spread rapidly, and after the epidemic in China, its cases increased throughout the world (1). In recent years, the use of GIS has increased significantly in order to determine the geographical distribution patterns of diseases in medical and health sciences (2-4). In order to determine the spatial patterns of diseases, the local indicators of spatial association (LISA) in environmental GIS are substantially helpful. This model includes a set of methods to describe and visualize spatial distribution, identify atypical locations or spatial outliers, determine the patterns of spatial associations, clusters, or hot-spots, and finally propose spatial regimes or other types of spatial heterogeneity (5). Due to the spread of COVID-19 in many countries worldwide, including Iran, and particularly Qom Province as the origin of the disease in the country, there is a need to control and prevent disease propagation as much as possible by determining the spatial pattern and geographical distribution of the disease in different districts and areas of Qom Province to identify its high-risk areas. Subsequently, controlling and preventive measures can be carried out more purposefully. Therefore, this study was designed to analyze

the spatial distribution pattern of COVID-19 in central Iran using the LISA model. Geographical analyses to identify the geographical factors affecting the spread of the COVID-19 infection can help modify public health policies to constrain the virus. The aim of this study was to conduct a spatial analysis on COVID-19 affected regions in Qom Province using the LISA model. In a descriptive-analytical study, all the individuals infected with COVID-19 in Qom Province from February 19 to September 2020 were included in the study. The spatial distribution in urban areas was determined using the Moran coefficient in GIS. In addition, the spatial autocorrelation of the coronavirus was calculated in different urban districts of the province using the LISA method. The prevalence of COVID-19 in Qom Province was estimated to be 356.75 per 100,000 population. The spatial distribution maps of the COVID-19 disease in Qom Province showed that most cases (97%) of the disease occurred in the Markazi District and in the city of Qom, and a few cases (3%) had been reported from rural districts. The prevalence of COVID-19 in urban districts was 350.49 per 100,000 people, and in the rural areas of Qom Province, it was estimated at 4.51 per 100,000 population. Regarding the prevalence of this disease in urban areas, the District 7 (Holy shrine), District 4 (Zanbilabad-Salarieh), and District 6 (Imamzadeh Ebrahim Street) had the highest incidence rates of the disease in Qom City (Table 1).

Table 1. Prevalence of COVID-19 Infection in Urban Areas of Qom Province, Central Iran, from February 19, 2020, to September 2020

Urban Districts	Population	Cases	Incidence/100,000
1	78401	243	309.94
2	192060	671	349.37
3	189708	642	338.41
4	171363	808	471.51
5	192755	642	333.06
6	213356	930	435.89
7	41625	227	545.34
8	121890	225	184.59

With the spread of the novel coronavirus in Qom Province since February 19, 2020, in order to conduct the point pattern analysis of COVID-19 in the province, Moran's Index was calculated (Moran's Index: 0.106709, Z-score: 1.730283, and p-value: 0.083580 with 90% confidence interval). Accordingly, the spatial distribution pattern of the COVID-19 disease in Qom Province was drawn (Figure 1), which indicated that the highest prevalence of the disease was related to the urban districts of seven, four, and six, respectively (Table 1). Based on this analysis on the incidence of the COVID-19 infection, District 3 (Imam Khomeini St.) and District 6 (Imamzadeh Ebrahim St.), as two urban districts in the Province, were placed in the HH category of the LISA model, highlighting them as two foci of COVID-19 in Qom Province (Figure 2). This means that the incidence of the disease in these two districts is higher (above average), and at the same time, the two districts are also surrounded by areas with a high incidence of COVID-19 (i.e., high-value areas). Also, autocorrelation in these two urban districts was positive and included more than one-third of the population of Qom (33.55%). In addition, based on the LISA model, District 1 (Bajak), an urban region, was placed in the LH category, meaning that it was a low-value area surrounded by high-value regions (Figure 2). One of the most important geographical factors affecting the incidence of the coronavirus infection based on the spatial distribution model was distance or spatial proximity. So, health policy-makers should impose more restrictions to ensure the observance of health protocols by people to contain the coronavirus.

Footnotes

Authors' Contribution: AS and NJ contributed to designing the study and drafting the manuscript. AS, AK, MS, and SA were involved in data collection and data entry into the statistical software. AS, NJ, and BF contributed to data analysis. AS participated in study design and data analysis and drafted the original manuscript. AS and NJ participated in drafting the manuscript.
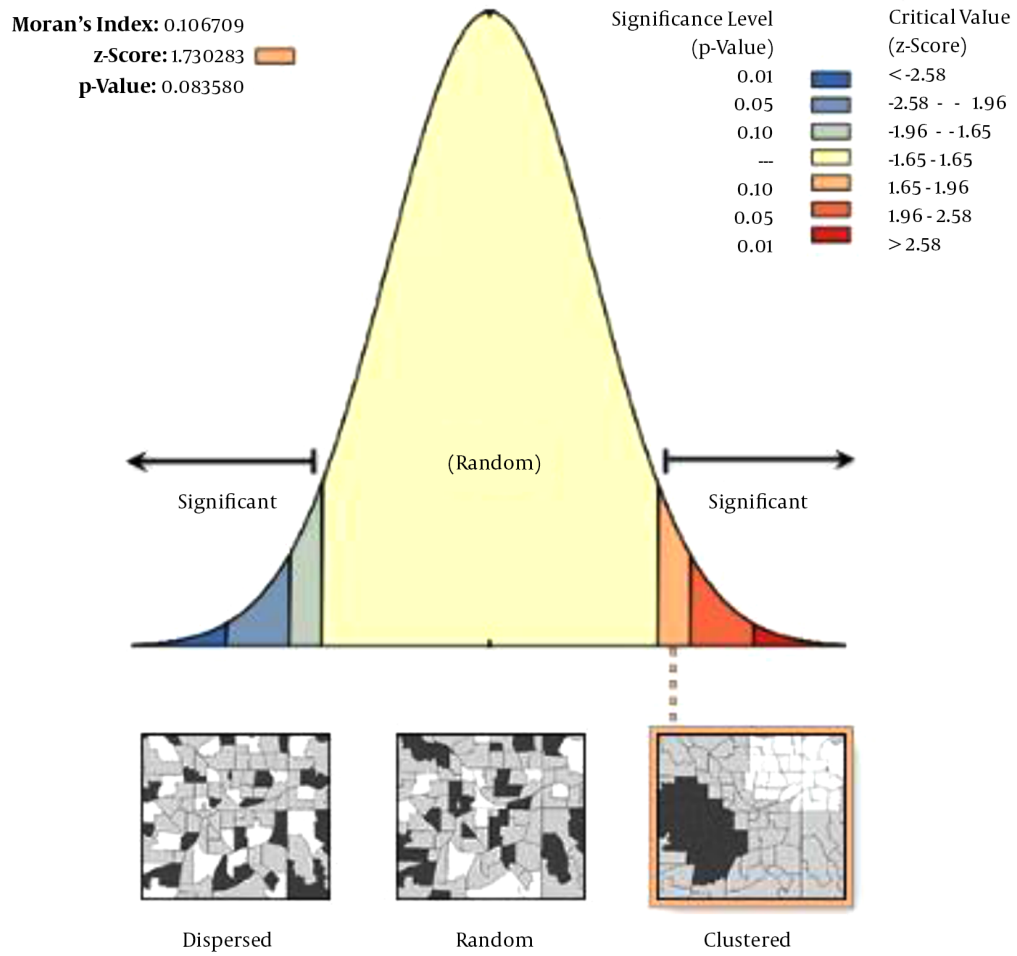
Conflict of Interests: The authors declare that they have no conflict of interest.

Ethical Approval: An ethical code was assigned to the study by the Institutional Ethics Committee of Qom University of Medical Sciences (code: IR.MUQ.REC.1399.036).

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Moran's Index: 0.106709
z-Score: 1.730283
p-Value: 0.083580

Significance Level (p-Value)
0.01
0.05
0.10

0.10
0.05
0.01

Critical Value (z-Score)
< -2.58
-2.58 - - 1.96
-1.96 - -1.65
-1.65 - 1.65
1.65 - 1.96
1.96 - 2.58
> 2.58

(Random)

Significant   Significant

Dispersed   Random   Clustered

Given the z-Score of 1.7302831992, there is a Less than 10% Likelihood that this Clustered Pattern Could be the Result of Random Chance.

Global Moran's I Summary

Figure 1. The point pattern analysis of COVID-19 in Qom Province from February 19, 2020, to September 2020.
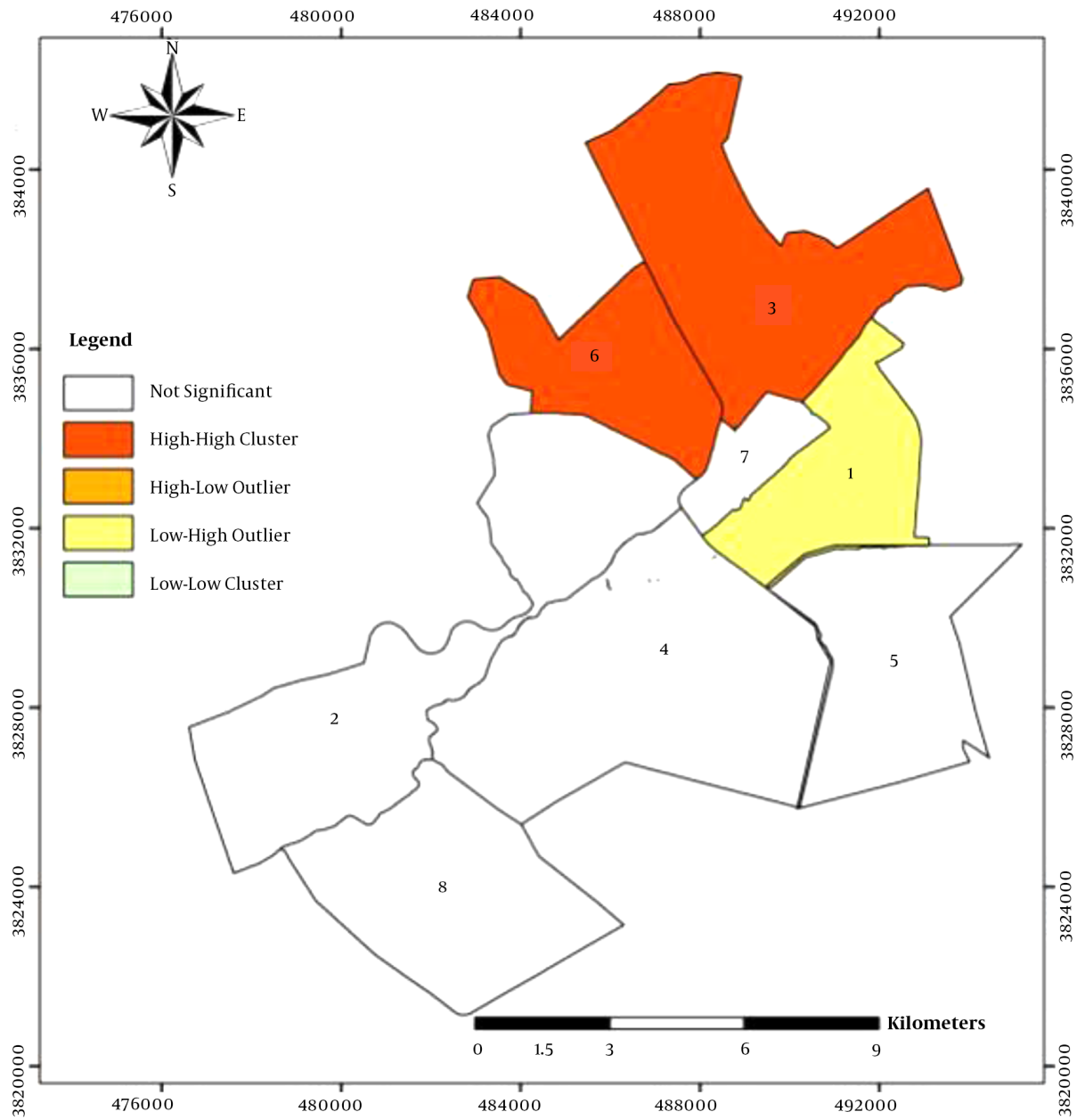
Figure 2. The spatial autocorrelation of the novel coronavirus using the local indicators of spatial association (LISA) in the urban districts of Qom City from February 19, 2020, to September 2020.