

A GEOSPATIAL ANALYSIS OF THE PARKS, EMERGENCY ASSEMBLY AREAS, AND URBAN GREEN SPACES IN IZMIR DISTRICTS

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ABSTRACT

Ensuring equity in the allocation of public resources is a central objective for planners. In the context of planning, equitable distribution involves strategically placing resources or facilities to maximize accessibility for a diverse range of spatially distinct social groups. Equity in resource distribution has been a focal point of interest across numerous disciplines. The equity mapping method, which utilizes visualization techniques within geographic information systems (GIS), serves as a valuable tool for analyzing the spatial equity in the distribution of public resources. In this study, equity mapping was applied to parks, green spaces, and emergency assembly areas - resources of significant societal importance - to evaluate individual accessibility to these public facilities. The fundamental methodological approach to equity mapping involves overlaying the distribution of accessibility measures with socioeconomic data to analyze spatial variations in equity. This approach relies on spatial univariate, bivariate, or multivariate analysis, which examines the mapped data distributions and spatial patterns to identify and characterize spatial associations. The study answers eight research questions: (1) the number of emergency assembly areas per capita by district, (2) the number of children's playgrounds per capita among the population aged 0-19 by district, (3) the number of fitness areas per capita among the population aged 20 and above by district, (4) the amount of urban green space per capita among the entire population by district, (5) the distance of the nearest emergency assembly area to the district center, (6) the distance of the nearest emergency assembly area to the neighborhood center, (7) the number of parks within reach of the neighborhood center, (8) number of parks within 1 km of buildings on a district basis. Obtained fundamental patterns of inequity in the distribution of focused public resources in the study may help the municipalities better understand the current situation, make plans for the following years and ensure a more equitable distribution of public resources.

Keywords: Equity Mapping; Geographical Information Systems; Environmental Justice; Spatial Analysis.

INTRODUCTION

The equal and fair distribution of public resources to the citizens is of great importance both to the government and the public. Planners who plan the distribution of public resources should carry out their work in a way that spatially defined social groups can easily access and benefit from in order to obtain the highest benefit from the resources. At this point, it is important to explain the concept of "fair distribution". Determining whether a fair distribution has been made brings to the agenda the question of "how is justice measured?" While the measurement of justice determines the methodology to be used in the distribution of resources, concepts such as who should benefit from the resources and social justice also bring some value judgments to this methodology (Talen, 1998). Public resources are part of the income of all individuals in society. Accordingly, ensuring a fair spatial distribution of public resources will directly affect the distribution of public welfare (Pahl 1971; Harvey 2010). The concept of urban planning, in which spatial and geographic information

constitutes an important input, is defined as «the technical, social and political process related to the design, development and maintenance of land use in an urban environment» (Maarseveen, Martinez J & Flacke J, 2019). Urban planning has become a lexicon of urban planning, especially in developed countries, where green areas have been permanently integrated into policies and urban practices (Allouche & Negm, 2021). Environmental problems that have reached critical dimensions in recent years and the problem of over-sprawl of urban areas necessitate planners to take nature into account in the design and management of urban environments. Green areas are now important areas not only for hygiene and aesthetic reasons, but also for improving the quality of life of the population (Clergeau, 2008; Donadieu 2013). The presence of green areas, parks and gardens in cities limits urban sprawl and plays a critical role in public health (Laille, Provendier & Colson, 2013).

In order to ensure that public resources are distributed fairly, the spatial equality of the distribution can be analyzed with Geographic Information Systems. Urban planning is one of the main applications of GIS, which is increasingly becoming an important component of planning support systems (Yeh, 1999). The equity mapping method, which utilizes visualization techniques within geographic information systems (GIS), serves as a valuable tool for analyzing the spatial equity in the distribution of public resources. In Geographic Information Systems, public resources can be represented visually and spatially, and public demographic characteristics can be represented both spatially and as attribute data, and equity maps can be created on the subject. The equity maps to be produced regarding the distribution of public resources provide an opportunity to solve the problem by revealing the spatial inconsistencies between resource needs and resource distribution (Talen, 1998).

In this study, equity mapping was applied to parks, green spaces, and emergency assembly areas - resources of significant societal importance - to evaluate individual accessibility to these public facilities. The fundamental methodological approach to equity mapping involves overlaying the distribution of accessibility measures with socioeconomic data to analyze spatial variations in equity. This approach relies on spatial univariate, bivariate, or multivariate analysis, which examines the mapped data distributions and spatial patterns to identify and characterize spatial associations.

CONCEPTUAL FRAMEWORK

Geographical Information Systems

A general definition of Geographic Information Systems can be as follows (Chen, 1999): "An information system that consists of computers, geographic data and users, that produces and outputs various geographic information through geographic data integration, storage, retrieval, processing and analysis, and that provides new information for land use, resource management, environmental monitoring, transportation, economic construction, urban planning and government management, and serves engineering design, planning, management and decision-making." Based on this definition, it can be said that GIS is a computer system that deals with location data on the earth's surface and attribute data related to these locations. GIS is an interdisciplinary subject based on natural geography, cartography, surveying, remote sensing, graphics and images, and computer application technology (Li Deren, 1997). GIS is used in many different fields such as agriculture, forestry, resource & environment management, investigations, evaluations & predictions of mineral resources, hydrology & water conservancy, urban planning & management, disaster assessment & prediction, e-government affairs and public service applications. Among these areas, resource & environment management, urban planning & management, disaster assessment & prediction, e-government affairs are the areas directly related to the subject of the presented study (Wang, 2021).

Many applications have been carried out in China in recent years regarding the use of GIS technique in urban management. With GIS management systems established within the scope of many cities such as Beijing, Shanghai and Tianjin, solutions have been provided in land planning & management, resource use planning & management, environmental planning & management, urban planning & management and traffic management & control. The concept of "inter-city GIS" was also first proposed in a GIS forum held in China. It is suggested that studies be carried out on providing control and management with GIS technique in densely populated cities with inter-city GIS (Wang, 2021).

GIS technology is widely used in disaster monitoring, disaster prediction, disaster aid, emergency rescue and post-disaster recovery studies. For example, GIS technique can be used in planning the easy transportation of citizens to assembly areas after an earthquake and in delivering aid to citizens in an equal and fair manner (Wang, 2021).

The GIS technique can also be used in traffic management, monitoring and planning. For example, the GIS technique can be used in querying city bus lines and stops, city trip planning, real-time road status query, and access to public transportation facilities (Wang, 2021).

Equity Mapping

Equity mapping is a method that allows the accessibility of a certain resource to be questioned and analyzed from different points. In equity mapping, both spatial and attribute data can be used to reveal inequalities and injustices in accessibility. In a study conducted for Los Angeles in the literature, children and youth were questioned about their access to parks according to their race, ethnicity and socioeconomic status (Wolch, Wilson & Fehrenbach, 2005). As a result of the analysis, it was determined that low-income and densely poor areas, as well as neighborhoods dominated by Latinos, African Americans and Asian Pacific Islanders, had significantly lower levels of access to parks than the white-dominated areas of the city.

Following an equal and fair path in the distribution of resources requires the collaboration of many disciplines (Talen, 1998). The criteria used by researchers working in different disciplines on this subject also vary depending on their fields. For example, in resource sharing analysis, many criteria such as political preferences, government structure, financial requirements, service management, and political outcomes can be included in this process. For the purpose of analyzing the distribution of public resources, spatial criteria and a limited number of demographic characteristics were used within the scope of this study. Other criteria are outside the scope of the study.

In the concept of equality regarding the planning of local services, five criteria are generally observed: equality, need, demand, preference and willingness to pay (Lucy, 1981). Equal distribution is defined as equality where all citizens can receive the same public benefit regardless of criteria such as socioeconomic status and willingness to pay. Equality in the distribution of public benefits can also be distributed according to the individual needs of citizens. This situation is defined as "compensatory" equality and ensures "unequal treatment of unequals". Public services and resources can also be distributed fairly according to demand. In this distribution, the principle of providing the relevant service as a priority to the location with the highest need is observed. In another equal distribution method, the cost of the service is taken into account (Talen, 1998). Population and age data were used to analyze the distribution of resources considered within the scope of the presented study.

For equality mapping, the distribution of accessibility criteria and the distribution of socioeconomic data are mapped. While creating equality maps, three different variables are used: location information, population and housing characteristics, and facility characteristics. By adding these variables to the project, citizens' access distance to public services (for example, access distance to parks and green areas), socioeconomic data, and attribute

information regarding public services can be analyzed and queries can be made depending on the location (Talen- 1998).

When conducting a needs-based equality analysis, the spatial distribution of public services according to the locations of different socioeconomic groups is examined. These two concepts are related to each other by measuring the accessibility values between public services and population groups. Accessibility can be measured in different ways. The methods used for this purpose in the literature are the gravity potential formula, travel cost, covering objectives, and minimum distance measurement methods. Within the scope of the presented study, minimum distance (and access time cost) and covering objectives methods were used.

In the "Covering Objectives" model, a critical distance (covering radius) is defined and a buffer area with this radius is created around the relevant service points or citizens' locations. The number of services that the relevant citizen or citizens can access can be reached by counting the number of service points included in this area. By defining buffer zones around service points, information can be reached on how many citizens can access that service point. In the "Minimum Distance" model, the routes that citizens can reach the service point in the shortest distance and time are taken into account. The main objective in this model is to provide fair access by minimizing the access time for all citizens.

METHODOLOGY

Data Collection and Dataset Introduction

The data to be used in the study were obtained from the Izmir Metropolitan Municipality open data portal (Izmir Metropolitan Municipality Open Data Portal), the open spatial data portal OpenStreetMap (Open Street Map) and Google Maps (Google Maps). Location data (for example, park locations) that were not available in the data obtained from the Izmir Metropolitan Municipality open data portal were obtained by querying Google Maps and included in the study in this way. Two main data types were used in the study: spatial and attribute data. Spatial data consists of Izmir's provincial boundaries, district boundaries, district and neighborhood settlement points, emergency assembly area locations, park locations, and building polygons. Attribute data consists of district- and neighborhood-level population data, population data for the 0–19 age group, population data for individuals aged 20 and above, district-level urban green space data, the number of children's playgrounds, the number of fitness areas, district names, and neighborhood names. The majority of the data was sourced from the Izmir Metropolitan Municipality's open data portal and OpenStreetMap open data portal, while inaccessible data was manually collected using Google Maps. The GIS application was developed with the open-source Quantum GIS (QGIS) application. The acquired data was transferred to the QGIS environment, spatial data - attribute matching was performed, and the data was made ready for spatial queries and attribute queries. Figure 1 presents the view obtained with the study area and spatial and attribute data imported into the QGIS environment.

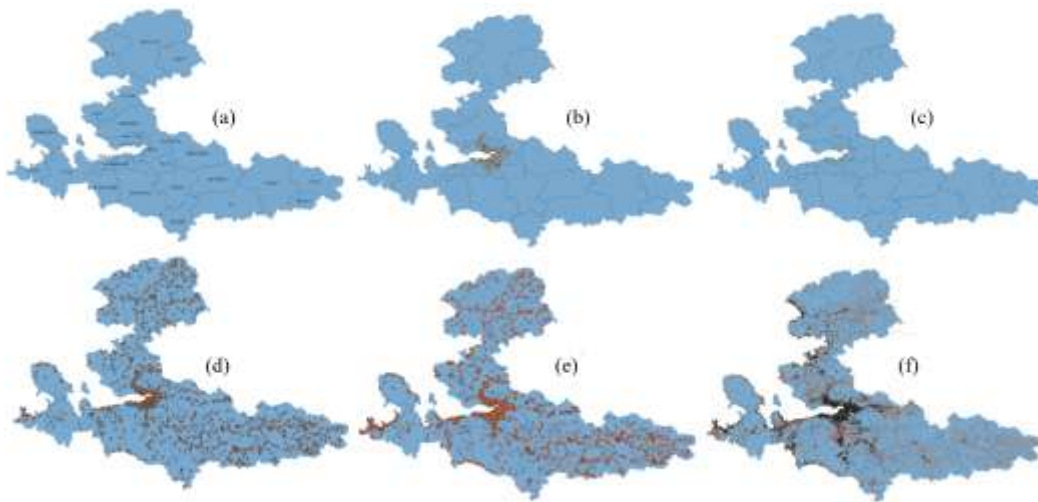


Figure 1 Study Area (a: Izmir city and district boundaries, b: park locations, c: district settlement point, d: neighbor settlement point, e: emergency assembly area locations, f: Izmir road lines and building polygons)

Spatial Analysis, Statistics, and Equity Mapping

The spatial analyses used in the study were performed with functions such as investigating the points remaining within the polygon and the total number of points, calculating the closest point and the shortest distance in another layer for each point in a certain layer, creating buffer regions of 1 km around the focused points, and investigating the points and the total number of points remaining within these buffer regions.

At this point, it is also important to define the concept of “accessibility”. There are many definitions in the literature regarding spatial accessibility. Considering these definitions, accessibility can be defined as “places within a distance where neighborhood residents can easily go and return with their children on a regular basis without using a vehicle every day”. For this, the average distance accepted in the literature is places with an average distance of 1 mile, with a quarter mile going and a quarter mile returning. Within the scope of the study, this distance was taken as 1 kilometer, with a half kilometer going and a half kilometer returning. In order to find the number of accessible parks on a neighborhood basis, 1 kilometer diameter buffer zones were created around the neighborhood centers and the number of parks within these buffers were obtained through spatial queries.

In this section, the methods applied to answer the research questions focused on in the study are explained separately for each research question: (1) the number of emergency assembly areas per capita by district, (2) the number of children's playgrounds per capita among the population aged 0-19 by district, (3) the number of fitness areas per capita among the population aged 20 and above by district, (4) the amount of urban green space per capita among the entire population by district, (5) the distance of the nearest emergency assembly area to the district center, (6) the distance of the nearest emergency assembly area to the neighborhood center, (7) the number of parks within reach of the neighborhood center, (8) number of parks within 1 km of buildings on a district basis.

(1) *The number of emergency assembly areas per capita by district:* Emergency assembly areas were shared as point data, district borders as polygon data. By overlapping the two layers, the first analysis was performed by calculating the points within the district polygons and the total number of points.

(2) *The number of children's playgrounds per capita among the population aged 0-19 by district:* Children's playground data was shared as point data and district borders as polygon data. Population data is an attribute data related to the district layer. It is possible to access population data as 0-19 age range data and 20 and above age range data. By overlapping the two layers, children's playground points within the district polygons and the total number of park areas were calculated. During the analysis of children's areas, the 0-19 age range was

taken as basis and the number of playgrounds per population was calculated on a district basis.

(3) *The number of fitness areas per capita among the population aged 20 and above by district:* The number of fitness areas data was shared as point data and district borders as polygon data. Population data is an attribute data related to the district layer. The number of fitness areas within the district polygons was calculated by overlapping the two layers. Considering that fitness areas are generally used by the population aged 20 and over, the population aged 20 and over was taken as the basis during this analysis and the number of fitness areas per population was calculated on a district basis.

(4) *The amount of urban green space per capita among the entire population by district:* The amount of green space is shared as amount of space on the basis of parks. Total amount of green space is an attribute data related to park point data. Two layers are overlapped using the attribute fusion method and parks within that district are found for each district and total amount of green space in these parks is calculated cumulatively. Assuming that green spaces are used by the entire population, the total amount of green space on the basis of district is divided by total population value.

(5) *The distance of the nearest emergency assembly area to the district center:* District center data and emergency assembly area data are available as point vector layers. For each district center, the emergency assembly area point closest to the district center was found and the distance between these two points was calculated.

Table 1 presents the results of the first five analyses. Park, playground, and fitness area data are not available for the districts of Çeşme, Karaburun, Dikili, Foça, Beydağ, Aliğa, Ödemiş, Bergama, Bayındır, Kemalpaşa, Kınık, Selçuk, Seferihisar, Tire, Torbalı, Menderes, Kiraz and Urla in the Izmir Metropolitan Municipality open data portal. This is the reason why zero values are observed for these districts in the table.

Table 1 The results of the first five analyses. 1: the number of emergency assembly areas, 2.1: the number of children's playgrounds, 2.2: number of playgrounds per child, 3.1: the number of fitness areas, 3.2: number of fitness areas per adult, 4: the amount of urban green space, 5: the distance of the nearest emergency assembly area.

DISTRICT	1	2.1	2.2	3.1	3.2	4	5
ALIAGA	57	23	0.00084487	0	0	379	1.67658805
BALCOVA	23	6	0.00041037	3	4.7461E-05	16	11.2269019
BAYINDIR	77	3	0.00030921	0	0	548	0
BAYRAKLI	132	21	0.0002842	16	7.0467E-05	30	1.42666698
BERGAMA	139	12	0.00049038	0	0	1544	0
BEYDAG	37	5	0.00201939	0	0	172	0
BORNOVA	73	28	0.00025918	14	4.1234E-05	220	2.7204063
BUCA	108	30	0.00022832	19	4.8458E-05	178	5.7308E-05
CESME	127	37	0.00374646	0	0	285	0
CIGLI	101	35	0.00070877	26	0.00015682	139	18.2186205
DIKILI	41	27	0.00330033	0	0	534	0
FOCA	51	17	0.00286726	0	0	251	0
GAZIEMIR	41	5	0.00014167	4	3.9034E-05	70	0.6147654
GUZELBAHÇE	64	3	0.00034638	1	3.4033E-05	77	1.69827042
KARABAGLAR	110	16	0.00013566	9	2.51E-05	89	0.78772298
KARABURUN	23	7	0.00363636	0	0	421	0
KARSIYAKA	119	23	0.00034991	12	4.3458E-05	51	1.5309764
KEMALPASA	164	10	0.000309	0	0	681	0
KINIK	57	2	0.00024756	0	0	479	0
KIRAZ	64	1	9.3537E-05	0	0	573	0
KONAK	67	128	0.00187001	123	0.00047518	24	3.50888176
MENDERES	71	3	0.00011306	0	0	777	0
MENEMEN	108	3	5.0639E-05	3	2.0201E-05	573	0.1193417
NARLIDERE	66	4	0.00033512	1	1.9916E-05	50	1.32417777
ODEMIS	152	15	0.00051363	0	0	1019	0
SEFERIHISAR	36	2	0.00016708	0	0	275	0
SELCUK	35	2	0.00022459	0	0	317	0
TIRE	107	3	0.00014541	0	0	716	0
TORBALI	101	9	0.00014222	0	0	577	0
URLA	76	1	6.7604E-05	0	0	727	0

(6) The distance of the nearest emergency assembly area to the neighborhood center: Neighborhood center data is not available in the Izmir Metropolitan Municipality data portal. Considering that the mukhtar offices are generally located in neighborhood centers, the mukhtar office locations were used as neighborhood centers. The locations of the mukhtar offices were accessed from Google Maps. For each neighborhood center, the emergency assembly area point closest to this neighborhood center was found and the distance between these two points was calculated. As a result of the process, the shortest distance data for 1286 neighborhoods was obtained. Since it is not possible to present the entire result as a table, only the first 20 neighborhoods with the shortest distance are shown in Table 2.

Table 2 The results of the sixth analysis

DISTRICT	NEIGHBOURHOOD	EM. ASS. AREA NAME	DISTANCE
KEMALPASA	HALILBEYLI	1 NO'LU AFET VE ACIL DURUM TOPLANMA ALANI	0.002863463
KINK	CUMALI	1 NO'LU AFET VE ACIL DURUM TOPLANMA ALANI	0.006425944
FOCA	YENIKOY	1 NO'LU AFET VE ACIL DURUM TOPLANMA ALANI	0.008818016
KEMALPASA	DEREKOY	2 NO'LU AFET VE ACIL DURUM TOPLANMA ALANI	0.008931351
BERGAMA	INESIR	1 NO'LU AFET VE ACIL DURUM TOPLANMA ALANI	0.009447507
BERGAMA	TIRMANLAR	1 NO'LU AFET VE ACIL DURUM TOPLANMA ALANI	0.01199063
KARABURUN	INECIK	1 NO'LU AFET VE ACIL DURUM TOPLANMA ALANI	0.012857425
TIRE	DALLIK	1 NO'LU AFET VE ACIL DURUM TOPLANMA ALANI	0.013035257
MENDERES	CATALCA	1 NO'LU AFET VE ACIL DURUM TOPLANMA ALANI	0.013322491
SELÇUK	ISABEY	1 NO'LU AFET VE ACIL DURUM TOPLANMA ALANI	0.013738585
ODEMIS	CAGLAYAN	1 NO'LU AFET VE ACIL DURUM TOPLANMA ALANI	0.014529099
ODEMIS	KURE	1 NO'LU AFET VE ACIL DURUM TOPLANMA ALANI	0.014992254
BORNOVA	ALTINDAG	2 NO'LU AFET VE ACIL DURUM TOPLANMA ALANI	0.015818028
BORNOVA	SARNICKOY	1 NO'LU AFET VE ACIL DURUM TOPLANMA ALANI	0.01589083
KARABAGLAR	DOGANCAV	4 NO'LU AFET VE ACIL DURUM TOPLANMA ALANI	0.015947892
BAYINDIR	KIZILCAOVA	1 NO'LU AFET VE ACIL DURUM TOPLANMA ALANI	0.016840735
BERGAMA	KOCAKOY	1 NO'LU AFET VE ACIL DURUM TOPLANMA ALANI	0.017273498
KINK	KARADERE	1 NO'LU AFET VE ACIL DURUM TOPLANMA ALANI	0.01736063
KEMALPASA	CUMALI	1 NO'LU AFET VE ACIL DURUM TOPLANMA ALANI	0.018086911
CIGLI	BALATICIK	10 NO'LU AFET VE ACIL DURUM TOPLANMA ALANI	0.018375836

(7) *The number of parks within reach of the neighborhood center:* For this analysis, buffer zones with a radius of 500 meters were created around the neighborhood centers. These buffer zones allow the querying of points that are within 1 kilometer reachability to the neighborhood center. Then, the total number of parks and the total number of children's areas within these buffer zones were calculated. Since it is not possible to present the entire result as a table, the top 20 neighborhoods with the highest number of parks and playgrounds are shown in Table 3.

Table 3 The results of the seventh analysis

NEIGHBOURHOOD	DISTRICT	NUMBER OF PARKS	NEIGHBOURHOOD	DISTRICT	NUMBER OF PLAYGROUND
AHMET TANER KISLALI	CIGLI	7	EMEK	BAYRAKLI	5
EVKA 2	CIGLI	6	FUADEDIPBOKSI	BAYRAKLI	5
AYDINLIKEVLER	CIGLI	5	AHMET TANER KISLALI	CIGLI	5
CAKABEY	KONAK	5	ALPARSLAN	BAYRAKLI	4
GUZELYALI	KONAK	5	CENGELHAN	BAYRAKLI	4
EMEK	BAYRAKLI	4	AYDINLIKEVLER	CIGLI	4
ATATURK	BUCA	4	EVKA 2	CIGLI	4
INONU	CIGLI	4	INONU	CIGLI	4
CANKAYA	KONAK	4	ADATEPE	BUCA	3
FATHI	KONAK	4	ATATURK	BUCA	3
FEVZIPASA	KONAK	4	CAGDAS	CIGLI	3
GUNGOR	KONAK	4	EVKA 5	CIGLI	3
SUMER	KONAK	4	BOZKURT	KONAK	3
YILDIZ	KONAK	4	CAKABEY	KONAK	3
CAGDAS	CIGLI	3	FATHI	KONAK	3
ESENYALI	KARABAGLAR	3	GUNGOR	KONAK	3
ALSANCAK	KONAK	3	NAMIK KEMAL	KONAK	3
BOZKURT	KONAK	3	ODUNKAPI	KONAK	3
DAYIEMIR	KONAK	3	SELÇUK	KONAK	3
MITHATPASA	KONAK	3	SUMER	KONAK	3

(8) *Number of parks within 1 km of buildings on a district basis:* Building data was obtained from the OpenStreetMap data portal. OpenStreetMap presents building information as polygon data. In the first stage for this analysis, point data showing the centers of building polygons were produced. Then, a 500-meter buffer zone was created around each building center. This zone represents an accessible area (1 kilometer area) for each building. In the last step, the total number of parks and children's playgrounds within each buffer zone was calculated. Since it is not possible to present the entire result as a table, the top 20 buildings with the highest number of parks and playgrounds are shown in Table 4.

RESULTS

The findings are explained separately for the eight analyses performed.

(1) *The number of emergency assembly areas per capita by district:* The district with the largest number of emergency assembly areas is Kemalpaşa with 164 assembly areas. The district with the smallest number of emergency assembly areas is Balçova with 23 assembly areas. The average number of emergency assembly areas in the districts is 80.9. 18 districts have a number below the average, and 12 districts have a number above the average.

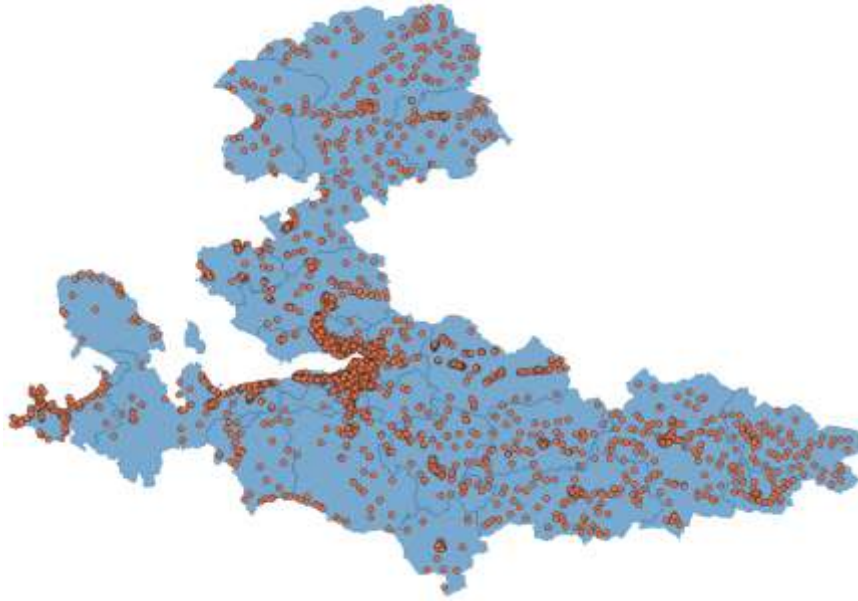


Figure 2 Izmir district boundaries and emergency assembly area locations

- (2) *The number of children's playgrounds per capita among the population aged 0-19 by district:* The district with the highest number of playgrounds is Konak with 128 playgrounds. The district with the lowest number of playgrounds is Urla with 1 playground (The information on playgrounds in Urla is obtained from Google Maps and may be misleading). The average number of playgrounds in the districts is 16,033. 19 districts have below-average playgrounds, and 11 districts have above-average playgrounds. Considering the number of children's playgrounds per child (0-19 age group), Çeşme district has the highest value with 0.003746456, and Menemen district has the lowest value with 5.06389E-05. The average number of children's playgrounds per child on a district basis in Izmir province is 0.00081194.
- (3) *The number of fitness areas per capita among the population aged 20 and above by district:* The district with the highest number of fitness groups is Konak with 123 fitness groups. The district with the least number of fitness groups is Narlıdere with 1 fitness group. The average number of fitness groups in the districts is 19.25 (districts with unavailable information are excluded from the average). 9 districts have below average fitness groups, and 4 districts have above average fitness groups. When we look at the number of fitness groups per adult (20 years of age and over), Konak district has the highest value with 0.000475177, and Narlıdere district has the lowest value with 1.99156E-05. The average number of fitness groups per adult by district in İzmir province is 8.51137E-05.
- (4) *The amount of urban green space per capita among the entire population by district:* The district with the highest amount of green space per capita is Çiğli with a value of 18.21862045. The district with the lowest amount of green space is Buca with a value of 5.7308E-05. The average amount of green space per capita in the districts is 3.4502598 (districts with no information are excluded from the average). The amount of green space per capita is below the average in 10 districts and above the average in 3 districts.

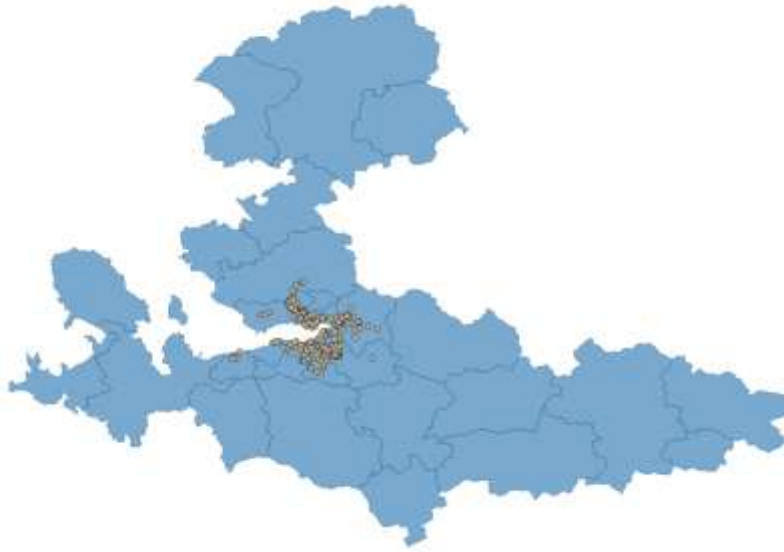


Figure 3 Izmir district boundaries and park area locations (park information is not available for many districts)

(5) *The distance of the nearest emergency assembly area to the district center:* When the distances between the district center and the emergency assembly area are considered, it has been determined that the shortest distance is for Çeşme and the longest distance is for Foça. The average distance between the district center and the nearest emergency assembly area is 0.318247166. 21 districts have the shortest distance value below this value, and 9 districts have the shortest distance value above this value.

(6) *The distance of the nearest emergency assembly area to the neighborhood center:* When the distances between the neighborhood center and the emergency assembly area are considered, it has been determined that the shortest distance is for Halilbeyli neighborhood of Kemalpaşa district, and the longest distance is for Yıldızlar neighborhood of Buca district. The average distance between the neighborhood center and the nearest emergency assembly area is 0.259648186. 870 neighborhoods have the shortest distance value below this value, and 415 neighborhoods have the shortest distance value above this value.

(7) *The number of parks within reach of the neighborhood center:* Considering the number of parks accessible from the neighborhood center (within 1 kilometer neighborhood), Ahmet Taner Kışlalı neighborhood in Çiğli district has the highest value with 7 parks, while 98 neighborhoods in different districts have the lowest value with 1 park. The average number of parks within 1 kilometer neighborhood is 1.69. 98 neighborhoods have an average number of accessible parks, and 64 neighborhoods have an average number of accessible parks. Considering the number of children's playgrounds accessible from the neighborhood center (within 1 kilometer neighborhood), Emek neighborhood in Bayraklı district has the highest value with 5 playgrounds, while 92 neighborhoods in different districts have the lowest value with 1 playground. The average number of children's playgrounds within 1 kilometer neighborhood is 1.578571429. 92 neighborhoods have an average number of accessible playgrounds, and 72 neighborhoods have an average number of accessible playgrounds.

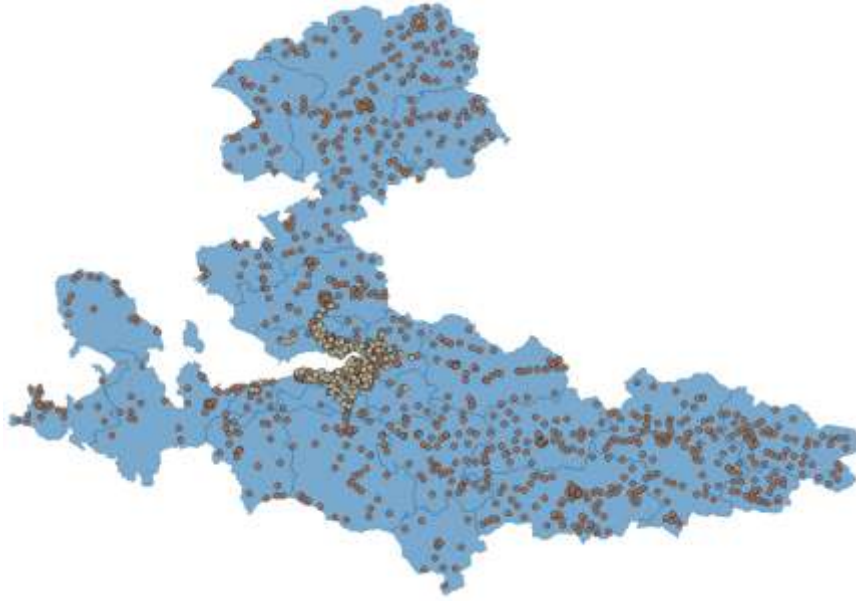


Figure 4 Izmir district boundaries, neighborhood centers, neighborhood center 1 km buffer area and park area locations

(8) Number of parks within 1 km of buildings on a district basis: In order to query the number of accessible parks and playgrounds on a building basis, the locations of the buildings must be known. Building polygon data was obtained from the OpenStreetMap open data portal. The data set provided by the portal includes data for 418160 buildings. The maximum number of parks within 1 kilometer of buildings was determined as 9. 311897 buildings do not have any parks within 1 kilometer of their neighborhood. The average number of parks is 0.378496269. The maximum number of playgrounds within 1 kilometer of buildings was determined as 8. 327492 buildings do not have any playgrounds within 1 kilometer of their neighborhood. The average number of playgrounds is 0.33587622.

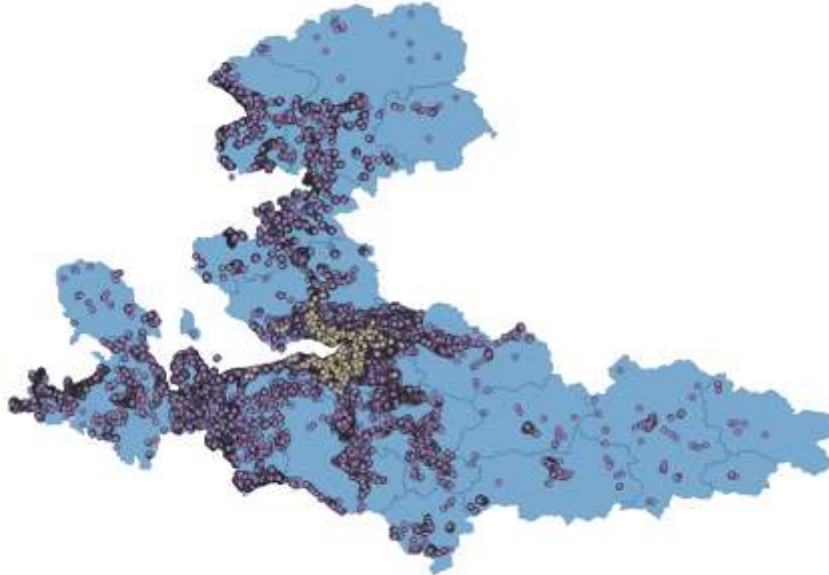


Figure 5 Izmir district boundaries, building centers, building center 1 km buffer area and parking area locations

CONCLUSION AND DISCUSSION

The equality-mapping method is an important tool for performing spatial equality analyses and revealing inequalities and injustices. Equality maps can be easily created with the GIS technique, which allows spatial data and attribute data to be interrogated together. The results of these analyses can be used as a decision support system during the planning phase of the sharing of public resources by municipalities and can contribute to increasing social welfare by eliminating inequalities and injustices in sharing.

The inequity patterns obtained as a result of the study are limited to the data used in the study. In the distance measurement phase, the point locations of emergency assembly areas and park areas and the point locations of neighborhood and district centers were used. At this point, it was assumed that the population was mostly located in the neighborhood centers. It can be said that more accurate patterns can be obtained by distributing the population to buildings on a neighborhood basis, obtaining the point locations of the buildings and obtaining the locations of the parks. Obtained fundamental patterns of inequity in the distribution of focused public resources in the study may help the municipalities better understand the current situation, make plans for the following years and ensure a more equitable distribution of public resources.

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