Spatial Analysis of Medical Services in Dhi-Qar Province Using GIS Tools

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Abstract

This research aims to study the spatial distribution of medical health centers in the Dhi-Qar governorate to determine the areas of strength and weakness for the medical service in the region. The required data was obtained from the Dhi-Qar Health Department. The Governorate is characterized by a large area (about 13738.95 km2), divided into 15 administrative units according to the official administrative division in Iraq, it contains huge swamps and ancient monuments. In this research, some important issues have b1een evaluated such as the nature and characteristics of the available health services in the whole governorate are, and how it is close to the citizen in terms of nearest distance to closest medical service, the research also aims to come up with an updateable database to enable the Dhi-Qar Health Directorate to benefit from and receive it and add the necessary data in each center to build an integrated database and facilitate the circulation of information. To enhance the health status of the city. This study applied GIS tools (IDW) for the spatial distribution of primary-care centers and registered citizens of the medical centers in Dhi-Qar Governorate, by scales health services positions and population density. In a descriptive and statical analysis. According to the preliminary results, the spatial distribution of health centers and health services in Dhi Qar needs to be updated to take into account population changes.

Keywords: ArcGIS 10.7, Urban, Spatial Analysis, Sustainability, Medical Service Center, IDW.

1. Introduction

This study is dedicated to get some measures about the spatial distribution of health services provided by the Ministry of Health in Dhi Qar province. Some tools relevant to Geographic information systems have been used to collect, study and analyze data. Figure (1) presents the study area of Dhi-Qar Governorate.The spatial boundaries were represented by those of the Dhi-Qar Governorate for the year 2020, the astronomical location of Dhi-Qar Governorate determined between latitude (30.40 ° -32.00 °) and longitude (45.50°-47.15 °)[1]. The geographical location is bordered by the governorates: Basra (from the south and southeast), and Maysan (East), Wasit (North), AL Muthanna (Southwest), and AL_Qadisiyah (Northwest)[2]... It consists of (15) districts and (8) sub-districts according to their administrative division. It is ranked seventh among the governorates of Iraq in terms of area, as its land area is (13738.95) km2, divided into 15 administrative units, and it also contains (900) km² of water bodies, as well as archaeological sites. Navoni, J. A.et al (at 2014) conducted a study to calculate the expected levels of as in water from the observed water levels' geographical location, using (IDW). The work was to behavior a risk assessment by applying spatial analysis methods, re-imagining exposure as a variable dependent on time and place, to redefine the population's risk status in the studied area. The information obtained displays future scenarios to be studied, to assist in setting risk management

priorities [3]. Zulu, et al (at 2014) uses inverse distance weighting in GIS tools to create continuous surfaces for the spread of HIV from the data for several years, multiple correlations and regression analyzes have been used [4].Shankardass and Jerrett, M. et al., (at 2015) used spatial analysis methods for the IDW and LUR models and chi-square test to examine the geographical distribution of predictions of the main outcomes of this distribution. Conducted according to ISAAC methodology to capture the ethnically diverse study population. [5].N. D. N. Abd Kadir and N. Adnan (at 2016) have made spatial distribution measures for high school. This study used the Inverse WeightedDistance as an interpolation method in GIS to map the trend surface of the science and mathematics score average (GPA) as a project variable [6]. Martina Calovi and Chiara Seghieri (at2018) A GIS-based approach was designed to provide support to healthcare management with the spatial reorganization of outpatient care in Italy. Spatial data, geographic maps, and metrics for the geospatial potential accessibility index were used to provide healthcare administrators with a palpable image of outpatient clinic accessibility. The number of operations and the distance were also considered. Three cases are presented each of which demonstrates three different management techniques. According to the report selecting outpatient clinics while maintaining access to the service [7].W. S. Sebti, S. M. A. El-razek, and H. M. El-Bakry (at 2019) specified the use of spatial tools and analysis tools available in QGIS to measure the distance between the average population center of concentration and the closest hospitals and used the Centroids tool to determine the point of population center and hospitals. The distance between the average a population center and the closest (private) hospitals were measured using the Buffer Tool, the results indicated a lack of interest in health centers and units distributed in residential areas and an acute shortage of doctors and health workers[8]. Hussein, et al (at 2020) study the spatial and temporal variation of noise in the educational campus using the field-collected data and GIS system, processing the data to create spatial maps using interpolation tools (GIS) one best type to represent noise, the results showed that there is a high level of noise that and does not match international standards [9]This research studies the spatial variation of health services in Dhi Qar Governorate, which includes (primary medical centers), using field-collected data and a geographic information system.
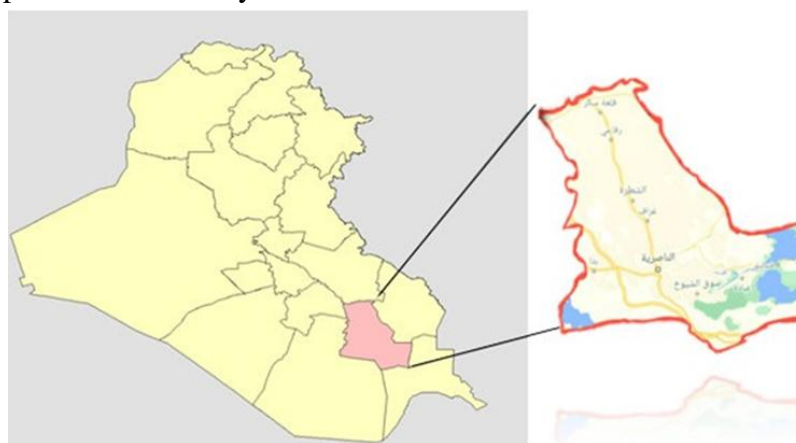

Figure (1) Dhi-Qar province in Iraq

2. Methodology

The study follows a specific methodology represented in finding the main factors for the spatial distribution of health centers, the research works to extract the indicator and then measure it in the study area.The research works to extract the indicator and then measure it in the study area. The flowchart of the study methodology appears is shown in Figure (2).
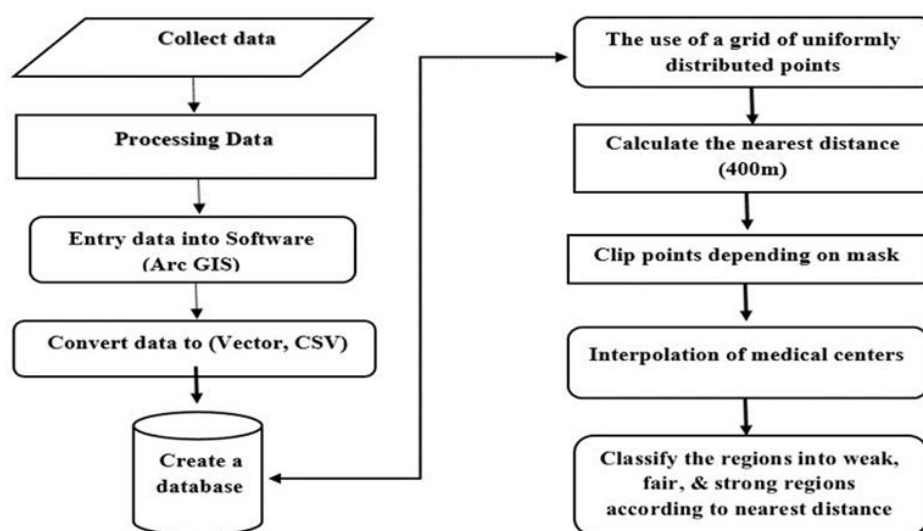

Figure (2) the flowchart of the study methodology

The steps of the work stages flowchart as follows:

The stages of data collection, sorting, classification, and placement points in their real locations on the map.

Process the data.Data processing in this stage, data were collected that include the names of health centers, the preparation of health personnel, knowledge of medical services in each health center, their order in Excel tables, their classification according to the study, and determine geographical locations to (217) primary health centers, hospitals provide a secondary service, specialized centers that provide a tertiary service in Dhi Qar Government. Data entry and processing, and dropping data collected on digital maps and tables to carry out an analysis this data [10].

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3. Determine the points based on the shape file mask for each administrative unit,the polygons of the study area must be identical to the grid of points of the study area mapped in shape, size, and location[14][15].

4. The data entry stage of the Arc GIS programto download the data, click on the "Add Data" pop-up window in the ArcGIS program. When data is uploaded, all files will be listed in the right-hand part (table of contents) that includes the data of the study area [16].

5. The stage of converting data into a vector and in CSV format. Text files, CSV files, and Excel spreadsheets are great ways to store data, CSV file also contains plain text and is versatile because it can be opened on any operating system, in any text editor, and also in spreadsheet applications, like Excel.

6. Create a dedicated database[17].

7. Use a network of uniform grid points the distance between each two points 400 meters[18].

8. Calculate the distance of nearest health center to each grid point.

9. Make interpolation using (IDW) of the health centers, services, and draw the contour line to determine the centers 'clusters in each line[19][20].

10. Classify the regions into weak, fair, & strong regions according to nearest distance in Dhi-Qar province[21].

The formula used for IDW is as follows:

$$\acute{z}(s_o) = \sum_{i=1}^{N} \lambda_i\, z(s_i) \quad, \tag{1}$$

Where: N The number of sample points surrounding the prediction location$s_\circ$.

λ_i The weight s assigned to each measured point these weights decrease with distance.

Z The observed value at the location.

The formula used to determine eights for known values is:

$$\lambda_i = \frac{|d(s_i - s_o)|^\rho}{\sum_{i=1}^{N}|d(s_i - s_o)|^\rho}, \tag{2}$$

Where, $d_i$is the distance between $s_\circ$ ands_i;

ρ is the power parameter, which is the main factor affecting the accuracy of IDW; N represents the number of sampled points used for the estimation [22][23].

Several components of health services inDhiQar Governorate were identified in study; the following parameters were taken into: (a) the number of primary health centers include the main, subsidiary, support centers; (b) the No. of Doctors, health professions, pharmacists[24].

The total number of primary health centers have reached (217) centers, the number of doctors

(258), while the number of health professions reached (5482), pharmacists of 163 for the governorate. The registered citizen'spopulation is (2,263,695) million, according to the Dhi Qar Health Directorate for the year 2020, aspresented in table (1)[25].

Table (1) somedescriptive details about medical health services in Dhi Qar Governorate

District Name	# of Health centers	# of doctors	# of Health professions	# of pharmacists
AL Nasiriyah	41	82	1151	35
AL Refai	13	15	231	10
SuqAL_Shoyiok	25	29	776	28
Garmat	18	9	320	4
AL_Ghebaish	8	3	127	2
AL_Shatra	23	30	798	12
AL Dawaya	9	9	126	0
AL_ Aslah	15	9	226	6
Said Dakhel	10	8	33	2
Gulat Suqar	8	13	314	3
AL Fuhod	9	3	234	1
AL Graff	16	13	359	37
AL Nasr	9	9	314	5
AL Fajr	7	15	210	1
AL Battha	8	11	79	17

2.1Classification and analysis of the health center

once the geographical database that was created through the presented study was built, the first topic was to obtain a clear understanding of the current situation regarding the locations of health centers and their distribution in Dhi Qar Governorate. There are (217) health centers in different regions of the governorate. The resulting site pattern indicates that the existing centers are located in nearly every district and are distributed to service all parts of the city.as Figure (3) distribution health centers in Dhi-Qar. Figure (4) also shows the distribution of the number of citizens registered in each district.However, it was classified into several categories, starting from strong to weak[26][27].
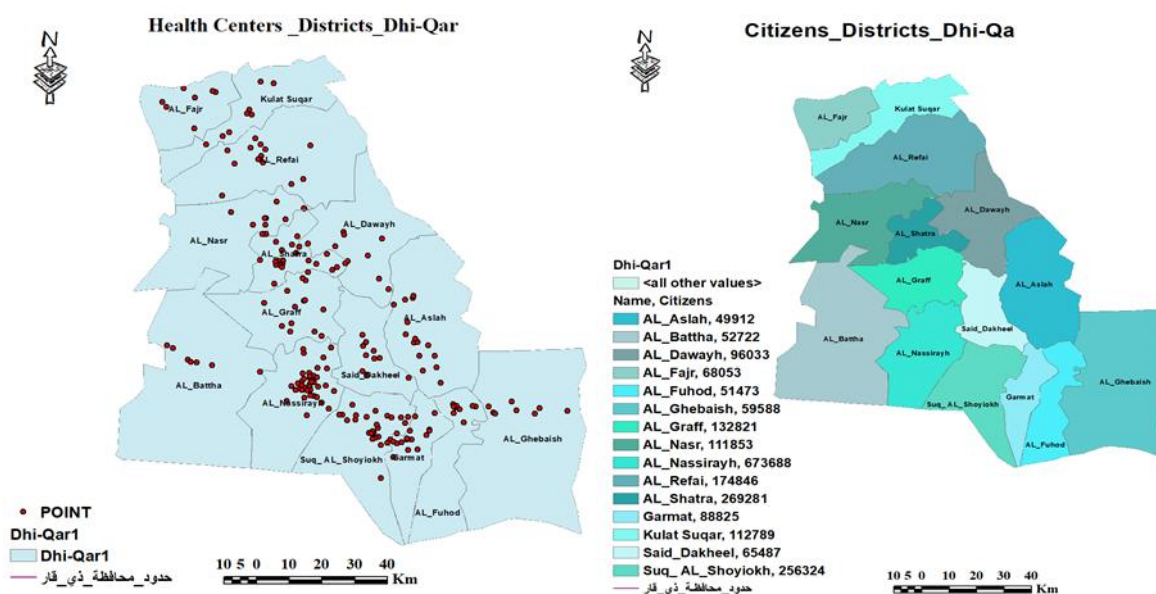
(3) distribution health center in Dhi-QarFigure (4) distribution citizens inDhi-Qar

3. Results

Based on the applied steps mentioned in the methodology section, IDW processes were applied to predict all centers and services locations relative to registered citizens in each district and the spatial distribution of health centers using GIS tools. The dot pattern of medical and health services was classified into five categories in all health centers. The distribution of the medical services map (Figure 5) has been determined, and Map (7) represents the distribution of health services in Dhi Qar Governorate. These maps explain the number of centers and the extended area of services around primary care centers. The ratio of the number of health cadres to the number of citizens registered in (5 - 20 health centers) about 2 - 9% for a strong category, indicating that there is a large discrepancy between the units that were analyzed. The lowest difference between (55-85 health centers) was 25-39%, which is a weak category. As for the middle class, the percentage stabilized at about 21% in (46 health centers). As shown in Figure (5).Services can be calculated at various levels based on the effects of the health service measurement in the (IDW) process. Figure (6) of doctors to registered citizens, demonstrating that the larger the population, the lower the operation. It has to be the right one. The medical service is proportional to the population in an indirect way**.**

Figure (5) Distribution MedicalService   **Figure (6) The values of the variation calculatedinIDWtoolfor the medical staff in the Health Centers**

The ratio of the number of medical personnel to the number of citizens registered in (4-25 health centers) was about 5-32% for the strong and above-average category, which indicates the existence of a medical deficit. The lowest difference between (10-24 health centers) ranged between 13-31%, which is weak to very weak category. As for the average group, the percentage stabilized at about 18% in (14 health centers), as shown in Figure (7)

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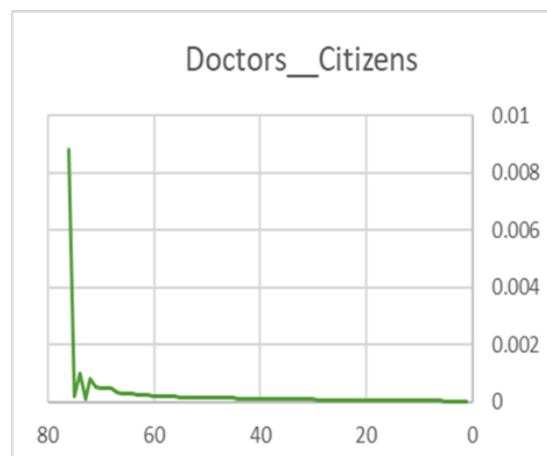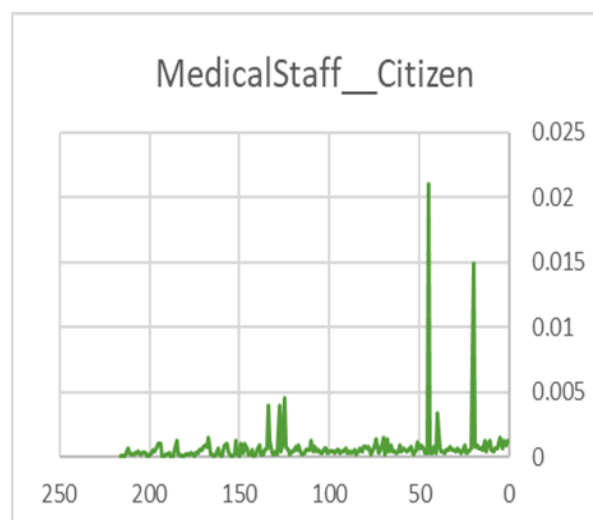

Figure (7) Distribution HealthService   Figure (8) The values of the variation calculatedinIDWtoolforthe health staff in the Health Centers

The Table (2) Distribution Medical Staff and (3)Distribution Health Staff   below shows the classification for both the doctors' service and the medical staff according to the map legend using the IDW method.

Range	Symbol	Classify
0.0000181- 0.0000659		Very Weak
0.0000659-0,0000801		
0.0000801- 0.0000843		Weak
0.0000843-0.0000985		
0.0000985-0.000146		Moderate
0.000146 -o. ooo307		above moderate
0.000307-0.00085		
0.00085-0.000268		Strong
0.000268-0.00883		

The Table (2) Distribution Medical Staff

Range	Symbol	Classify
0.0000122- 0.00028		Very Weak
0.00028-0,000382		
0.0000382- 0.000421		Weak
0.000421-0.000523		
0.000523-0.000791		Moderate
0.000791 -0.0015		above moderate
0.0015-0.00335		
0.00335-0.00823		Strong
0.00823-0.0211		

The Table (3) Distribution Health Staff

This study obtained data related to the number of medical staff and the number of health centers and citizens registered in each primary health center in Dhi Qar. The data were included in both Tables (4) and (5). The percentages of the medical staff relative to the number of citizens were also included in Table (6).

Table (4): The medical staff shows the percentage of registered citizens in Dhi Qar Governorate

District Name	X	Y	Families	Citizens	Doctors	Doctors_Citizens
AL Nasiriyah	619845	3434597	103078	629981	82	0.01376

AL Refai	605997	3509104	28739	172429	15	0.000746
SuqAL_Shoyiok	640118	3418051	43212	259269	29	0.001051
Garmat	650014	3417416	15109	90654	9	0.000388
AL_Ghebaish	690262	3427368	10123	60738	3	0.000132
AL_Shatra	610072	3475258	41171	247031	30	0.001068
AL Dawaya	631292	3484783	17752	106518	9	0.000416
AL_ Aslah	652458	3449329	9578	57472	12	0.000843
Said Dakhel	635525	3444566	8688	52126	8	0.000408
Gulat Suqar	601602	3526169	18055	108332	13	0.000343
AL Fuhod	664365	3428691	6799	40794	3	0.000143
AL Graff	617798	3464145	18433	110598	13	0.000699
AL Nasr	605468	3489679	18661	111957	9	0.000329
AL Fajr	591018	3531038	11105	66631	3	0.000088
AL Battha	583442	3442650	8535	51219	11	0.000438

Table (5): The Health staff shows the percentage of registered citizens in Dhi Qar Governorate

Districts	X	Y	Families	Citizens	Medical Staff	Medical Staff/Citizen
AL Nasiriyah	619845	3434597	113521	699527	332.4	0.05076
AL Refai	605997	3509104	36661	219969	64.8	0.00346
SuqAL_Shoyiok	640118	3418051	53469	320810	198.2	0.020796
Garmat	650014	3417416	23749	142489	75	0.008091
AL_Ghebaish	690262	3427368	12616	75697	29.8	0.002769
AL_Shatra	610072	3475258	49017	292811	193.2	0.017094
AL Dawaya	631292	3484783	22197	133210	32	0.00248
AL_ Aslah	652458	3449329	14599	87590	59.4	0.020389
Said Dakhel	635525	3444566	13370	80209	27.4	0.002542
GulatSuqar	601602	3526169	21632	129789	77.3	0.003786
AL Fuhod	664365	3428691	11597	69577	51.1	0.007085
AL Graff	617798	3464145	30411	182431	145.7	0.009334
AL Nasr	605468	3489679	23120	138713	74.3	0.003917
AL Fajr	591018	3531038	13988	83929	45.5	0.003982
AL Battha	583442	3442650	10817	64919	33.3	0.001827

Table (6) shows the percentage of the number of Health Staffs in relation to the registered citizens

District Name	Doctors__Citizens	Percentage	Medical Staff__Citizen	Percentage
AL Nasiriyah	0.01376	65 %	0.05076	32 %
AL Refai	0.000746	4 %	0.00346	2 %
SuqAL_Shoyiok	0.001051	5 %	0.020796	13 %

Garmat	0.000388	2 %	0.008091	5 %
AL_Ghebaish	0.000132	0.6 %	0.002769	2 %
AL_Shatra	0.001068	5 %	0.017094	11 %
AL Dawaya	0.000416	2 %	0.00248	6 %
AL_ Aslah	0.000843	4 %	0.020389	13 %
Said Dakhel	0.000408	2 %	0.002542	2 %
Gulat Suqar	0.000343	2 %	0.003786	3 %
AL Fuhod	0.000143	0.6 %	0.007085	5 %
AL Graff	0.000699	4 %	0.009334	6 %
AL Nasr	0.000329	2 %	0.003917	3 %
AL Fajr	0.000088	0.4 %	0.003982	3 %
AL Battha	0.000438	2 %	0.001827	1 %

4. Conclusion

The results of health centers' maps and service distribution for the geographical location and data collected in Dhi Qar from 2019 to 2020 revealed that medical service calculation was available in 75 primary health centers out of 217, with values ranging from 25 to 39 percent in the locations with the lowest level of medical service. The support of 21% of these centers is extremely weak. Many primary health centers that were closed in some areas were monitored, and some did not have any medical service, although the ratio of 2-9 percent in (5-20 health centers) was seen as a strong medical service .One of the most important issues for the services provided to the community is a clear understanding of the distribution of health services. Methods are evaluated using completeness techniques through the (IDW) tool. The study showed that the fulfillment maps accurately showed the distribution of centers and identified those that lacked medical services by analysis based on data collected. In addition to representing the number of citizens registered in each district. The percentages of medical services provided in the study area varied. Solving these problems may require imaginative extensions of an existing framework, the introduction of completely new techniques.

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