



Exploring the role of place on COVID-19 spatial distribution in 22 districts of Tehran, Iran

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Abstract Our purpose in this paper is to emphasize the theory of “the effect of the role of place on the spatial distribution of phenomena”, whether problems or opportunities. In almost a year, COVID-19 has disrupted people’s lives in Iran and caused minor to large damages in various aspects of citizens’ lives. The outbreak of the disease in the metropolis of Tehran, given that it is the capital of Iran, is however more worrying than other cities in Iran. Therefore, the importance of this research is that it tries to provide hypotheses that explain the reason for the increase in the incidence of the disease by emphasizing the role of place in some districts of Tehran and by statistical analysis and preparing a questionnaire and questions from the elite and Executive experts and citizens in different districts of Tehran have been trained. The results showed that there was a direct positive correlation between the role of place (economic, cultural, political and environmental) in the 22 districts of Tehran and the increased population and increased number of coronavirus-infected people. According to the evaluation of the performance (role) of each district in Tehran, districts 11, 12, 17 and 20 had the most economic places (bazaar and mall), as a result the number of coronavirus-infected people was higher in these districts. The political places are in the next place. The districts where most political places were located were 8 and 11. Areas with service and cultural places such as passenger terminals, subway stations, universities and hospitals were the last in exposing to this virus.

Keywords Spatial distribution · Role of place · Tehran · COVID-19

1 Introduction

City is a bed full of potential for exploration and research. Due to the connection of the city with the daily events in the world, it is necessary to study it in different schools and fields. In other words, as a geographical (natural and human) phenomenon, city is the bed of political, economic and cultural tensions and challenges, which are interconnected warps and woofs in the urban space [1].

The “study of the city” is the understanding of regional society by studying its spatial structure, politics, and economic system. Because city is the first living environment of citizens that has the greatest effect on the geographical-political aspects of the world) [2].

Many scholars believe that the city is a social invention that its size, location, and internal organization are shaped based on “power” and many changes in the structure and role of the city are materialized due to the mobility of “citizens”. The shape and appearance of the city, like the country, represents uplift pressure. Urban space processes have therefore more or less effects on the whole concept of politics, especially political development [3].

Undoubtedly, the disruption of the service distribution system and the failure of public service system is the main factor for the rapid growth of urbanization and the overgrown urban spaces [4] which has caused different roles of place in different urban areas. Citizens like to live in areas with more facilities. More facilities thus depend on the role of places. The fact that the luxury economic places distribute goods, and clean and beautiful living places that create beautiful landscapes, and most organizations and

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political institutions such as ministries, etc. are located in the uptown (for various reasons) and these conditions lead to the distribution of the population and ultimately to the distribution of social harms or vice versa, public services and welfare. Inequalities due to the improper distribution of wealth, opportunity and power among places and geographical spaces as human structural habitat, referred to as spatial injustice, is one of the precursors to the spread and intensification of the destructive effects of epidemic diseases like COVID 19.

COVID-19 is not the first and last pandemic in human life, but part of the historical course of the phenomenon of infectious and spreadable diseases on Earth, other cases of which have occurred in the past and will occur in the future. Therefore, based on any such experience, the World Health Organization, national governments, local governments, NGOs and citizens should always design an appropriate and synergistic response model to deal with them and implement it with prior preparation. In fact, the outbreak of infectious diseases has long been associated with human society. In modern times, infectious diseases are one of the main causes of death in humans [5].

In this regard, the spatial distribution (analysis) method has a significant credibility, because this method examines the origin, quality and distribution of the phenomena in the geographical area of cities and achieves basic data for drawing a map.

Spatial analysis is a scientific attempt to understand the centers of social harm in the context of geographical study patterns [6]. Studying the role of places in different urban areas is an essential and basic task for planning and reforms to ensure health and reduce various crises. Geography is the science of place and space that seeks to study the spatial distribution of phenomena and their spatial relationships on Earth. Spatial concepts such as placement, organization, distribution, distribution pattern, shape, ranking, distance, location, classification, and geographical and network relations are studied within this definition [7]. Different geographical places and areas have different values depending on their location and specifications. The set of these values, which are mainly influenced by geographical factors, “empower” a place or region, and places or regions usually use this power to “develop the sphere of influence” and “effectiveness”. The values of a place are also influenced by its internal features and characteristics. These values may come from the natural capabilities of a region such as location and size, resources and mines, climate and access to important seas and straits, or they may be the product of human and social characteristics such as historical antiquity, economic, social, political, cultural, religious, scientific or technical power. The combination of these variables, potential and actual capabilities of a geographical place or region helps us to have a

better picture of it. It will also help to better understand how powerful a place or geographical area is and what functions and roles it can play in political, social and cultural issues. In other words, there is a deep relationship between the role of a place and a geographical region and its “degree of power”. That is, the wider the function a role has, i.e. the more distal it is, the stronger the geographical place would be. Because the wider scope of these functions reflects their higher degree of effectiveness with other places and regions. For example, “global cities” are among these places that have high performance, especially in the economic and political fields [8]. In a way, this difference has determined the role of different places, structures and social and physical institutions for the people of the society and creates many latent and manifest differences among them. These distinctions are often made by culture, economics, politics, and the environment, consequently creates different education, residential location, job status, ownership, property, and wealth for individuals in different places, resulting in the different spatial distribution of services and material and spiritual damages in different places according to the identity of the place and in parallel with the role of places in different urban areas, the spatial distribution in different dimensions of life decreases and increases. Unequal urban places provide unequal opportunities for citizens of different regions and increase the population of people in some places and decrease them in others, leading to unequal spatial distribution of potentials and harms. Welfare services, the formation and growth of slum and poor areas and the decline in deprivation in urban areas are the main consequences of inequality in urban areas [9]. The necessity and importance of research is that it states that differences in places create a situation in which socially valuable things such as wealth, power, social status, and cultural capital, are different. In fact, the role (identity) of place plays a key role in power of place and its empowerment.

2 Theoretical principles

The COVID-19 is an ongoing pandemic that is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [10].

Coronaviruses are a family of ribonucleic acid viruses. CoV infection is common in animals and humans. Some CoV particles are common between humans and animals, meaning they can be transmitted between animals and humans. In humans, the virus can cause diseases ranging from the common cold to more severe illnesses such as acute respiratory syndrome. In December 2019, human cases of pneumonia of unknown origin were reported in Wuhan, Hubei Province, China. Chinese authorities have

identified a new CoV as the trigger. Since then, almost every country has reported human cases, and COVID-19 has been declared an epidemic by the World Health Organization [11].

This disease traversed the international borders and entered other geographical spaces and all countries in a short time. The outbreak has spread rapidly around the world, the basic activities on which we all depend are deeply disrupted, and all human beings are endangered in terms of livelihood. In China, the outbreak coincided with *chunyun*, the annual period of mass migration for the Spring Festival holidays that was to begin on 25 January, 2020. To contain the outbreak, China implemented unprecedented intervention strategies on 23 January 2020. Whole cities were quarantined, the national holidays were extended, strict measures limiting travel and public gatherings were introduced, public spaces were closed, and rigorous temperature monitoring was implemented nationwide [10].

The diversity of infectious diseases and the study of effective factors in the disease epidemic and control parameters for such diseases are important factors that control the disease in the whole society. In some infectious diseases, transmission of the disease is possible through contact between the carrier and a healthy person [12]. In addition to the health system, other organizations and institutions are involved in the control and management of the epidemics [13]. The spread of the disease is therefore one of the oldest issues of human society that has been studied. In some parts of the world, such as Iran, the United States, the United Kingdom, and Italy, governments have done hesitant and unsystematic delayed reactions in temporal and spatial dimensions, causing COVID 19 to spread rapidly from the primary focus to other places and spaces within and outside the country and caused uncontrollable infection inside and outside the borders. One of the most effective ways to deal with this crisis is to obtain timely and accurate information (WTO). Discussion about the development of spatial planning patterns is important because it reflects the demands of different groups in society about space production activities. It is necessary to initially explain the concept of “space” and “place” and the perception of geographers of these concepts to some extent to explain the spatial distribution theory. “Place” as the focus of geography is actually the center of conscious and voluntary action of human beings. The concept of “space” entered the geographical literature with the article by Fred Kurt Schaefer in the 1950s on exceptionalism. Every objective reality has a specific location. The spatial distribution of objective realities are arranged in such a way that we can analyze and develop rules about them in terms of density, patterning and distribution. Dimensions of space are formed by the relative distance, direction and

position. The theme of a space along with the unequal distribution of natural and human phenomena causes mobility in society [14].

Since the 1970s, due to the rapid growth of urban population in most countries and the irregular increase of social harms, special attention has been paid to geographical and spatial studies. These results effectively help to prevent all kinds of social harms through more appropriate design of urban places, identifying the main focus and better control of these places and changing them to resilient and desirable places. For example, according to Sherman’s theory of “hotspots of crime”, it can be stated that the type of environmental activities affect the density of damage [15] and the activities in the place have a direct effect on the COVID-19 distribution. Because the conditions are provided for population density in some places, as a result population density is the main factor in the COVID-19 distribution. In spatial distribution, it is assumed that a phenomenon arises from a unique source and that heresy occurs only once. The theory of spatial dispersion was first proposed by Torsten Hagerstrand [16].

On the spread of various phenomena that impose severe socio-economic effects on a part of the geographical area and its people, Hagerstrand has raised several questions about this type of expansion and the stages of the phenomena distribution, some of which are as follows: How do geographical phenomena flow, displace or expand sufficiently between areas? Where are the main centers of these phenomena? What are the conditions of these centers? Why do phenomena spread in a certain direction? [17].

Hagerstrand believes that factors such as the distance between the source of information and innovation and their recipient, such as linguistic, ethnic, psychological, religious, political, pilgrimage, and cultural differences, prevent such a process. Based on the theory that applied geography is one of the most important steps in the process of geographical spatial analysis, the spatial distribution process is influenced by several factors. Some of these factors are: characteristics of the phenomena and the degree of their attractiveness, the quality of the expansion of phenomena, hotspot(s) of phenomena, population ready to accept with different fields of acceptance, different resistances of population to innovations or enthusiasm and their support of innovations and phenomena, the share of distance in the process of information distribution and the spread of phenomena, barriers to obtaining information in different places, the role of media and governments, the share of time in resisting or accepting phenomena and innovations among the population, the role of quality of communication, social structure and role of officials, selection and decision making [18]. Spatial distribution can be generally examined in terms of two dimensions (Fig. 1).

The results of Hagerstrand studies in European countries, especially in the United States, attracted the attention of many geographers and thinkers, and that theory was used in various fields and disciplines to explain the reason for phenomena spread. So that, the American geographer Robert McCool examined the theory on the origins of the Vietnam and Cuba Wars and the unrest in the black ghettos of the United States, and analyzed the characteristics of these protests according to the social and environmental conditions of these areas [19]. In this way, Radcliffe describes three types of spatial distribution models [20], which are referred to in (Fig. 2).

The starting point for data analysis in relation to various variables such as COVID-19 is derived from the relationship between Spatial features [21] and disease. Since the focus of people in a specific geographical area during a period is called critical points or areas, one of the important requirements for identifying critical points of the disease is to pay attention to the location and characteristics of the place. This concept has become important among urban thinkers and researchers in the last 15 years and it is currently considered as a valid achievement for dealing with social deviations and preventing social harms. Spatial transactions at critical points lead to the display of sensitive places on the map, and such maps accelerate the identification of the geographical location of critical points of the crime. The data sometimes depend on their placement in the place, and in fact their dependence is a function of their distance of placement. In fact, there is a direct relationship between the values of a variable and their distance and placement [22].

The spatial distribution of data related to different variables aims at determining the focus areas of events and how they are distributed in different places. One of the most important consequences of the rapid growth of urbanization and physical development of the cities in recent decades has been the disintegration of the

distribution system of city service centers, which has paved the way for social and spatial inequality among citizens in benefiting and balanced distribution of these services. This has not only made urban management difficult in providing public services, but also has made the efficient and effective management passive and contingent in the age of globalization. By evaluating the development of regions, their possibilities can be examined from different perspectives, such as the use of services, infrastructure and welfare, economic, service and infrastructure spaces, and the necessary tools can be provided to determine the goal and decide on resource allocation in less developed areas. Because, in the last half century, cities have provided unbalanced urban growth and development [23] due to urbanization and increasing population and suburbanization in metropolises, which is currently one of the most important aspects of global change [24].

Strengthening and emphasizing the role of spatial connection enables us to give each place a social, economic, or behavioral relationship. Therefore, explaining the role and type of places in the city helps in the occurrence of social harms, including infectious diseases. Since the occurrence of various types of social harms such as diseases on the one hand requires a favorable place and environment, the presence of some features in urban areas makes them proper places for the development of harm to citizens. As it can be said, the population of cities has increased, but the management that can meet their different demands is almost improper [25]. Whenever the effect of spatial distribution and physical environment on the promotion of safety and health and harm reduction is emphasized, the “defensible space” and “space syntax” theories show their significance. In the defensible space theory, Newman has emphasized the significance of the role of place and the controlled or uncontrolled presence of citizens for the occurrence of harm. Among these, three components of body, community and economy are significant [26]. In

Fig. 1 Spatial distribution dimensions

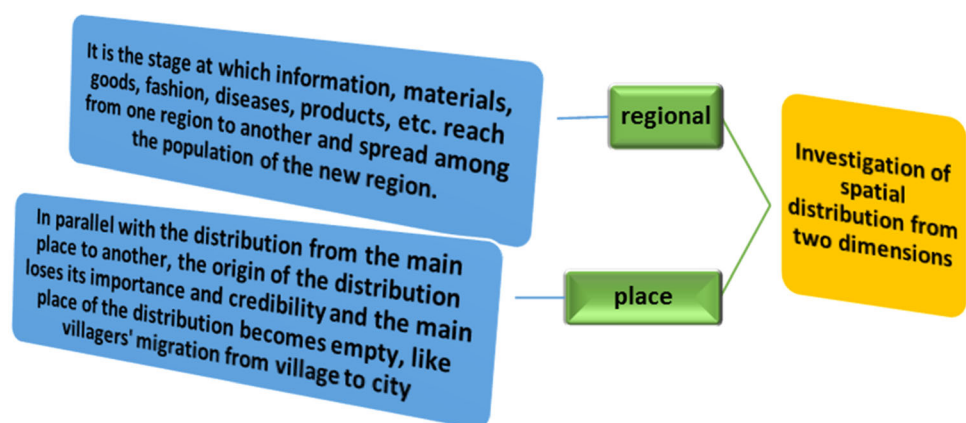
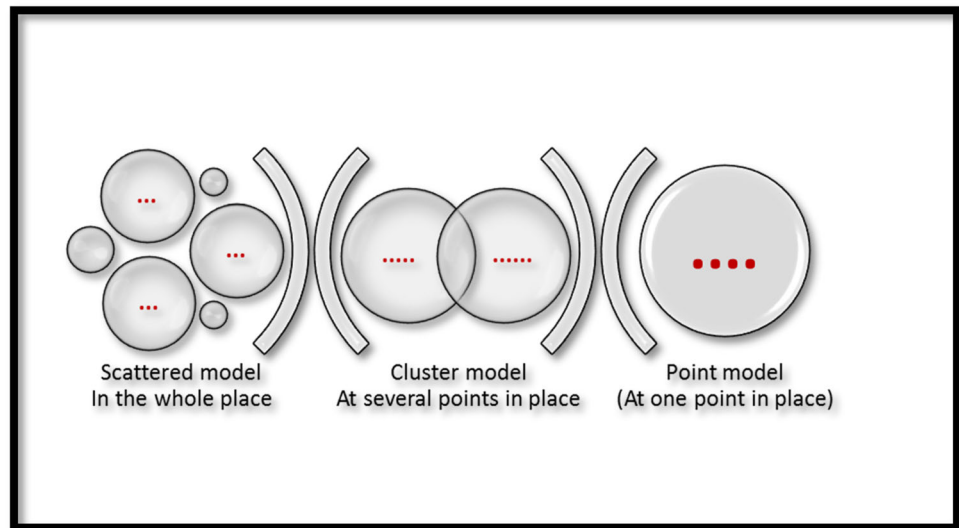


Fig. 2 Three types of spatial distribution models of phenomena in space



other words, in urban systems, economic, political and cultural factors are currently far more important than traditional factors such as geometry and distance.

In the late 1970s, Bill Hillier proposed the “place syntax” theory and method to recognize the spatial structure and configuration of the city, and based on that, he referred to the interaction of the structure of place, social organization and behaviors. This theory believes that the space and places in it are the core in the occurrence of social and cultural events. This means that place and the relationship between places define the movements, events and behaviors within it. However, since place is formed through social, cultural, and economic processes, it is usually considered a context for social and cultural activities and is assumed to be invisible (Fig. 3). In this regard, he believes that spatial and social forms follow such a close relationship that spatial configuration alone can define many social models such as land and housing price models, land use model, location of social damage etc. Thus, in analyzing the type of place and behavior of the audience in it, the important point is to consider the relationship between the place in a larger system [27]. According to Muir, for a geographer, trying to study a political-geographical phenomenon without sufficient attention to the political environment is similar to the study of morphologists of a landscape that considers the structure of the landscape regardless of the processes that shape these landscapes [28]. Proponents of the place grounded approach generally argue that the physical environment can be used to influence behavior properly, which reduces the incidence of social harm (such as disease) and thus identify the spatial distribution of the variable in question by considering the focus of the variable during the display process and determine the boundaries of density and focus at the city level [29]. Thus, it is tried to take measures to identify the

factors of this focus to provide appropriate strategies and policies to reduce or eliminate the effect of these factors, especially in the capital cities, and to prevent the occurrence of these incidents in the future. Also, from Cohen’s point of view, ecumenics are the most populous and active economic areas. They are traditionally known for their connection to dense transportation networks that indicate economic centralization [30]. But Cohen’s concern is to understand this system and to understand man and society and to act on the land that is occupied. In the meantime, the role of place is very important. In fact, it can be said that the place changes earlier than the region and both of them change sooner than the landscape. However, it is true that every aspect of the entire city system interacts with another aspect of it, in such a way that exchanges and political decisions reform the political structure and these change the values of society as the system rotates [31]

3 Methods

The metropolis of Tehran is the capital of Iran and capital of Tehran province. Tehran with an area of 730 km² in terms of geographical location is located between 51° and 3′ to 51° and 44′ east longitude (approximately 50 km) and 35° and 32′ to 35° and 56′ north latitude (approximately 30°). The city is located in the Mediterranean climate in the southern slopes of the Alborz highlands in the foothills to the plains where the slope is on the alluvial sediments of the fourth period from a height of 1.040 to 1.480 m above sea level [32]. Tehran region and city is spread in the width of two mountains and desert on the southern slopes of Alborz. Tehran zone opens to the plains of Shahriar and Varamin from the south and southwest and is surrounded by mountains in the north and east. The natural boundary

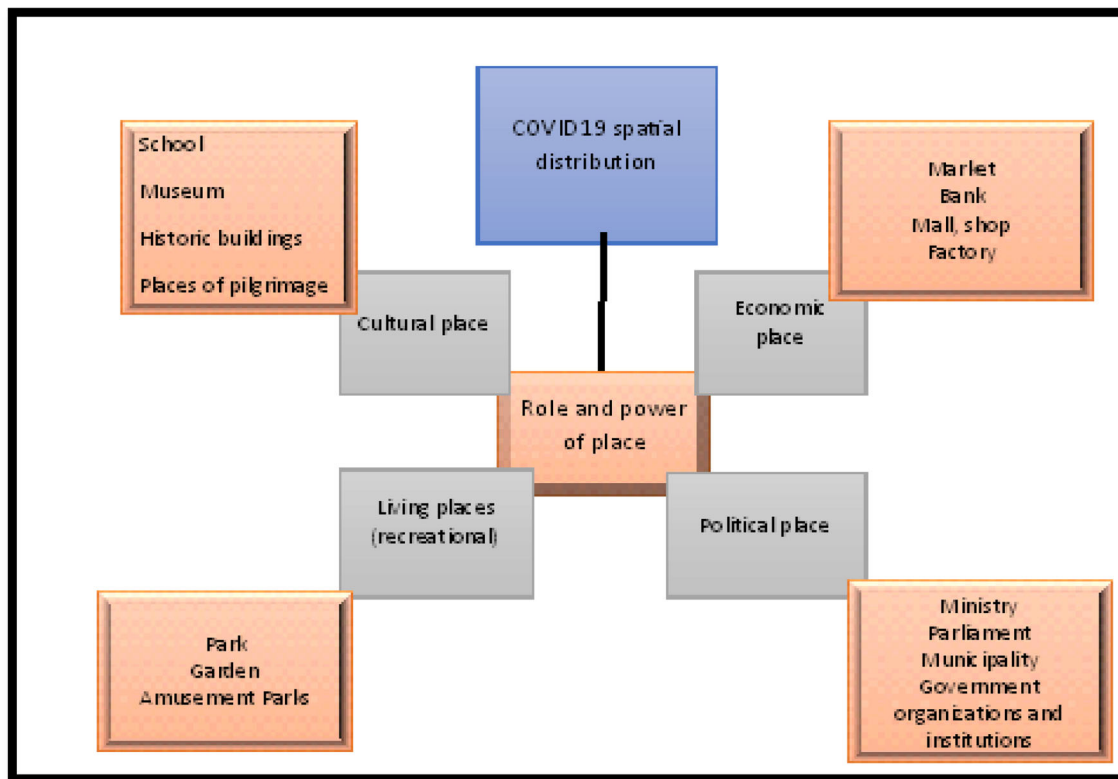


Fig. 3 Research model

of the geographical space of Tehran is determined both in the mountains and in the plain by two rivers, Jajroud and Karaj, which cut the central Alborz Mountain deeply in the northern wall of Tehran and divide it into three separate parts [33]. Tehran is the most populous city and capital of Iran and the capital of the province. With a population of 8693,706, it is the 15th most populous city in the world and the 28th largest city in the world in terms of population and the 125th metropolis of the world and the most populous city in West Asia. It is the second most populous metropolis in the Middle East. Tehran is divided into 22 districts (Fig. 4), 123 areas and 374 neighborhoods in terms of administrative divisions. Among the districts of Tehran, the highest area belongs to areas 1, 4 and 22 and the least area belongs to areas 10, 13 and 17 [34]. Tehran's performance as the capital since the second decade of the last century, i.e. since 1210, made it the center of economic, social, and cultural activities and the center of all executive policies and at the top of the urban hierarchy, it became the most important center of communication between the country and abroad and became the center of political and economic exchanges and relations as a result of cultural dynamics and integration in the world economy. Having more and more facilities, services and resources in Tehran accelerated the growth and expansion of the population and body of this city. The adverse consequences of the irregular

growth and expansion of Tehran are not limited to this city. Its effects extend far beyond the city limits. The transformation of villages around Tehran into cities and the integration of some of them to Tehran after being recognized and gaining legal identity as a driving force has led to the rapid growth of these villages, which can be referred to it as an epidemic of urbanism in comparison with the natural growth of cities. The Center for Statistics and Urban Monitoring of Tehran Municipality ICT Organization presented the population growth rate in 2018, in which used the last census conducted in 2016. This census is conducted every 5 years and its information is provided by the National Statistics Center. According to the information obtained, the population of the capital is 8 million 679 thousand 950 people, of which 4 million 364 thousand 754 are women and 4 million 315 thousand 205 are men. According to statistics provided by the National Statistics Center, the number of households in the capital is 2 million 907 thousand 24. Districts 4 and 5 have the highest and district 9 the least population density [35]. Tehran is the 15th most populous city in the world with an area of 730 km². In 2015, Tehran accounted for about 18% of the total population aged 10 and over. In general, the share of employment in the main economic sectors of Tehran in 2016 was more than 90%. The total price index of Tehran consumer goods and services in June 2017 was equal to

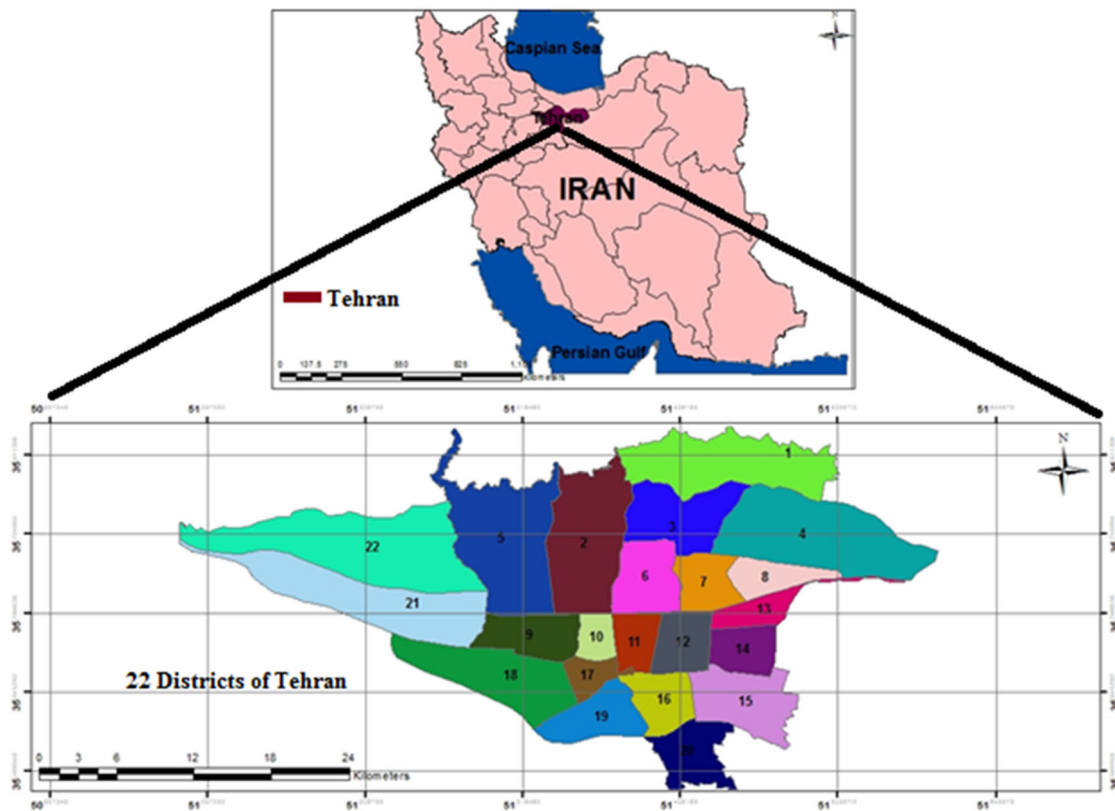


Fig. 4 Tehran metropolis and 22 Districts of Tehran, Iran

254.3. This index in June 2017 for the whole country is 267.3. In 2014, Tehran accounted for 23.6% of the country's gross domestic product. The share of various economic sectors in the value added of Tehran in the agricultural sector was 2.3 percent, the service sector was 76.7 percent and in the industrial, mining, construction, water, electricity and gas sectors was 21 percent. According to the latest statistics published by the Statistics Center of Iran, the value of GDP in Tehran province in 2014 was about 271 thousand billion tomans, which is 23.6 percent of GDP in the country [36].

Due to the sensitive situation of capital and the emphasis of the National Headquarter for Corona Disease Management, 425 new patients are admitted to the normal ward and 102 new cases to the intensive care unit in Tehran overnight, and the number of people admitted to hospitals and medical centers has grown by 8% and about 5% of those referred to medical centers and health centers were hospitalized [37]. It is necessary to study the role of various variables in reducing and increasing the prevalence of the disease to open a way to fight this crisis. The metropolis of Tehran is in coronavirus red zone. According to statistics provided by the Ministry of Health of Iran, since the beginning of October 2020, the number of patients in Iran has increased significantly, most of which are related to the

city of Tehran (the capital of the country). In total, by the end of October, the number of patients in Iran has reached 581,824[38]. Figure 1 shows the upward trend in the number of patients in Iran since October. (Fig. 5).

This is an exploratory research. It is applied in terms of objective and survey method is used in it. The statistical population are from 22 districts in Tehran. Based on random sampling method through Cochran's formula with an error level of 0.05%, 220 people were selected from citizens of all districts as statistical sample. In this study, the data collection tool is a researcher-made and archival (library-Internet) questionnaire. Data collection tools were interviews, questionnaires and research variables are measured based on the Likert scale. Questionnaires that are answered randomly by citizens are used to determine this correlation. The validity of the questionnaire has already been confirmed by experts and professors of the University of Tehran and its reliability has been confirmed by Cronbach's alpha test with 0.9%. The independent variables of the research are the various places and the dependent variable is the spatial distribution of COVID-19 in 22 districts in Tehran. Finally, the level of correlation between the COVID-19 spatial distribution index and the various places is measured through the Pearson correlation test And the significance level for the Pearson correlation test

Fig. 5 The upward trend in the number of patients in Iran, raw data

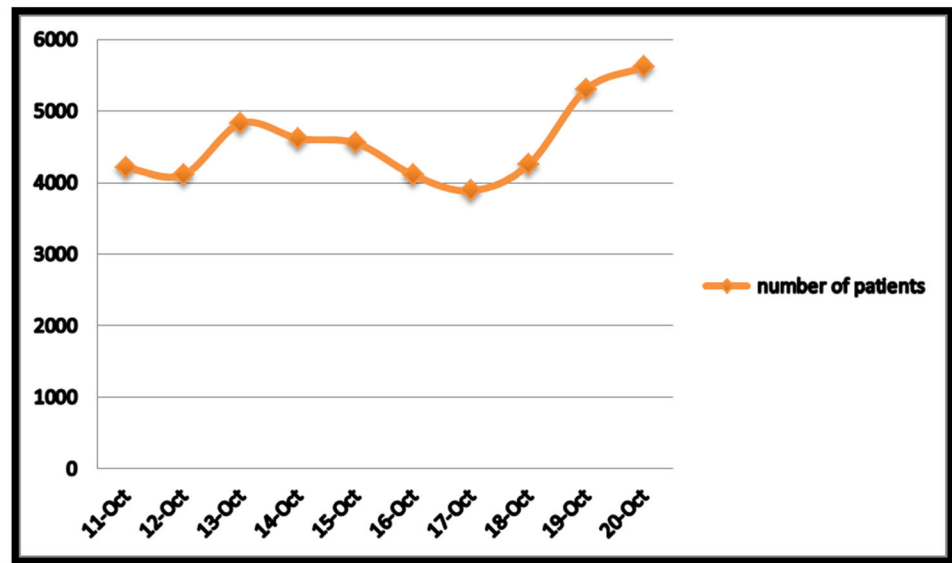


Table 1 Demographic characteristics of the statistical community

22 districts of Tehran	Population based on the 2016 census, the latest census in Iran(Million)	Area without privacy (sq. Km)
District 1	487,508	34
District 2	701,303	47
District 3	330,649	30
District 4	919,001	72
District 5	856,565	54
District 6	251,384	44
District 7	312,194	15
District 8	425,197	72
District 9	174,239	19
District 10	327,115	81
District 11	288,884	11
District 12	240,720	91
District 13	276,027	80
District 14	484,333	32
District 15	638,740	29
District 16	783,278	16
District 17	348,589	18
District 18	391,368	80
District 19	244,350	89
District 20	340,861	17
District 21	162,681	51
District 22	199,459	62
Total	8,679,950	730

(Statistics Center of Iran and Tehran Municipality)

Table 2 Questions and frequency distribution

Questions	Likert scale	Absolute frequency	Absolute frequency percentage
1- The effect of the market on the disease	Very little	5	2
	Little	17	8
	Average	21	10
	Much	83	37
	Very much	94	43
	Total	220	100
2- The effect of shrines on the disease	Very little	22	10
	Little	28	12
	Average	85	39
	Much	73	33
	Very much	12	6
	Total	220	100
3- The effect of training centers on the spread of the disease	Very little	8	4
	Little	12	6
	Average	93	42
	Much	64	29
	Very much	43	19
	Total	220	100
4. The effect of political institutions and organizations on the disease	Very little	4	2
	Little	9	4
	Average	31	14
	Much	106	48
	Very much	70	32
	Total	220	100
5. The effect of shops and malls on the disease	Very little	13	6
	Little	11	5
	Average	26	12
	Much	101	46
	Very much	69	31
	Total	220	100
6- The effect of parks and gardens on the disease	Very little	28	13
	Little	47	22
	Average	115	52
	Much	16	7
	Very much	14	6
	Total	220	100
7. The effect of banks on the disease	Very little	13	7
	Little	12	5
	Average	43	20
	Much	65	29
	Very much	87	39
	Total	220	100
8. The effect of stores on the disease	Very little	18	8
	Little	23	10
	Average	38	17
	Much	63	28
	Very much	78	37
	Total	220	100

Table 2 continued

Questions	Likert scale	Absolute frequency	Absolute frequency percentage
9- The effect of factories and industries on the disease	Very little	23	10
	Little	8	4
	Average	13	6
	Much	132	60
	Very much	44	20
	Total	220	100
10- The effect of the role of place in the disease	Very little	18	8
	Little	26	12
	Average	33	15
	Much	56	25
	Very much	87	40
	Total	220	100

is./8. Excel is also used to create a database, and Smart is used to draw figures and diagrams to better understand the concepts.

4 Analysis and results

In the present study, a questionnaire was designed with 10 questions to answer the question “Is the role and identity of place effective in the spatial distribution of COVID-19?” The questions of which examine the role or power of the place. Here, the statistical population of the 22 districts of Tehran is considered. A statistical sample of 220 elites and executive experts and citizens of different districts were asked with a questionnaire. Our statistical sample was randomly selected from among the citizens of Tehran. Of course, 60% of the selected people are men and 40% women (Tables 1, 2).

According to (Table 3), it can be said that the economic role of places is clear in almost all 22 districts, after that, the political and cultural roles are important, respectively. Therefore, the number of economic places is almost too many and the 3D role of production, distribution and consumption causes population density, and then we must seek to prove the research hypothesis according to the available statistics and statistical data of the questionnaire. That is, to prove the hypothesis that the place affects the spatial distribution of COVID-19, we conclude whether there is a positive or negative correlation between the variables with statistical analysis of correlation and t-test.

In the evaluation of the main indices, very little is the least score and very much is the highest score. Overall, the respondents had selected very much or much for the effect of the dependent variable from the independent (the role of places on the spatial transaction of COVID-19), which

means confirming the main indices related to the main hypothesis and also the compatibility of indices with the statistical community and in other words, the need for their consideration.

“Economic places” with an average of 43% and a frequency of 94 are among the main priorities of elites, professionals and citizens. After economic development, “political places” with an average of 48% and “cultural places” with an average of 6% are considered important by experts, respectively and “living places” with an average of 3% play the least role in the spread of the disease.

Statistical results show that in districts with more economic places, the incidence of coronavirus has been higher because economic places play a role in three production, distribution and consumption dimensions and have more power than other places in increasing and aggregation of population. They are therefore more prone to increase the spatial distribution of COVID-19 than other places. The results (Table 4) show that districts 11, 12 and 17 have the most economic places, and as a result, the number of people with coronavirus is higher in these districts. After economic places, the political places in districts 8 and 11 are in danger because these works has not been closed and they faced a high prevalence of disease. But among the 22 districts, district 8 has more political centers than others, and the incidence of the disease is in second priority (Fig. 6).

In order to test the main hypothesis and investigate the effect of the proposed indices (independent variable of place roles) on the spatial distribution of COVID-19 (dependent variable), multiple regression was used that addressed the indirect and general effects of places in addition to determining the linear composition of the relationship between variables. It is necessary to explain that this method of path analysis was performed to test and

Table 3 Spatial role of 22 districts of Tehran

22 districts of Tehran	The main role of place	Type of locations
District 1	Cultural	-The most important tourism hub -Residential settlement -Tajrish Bazaar -Higher education centers and medical institutions -Important shrines in Tehran
District 2	Residential	-Residential houses -Green spaces
District 3	Treatment and services	-The most important hospitals in Tehran such as Baqiyatallah, Valiasr and Mofid etc -Malls and cinemas -Schools -Ab va Atash park
District 4	Environmental and residential	-Eshraq Cultural Center -University of Science and Industry -Parks and forest areas -The lush valleys of Fasham, Oshan and Meygun
District 5	Cultural	-Amusement parks -Parks -Sports centers
District 6	Economic and cultural	-Central region of Tehran -Reputable national universities, University of Tehran -Valiasr Square Shopping Centers
District 7	Political	-Residential houses -Old textures -Several cultural centers and libraries
District 8	Residential	-Tehran Mosalla mosque -Several government ministries and agencies
District 9	Services	-International Airport -Worn textures
District 10	Recreational	-Dense tissues -Gardens and parks
District 11	Political	-Political and military centers -Health centers -Important economic centers
District 12	Cultural and economic	-Museums and historical buildings -Tehran Bazaar and Shopping Centers
District 13	Environmental	-Several villages -Worn textures
District 14	Services	-5 subway stations -green space
District 15	Residential	-Residential towns -Numerous green spaces
District 16	Economic Services	- South terminal and railway station - Multiple factories and warehouses - Customs
District 17	Residential Economic	-Local markets and vendors - Irregular alleys - A lot of old residential texture

Table 3 continued

22 districts of Tehran	The main role of place	Type of locations
District 18	Recreational and economic	- Kan River and green space - Factories and manufacturing industries
District 19	Recreational	Gardens Local parks
District 20	Economic Cultural	- Shrine of Sayyid al-Karim - Existence of local markets and shopping malls at reasonable prices - Several subway stations - Historical buildings
District 21	Cultural Economic	- Iran Cinema Town - Industrial and residential towns
District 22	Residential Sports	- Forest parks - Azadi Stadium

Table 4 Order of priority of districts and the role of districts in increasing the spatial distribution of COVID-19

No	Main role of district
1	District 17 with major economic role (many local markets)
2	District 11 with major economic role (Tehran Bazaar)
3	District 12 with major economic role
4	District 16 with major economic and service role
6	District 8 with major political role
7	Area 14 with major service role
8	District 6 with major economic and cultural role
9	District 9 service role

confirm the relationship between other indices related to key concepts of the research. This paper, sufficed to provide the test information of the main hypothesis. Based on the results of analysis of elites and specialists opinions in (Table 2), the spatial distribution of COVID-19 had a direct strong correlation with economic places with 88.8%.

The adjusted coefficient of determination also showed that 76.6% of the spatial distribution of COVID-19 was explained by political places. Finally, based on the standardized impact factor of independent variables on the dependent variable, the role and type of place had a statistically significant effect on the spatial distribution of COVID-19. Also, in terms of the impact factor of variables on the dependent variable, cultural sites with an impact factor of nearly 20% had little effect on the spread of the virus. The degree of perfect correlation was 1 and according to the effect of the dependent variable of

independent variables, we can prove or disprove the existing hypothesis and one of the important statistical analyzes in the field of geography is the use of kernel correlation coefficient test and t-test. (Table 5).

As a final step, the path analysis method were used to test the effectiveness of the dependent variable from independent variables (Fig. 7). Based on the data collected from the sample, the effect of the four places in 4 stages of path analysis and the effect of each indicator on other indicators were tested. Figure 7 shows the results of the final path analysis at the end of the fourth stage and the extent of direct and indirect effects of various places on the spatial distribution of COVID-19. According to the figure, it can be understood that the economic place has had the greatest impact on increasing the distribution of COVID-19 in Tehran.

5 Conclusions

The results showed that there was a direct relationship between the role of place or type of place and the spatial distribution of COVID-19 (Figs. 8, 9). In fact, the role of place initially led to population density or non-density, resulting in high population density and possibly an increase in people infected with COVID-19 (who may be carriers of the disease but have no signs of it) leading to severe disease spread. In fact, economic places such as banks, markets and shops are facing a higher population density and the disease is more likely to spread in these places. Next, political places such as governmental offices, ministries and parliaments, despite the large manpower and

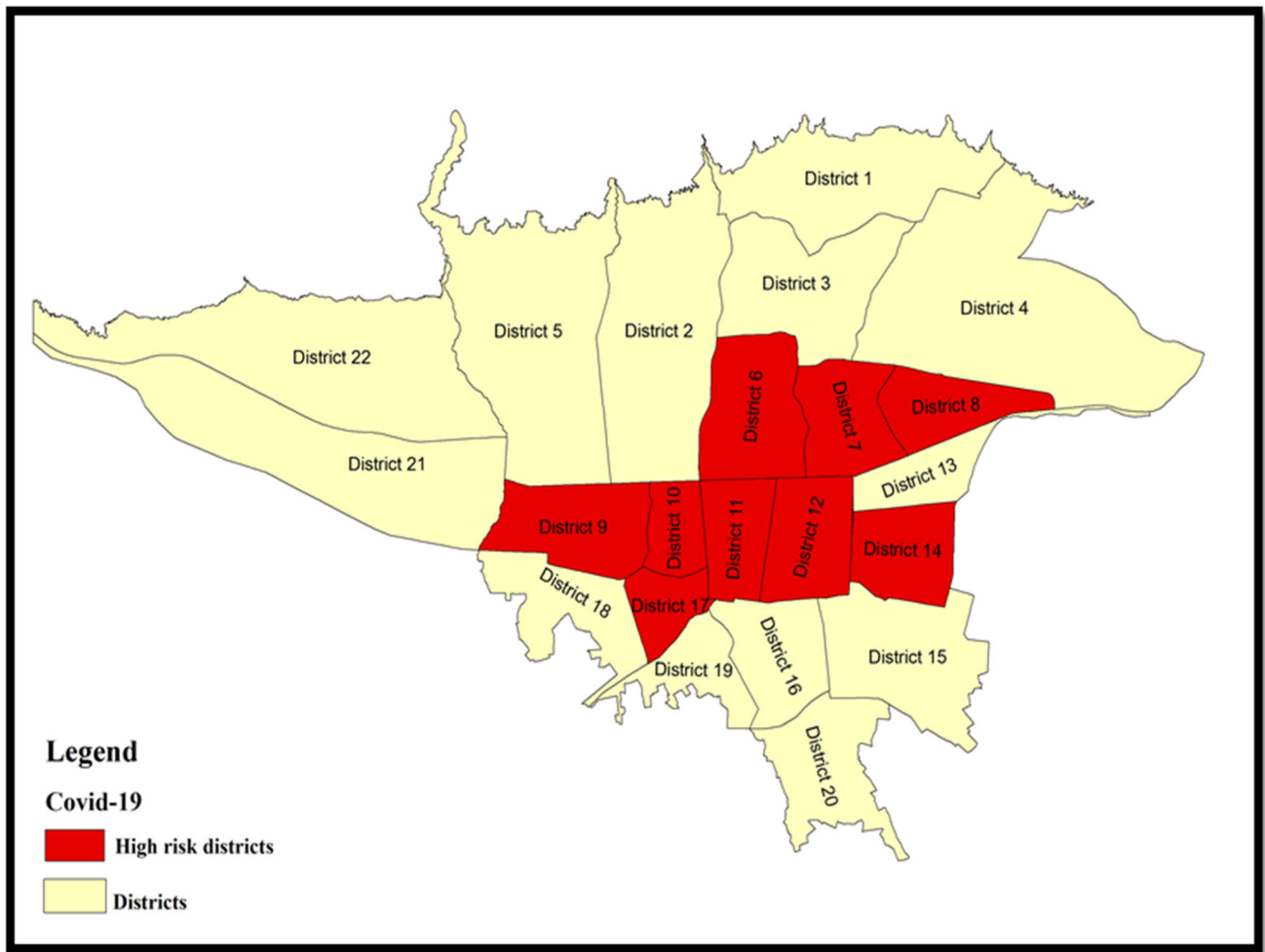


Fig. 6 Map of 9 economic districts in the red state of Corona

Table 5 Regression analysis of effectiveness, relationship and intensity coefficients of the role of place on the distribution of COVID-19

Standard estimation error	Adjusted coefficient of determination	Correlation value			
0.134	0.766	0.888			
Components	Sum of squares	DOF	Mean squares	F statistics	Significance level
Regression effect	2.469				
Residual	0.661				
Total	41				
Variable name	Non-standard coefficient Error B	Standardized coefficient	T	Significance level	
Fixed coefficient	0.913	0.110	0.276	0.030
Economic place	.001	3.774	0.327	0.065	0.244
Political place	.004	3.088	0.227	0.074	0.227
Cultural place	.000	7.633	0.599	0.043	0.332
Living place	.027	2.296	0.189	0.077	0.170

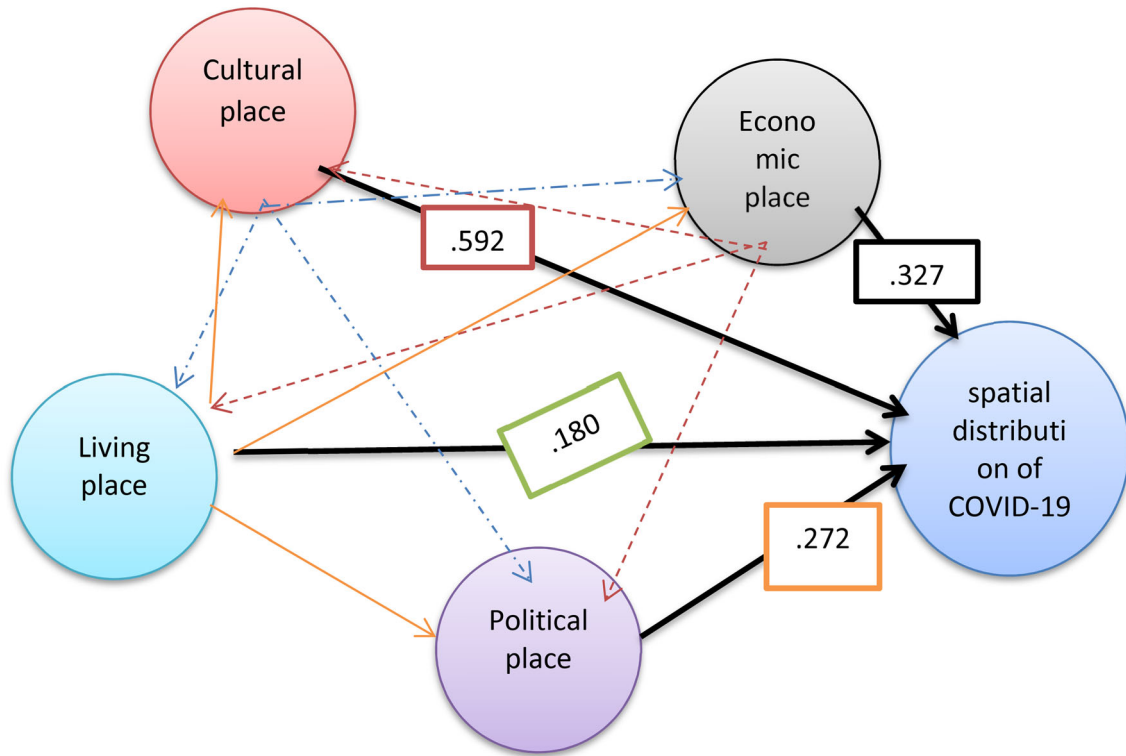


Fig. 7 Path analysis of the effect intensity

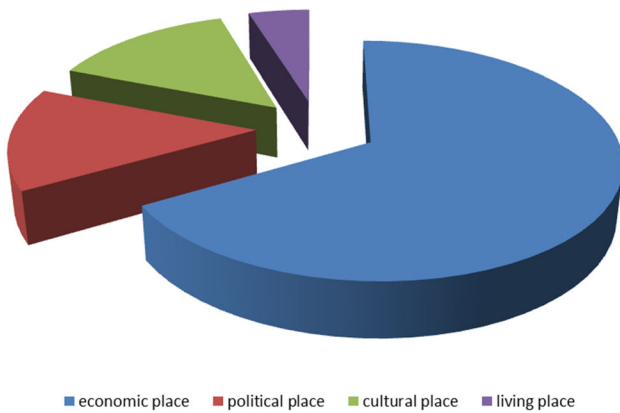
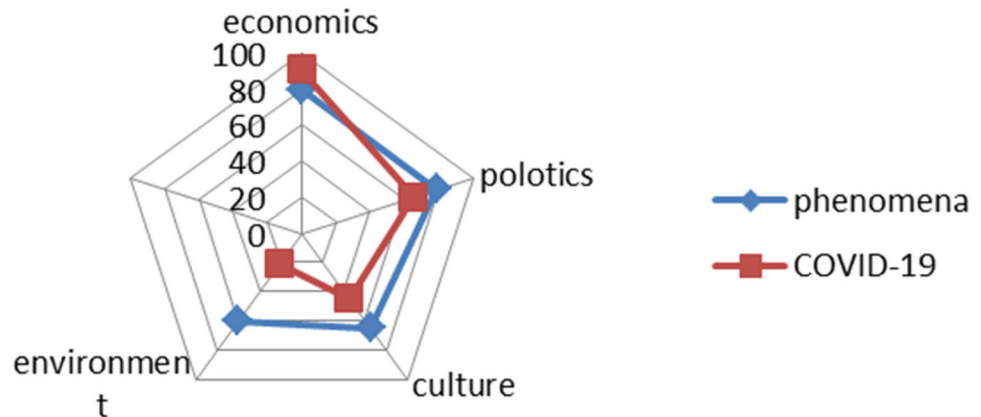


Fig. 8 The effect of role of place on COVID-19 distribution in 22 districts of Tehran

no closure, and police stations, barracks and checkpoints in different parts of Tehran are the second center of population density and the number of COVID-infected patients is more in them than organization with less people working in it. The third center of the disease are cultural and service

places such as places of pilgrimage, places of Friday prayers and libraries, etc. The environment and low population density face a small percentage of the spread of the disease, such as mountains, parks and gardens and the recreational places. Regarding the metropolis of Tehran, with the increase of the city’s population and the expansion of different places, inappropriate distribution of urban land use, uneven inflow in the northern and southern parts of Tehran, which gives the city an unbalanced appearance and causes weak social stratification and it has disrupted the urban texture in terms of spatial-physical structure. If left unsolved, consequences of continuing the status quo will lead to aggravation of problems. In fact, this research led to the presentation of the theory of “the role of place in the spatial distribution of phenomena”, whether problems or opportunities. The virus originally originated from the mother of the world economy, China, and spread due to the distribution of Chinese goods in countries around the world, and this shows that the economic role of the place in the distribution of phenomena (positive or negative) is very important.

Fig. 9 The effect of economics, politics, culture and environment on the phenomena and extent of COVID-19



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