Spatial Analysis of the Impact of Population Density on Health Facilities in Nanggalo District Padang City

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Abstract

The type of research used in this research is quantitative descriptive. The population in this study is the distribution of health facilities in Nanggalo District. Sampling in this study used total sampling with a sample of all health facility objects in Nanggalo District. The results of this research can be concluded that 1) The total distribution of health facilities in Nanggalo District is 17 units consisting of 11 pharmacies, 4 clinics and 2 health centers. Coordinates are taken directly in the field to find the exact location using the Global Position System (GPS) application. 2) The population density level of Nanggalo sub-district is 7438 people/km² with an area of 8.07 km². Tabiang Banda Gadang Village has a density of 7007 people/Km², Gurun Lawas Village has a density of 4352 People/Km², Kampung Olo Village has a density of 11242 People/Km², Kampung Lapai Village has a density of 15911 People/Km², Surau Gadang Village has a density of 8776 People/Km². km² and Kurao Pagang Village has a density of 4851 people/km². 3) Based on the significance value from the coefficient table, the value obtained is (0.11270679) or only 11% of population density influences or has a strong impact on health facilities in Nanggalo District.

Keywords: Impact, Population Density, Health Facilities

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1. Introduction

A health facility is a place or facility that provides medical services and care to people in need. Health facilities can include various types and levels from general health facilities to specialized health facilities. One of the most important elements in maintaining community welfare is that health services in each region have different levels of availability of health facilities and the number of health facilities available can also vary depending on location and level of access (Wulandari, Laila, and Mushandi 2023).

The development of population and activities will influence regional development by increasing the need for facilities, both public and social facilities. Usually, as the population increases, the population also increases. One of them is the desire for health which is an important factor for human survival (Nata, Hardati, and Arifien 2013).

Health development is one of the national initiatives in all areas of life and is carried out essentially in all regions of the country to achieve the highest level of public health. Development in the health sector is expected to be able to create a high quality of life for the Indonesian people, advanced and prosperous, as well as creating a nation that competitive in line with the vision and mission of national development for 2015-2019. Successful health development in the future includes not only easy access to health services, but also continuous improvement in the quality of health services. Access to health services is reflected in the increase in the number, network and quality of health facilities (Ridwan and Saftarina 2015).

Population growth every year affects the development of a country, because a large population requires various social and economic service facilities to develop individual potential. Volume or population can represent the potential or debt of a country. This potential becomes potential if the population is balanced with other resources and is achieved. The level of quality of life and welfare of the population in a particular area. The quality of life of a person or a community depends on many factors, such as population density, the availability of government facilities to improve the welfare of the community, the lifestyle adopted by the community, and the norms that apply in the area. In reality It is population density that has a real impact on people's quality of life. This is because high population density gives rise to various population problems, such as poverty and employment. The problems that arise there will have an impact. About the quality of life of the community (Antara and Suryana 2020). Padang City is the capital of West Sumatra province and its population continues to increase from year to year. As the provincial capital, Padang City must be able to meet and guarantee the needs of its citizens. Infrastructure plays an important role in supporting this process, because its development is regulated by policy

Based on the researchers' initial observations, they saw that health facilities had an effect on public population density at the Community Health Center in Nanggalo District, which was the object of research. Health facilities have not been fully utilized in accordance with the function of these work facilities, and until now there are still many obstacles or complaints from the community related to the lack of available health facilities. which results in a lack of access to services provided to the community. So that a lot of work is not completed at the appointed time.

Based on geographical location, next to, to the north, east of Kuranji District, west of Padang Utara District. Nanggalo District consists of 6 sub-districts. Surau Gadang sub-district has the smallest area of 0.91 km^2. In Nanggalo sub-district the researchers found 3 sub-districts that have health facilities, Kampung Olo sub-district, Surau Gadang sub-district and Kamp Lapai sub-district with the least number of health facilities so the researchers wanted to know how the population density is. regarding health facilities in Nanggalo District. With the problems of health facility services in Nanggalo District, Padang City, which are explained above, it is necessary to test the "Spatial Analysis of the Impact of Population Density on Health Facilities in Nanggalo District, Padang City"

Public Health Center

Puskesmas is a health service facility that carries out public health efforts and first-level individual health efforts, by prioritizing promotive and preventive efforts, to achieve the highest level of public health in its working area (Regulation of the Minister of Health of the Republic of Indonesia Number 75 of 2014 concerning Community Health Centers). Community Health Center is a functional implementation unit that functions as a center for health development, a center for fostering community participation in the health sector as well as a first-level health service center that carries out its activities in a comprehensive, integrated, sustainable manner for a community residing in a certain area (Azwar,1996).

Hospital

A hospital is a health service institution that provides comprehensive individual health services that provide inpatient, outpatient and emergency services (Hospital Law, 2014). Meanwhile, according to Wolper and Pena quoted by Azrul Azwar (1996) a hospital is a place where sick people seek and receive medical services. Based on the definition above, it can be concluded that a hospital is a more complete health service based on its services. Hospitals are divided into two: general hospitals, which serve all kinds of diseases or basic services, and special hospitals which provide health services based on certain types of diseases or services, for example the Mother and Child Hospital & Lung Hospital.

Pharmacy

Decree of the Minister of Health of the Republic of Indonesia No. 1332/Menkes/SK/X/2002, a pharmacy is a place where pharmaceutical work is carried out and the distribution of pharmaceutical preparations and other health supplies to the public. Pharmaceutical preparations are drugs, medicinal ingredients, native Indonesian medicines, medical devices and cosmetics. Meanwhile, health supplies are all materials and equipment needed to carry out health efforts. Pharmacy location is where the pharmacy is established. The location of the pharmacy is determined according to the application when applying for a pharmacy permit. Distances between pharmacies are no longer limited since the issuance of Minister of Health Regulation No. 244 of 1990 (MOH RI, 2015).

2. Method

The type of research used in this research is a quantitative descriptive method. is an objective situation that uses numbers, starting from collecting data, interpreting the data as well as its appearance and results (Arikunto, 2006) using a regional study design with a spatial approach based on geographic information system software.

The researcher here tries to measure exposure in the unit of analysis that has been determined where the unit of analysis is the population of Nanggalo District. The spatial analysis used involves a number of mathematical logic calculation and evaluation functions based on data and information to obtain conclusions at the end of the analysis process. What needs to be done In this research, we try to describe the impact of the distribution of health facilities on population density in Nanggalo District, Padang City.
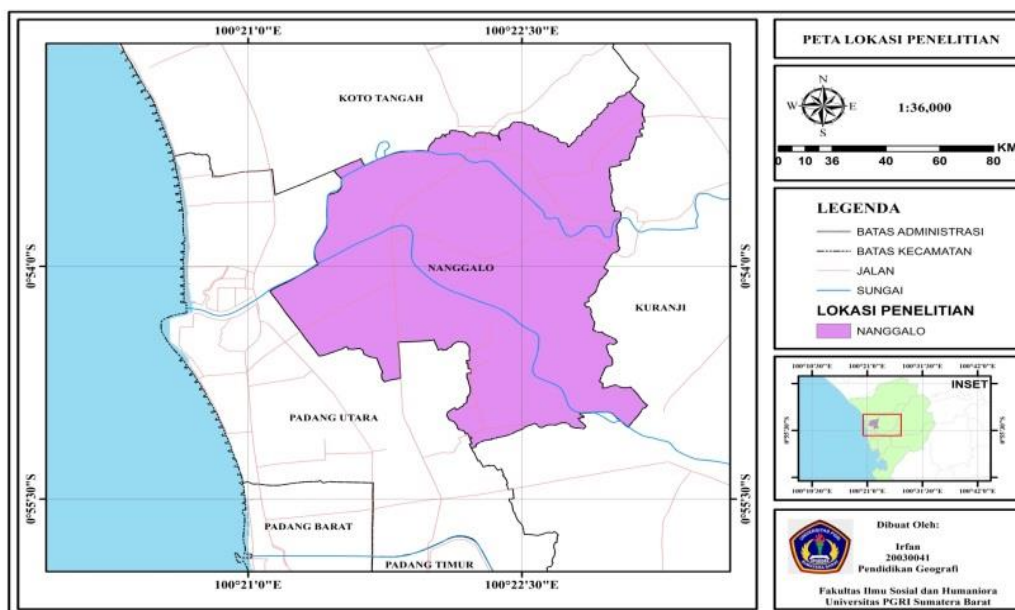
Figure 1. Map of Research Locations

A. Population

Population is the total data that is the center of attention of a researcher within a predetermined scope and time. Population is also the entire collection of elements that have a number of general characteristics, which consist of areas to be researched. The population in this study is Nanggalo District, Padang City with 6 sub-districts. For more details, see the table below:

Table 1. Population

Sub-districts	Hospital	Health clinic	Public Health Center	Pharmacy
Tabiang Banda Gadang	-			
Gurun Lawas	-			
Kampung Olo	-	1		3
Kampung Lapai	-	1	1	3
Surau Gadang	-	3	1	4
Kurao Pagang	-			
Total		17		

Source: BPS Padang City, 2021

B. Sample

According to (Sugiono, 2018) the sample is part of the number and characteristics possessed by the population taken from the population which must be truly representative or represent the population chosen to be used in the research. The sample in the research was seventeen health facilities located in Nanggalo District. From the population, Total Sampling was taken because the researcher wanted to examine the large number of health facilities in Nanggalo District in relation to population density.

Observation

Observation is a method and technique for collecting data by systematically observing and recording symptoms or phenomena. The observation technique in this research was carried out by direct observation in the field/survey, to determine the absolute location/coordinate points using GPS (Global Positioning System) at each health facility in Naggalo District, Padang City.

C. Documentation

Documentation is looking for data regarding things or variables in the form of notes, transcripts, books, newspapers, magazines, inscriptions, meeting minutes, agendas and so on (Arikunto, 2006). This data collection technique is carried out by citing available sources. The benefit of seeking information about health facility infrastructure in a study that compares population density with the number of health facilities is to understand whether the distribution of these facilities is adequate and in accordance with the needs of the community. With this data, it can be identified whether there is an imbalance between the number of health facilities and the population in an area. This is important for better health policy planning and resource allocation.

D. Data Analysis Techniques

Data analysis is a step that should not be ignored in research activities. Insight and thoroughness in considering the problem and the type of data obtained are very important to determine the most appropriate type of analysis. To find out the distribution of service facilities, the GIS application is used. A Geographic Information System (GIS) is a special information system that manages data containing spatial information (spatially referenced). Or in a narrower sense, it is a computer system that has the ability to build, storing, managing and displaying geographically referenced information, for example data identified according to its location, in a database.

This data was taken from BPS and processed it by mapping the distribution of health facilities, by taking coordinate points and mapping them using GIS analysis techniques. Practitioners also include people who build and operate data as part of this system. GIS is an information system that is based on computer work that enters, manages, manipulates and analyzes data and provides descriptions. (Aronoff, 1989)

To analyze population density, descriptive analysis methods can be used with the aim of presenting descriptive statistics such as mean, median and standard deviation of population density data as well as histograms or bar charts to visualize the distribution of population density (Ridwan, 2021).

E. Linear Regression Analysis

Linear regression analysis can be applied to understand the relationship between population density and health facilities in several key steps. First, data preparation involves defining the variables: the independent variable (X) represents population density in each geographic unit (e.g., sub-district, district), and the dependent variable (Y) is the number or relative number of health facilities (e.g., hospitals, clinics, pharmacies) within the same geographic areas. These variables will serve as the basis for the analysis.

In terms of variable measurement, population density (X) is typically expressed as the number of people per unit area, such as per square kilometer. Meanwhile, health facilities (Y) are quantified based on the number of facilities present in each geographic unit. These measurements provide the necessary data for the regression model.

The regression model used in this analysis is expressed as:

$$Y_i = \beta_0 + \beta_1 X_i + e_i \tag{1}$$

where Yi represents the number of health facilities in the ith geographic unit, and Xi is the population density in the ith geographic unit. The term β_0 is the intercept, β_1 is the regression coefficient indicating the relationship between population density and health facilities, and ε_i represents random error.

During regression analysis, the coefficients are estimated using the least squares method. This helps calculate the values of β_0 and β_1, which describe the strength and direction of the relationship between population density and health facilities. A significance test is then performed to determine whether the regression coefficient β_1 is statistically significant. If β_1 is positive and significant, it suggests that an increase in population density corresponds with an increase in the number of health facilities.

Finally, the results of the regression analysis are interpreted to provide insights into the relationship between population density and health facilities. These findings should be presented in a clear and useful manner for health decision-makers, enabling them to make informed choices regarding the distribution and planning of health services (Yuliara, 2016).

3. Result and Discussion

A. *Distribution of Health Service Facilities in Nanggalo District, Padang City*

The distribution of health facilities is carried out directly in the field to find the right place using the Global Position System (GPS) application. The following are the coordinates of health facilities in Nanggalo District:

Table 2. Distribution of Nanggalo District Health Facilities

No.	Medical facility	X	Y
1	Apotik Kimia Farma	100.3706	-0.89893
2	Apotik Indosehat	100.3723	-0.89885
3	Apotik Samudra	100.3729	-0.89875
4	Klinik Pratama Hutria	100.3731	-0.89679
5	Apotik Fitrah	100.3724	-0.89546
6	Klinik Pratama Mercubaktijaya	100.375	-0.89751
7	Puskesmas Nanggalo	100.367	-0.89396
8	Apotik Kimia Farma	100.3609	-0.90304
9	Apotik Murni Jaya	100.3597	-0.90377
10	Klinik Puri Medical	100.3566	-0.90545
11	Puskesmas Lapai	100.3617	-0.90332
12	Apotik Patimura	100.3626	-0.90533
13	Apotik Keluarga 16	100.3636	-0.90674
14	Apotik Bundo	100.3633	-0.8978
15	Klinik Armina Medika	100.3638	-0.89723
16	Apotik Kita	100.3633	-0.90139
17	Apotik Anugerah	100.3637	-0.90518

Source: Field Observation, 2024

From table 1 it is known that the distribution of health facilities in Nanggalo District is 17 units consisting of 11 pharmacies, 4 polyclinics and 2 health centers. For more details about the distribution of health facilities in Nanggalo District, you can see the figure 2 below:
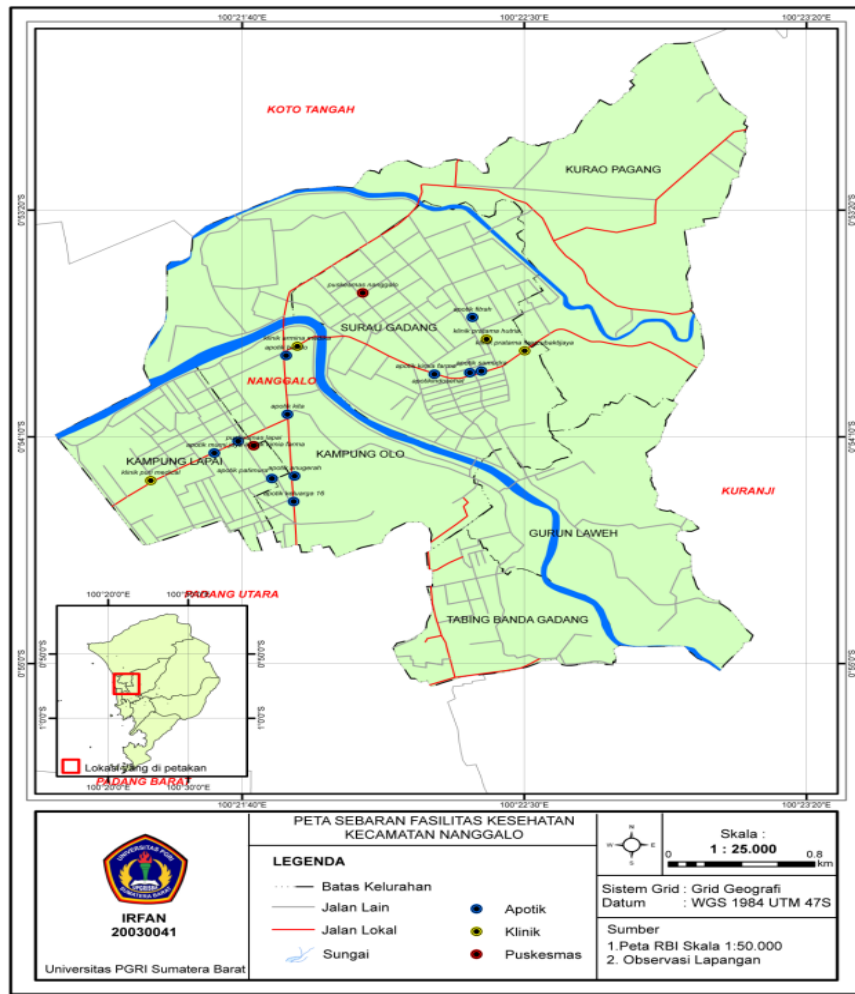
Figure 2. Map of the distribution of health facilities in Nanggalo District

B. *Population Density Level of Nanggalo District*

Population density is a condition that is said to be increasingly dense if the number of people in a certain spatial boundary increases compared to the area of the room (Sarwono,1992).

Table 3. Population Density of Nanggalo District

No.	Sub-district	Area (Km²)	Population (people)	Population density (People/Km²)
1	Tabiang Banda Gadang	0.91	6376	7007
2	Gurun Lawas	0.85	3699	4352
3	Kampung Olo	0.57	6408	11242
4	Kampung Lapai	0.61	9706	15911
5	Surau Gadang	2.28	20010	8776
6	Kurao Pagang	2.85	13824	4851
	Total	8.07	60023	7438

Source: Nanggalo District in 2023 figures

From the table above it can be seen that the population density of Nanggalo sub-

district is 7438 people/km² with an area of 8.07 km². Tabiang Banda Gadang Village has a density of 7007 people/Km², Gurun Lawas Village has a density of 4352 People/Km², Kampung Olo Village has a density of 11242 People/Km², Kampung Lapai Village has a density of 15911 People/Km², Surau Gadang Village has a density of 8776 People/Km². km² and Kurao Pagang Village has a density of 4851 people/km².

C. Impact of the Distribution of Health Facilities on Population Density in Nanggalo District

The influence of population density in a region will certainly influence the distribution of socio-economic facilities in a region. Influencing factors include Health Facilities.

Table 4. Population Density Level and Distribution of Facilities in Nanggalo District

Sub-district	Population density (X)	Health Facilities (Y)
Tabiang Banda Gadang	7007	0
Gurun Lawas	4352	0
Kampung Olo	11242	5
Kampung Lapai	15911	5
Surau Gadang	8776	7
Kurao Pagang	4851	0

Source:Author's Analysis, 2024

From the table above it is known that Tabiang Banda Gadang Village has a population density of 7007 people/Km² with a number of health facilities 0, Gurun Lawas Village has a population density of 4352 People/Km² with a number of health facilities 0, Kampung Olo Village has a population density of 11242 People/Km² with a total of health facilities 5, Kampung Lapai sub-district has a population density of 15911 people/km² with a number of health facilities 5, Surau Gadang sub-district has a population density of 8776 people/km² with a number of health facilities 7 and Kurao Pagang sub-district has a population density of 4851 people/km² with a number of health facilities 0.

To see the impact of the distribution of health facilities on population density, several statistical tests were carried out. The statistical test used in regression analysis is a simple linear test of the coefficient of determination, whether variable X has an effect on variable Y. (Rosyid, A., Ali, J., & Priyono, H. (2017)

The results of calculations using simple linear regression analysis using the SPSS program, the following values are obtained:

Table 5. Coefficient of Determination of Population Density on Health Facilities

	Coefficients	Standard Error	t Stat	Sig
Constant	-1.689311	2.45514993548479	-0.688068	0.5292345
Population density (X)	0.00052045	0.0002568	2.026140	0.11270679

Source:Author's Analysis, 2024

From the table above, it is known that the constant value (a) is -1.689311, while

the regression coefficient value (b) is 0.00052045. so the regression equation can be written:

$$Y = -1.689311 + 0.00052045X \qquad (2)$$

Based on the significance value from the coefficient table, the value obtained is (0.11270679) or only 11% of population density influences or has a strong impact on health facilities in Nanggalo District. If the correlation value has a p-value of more than 0.05, it means that the correlation is not statistically significant at the 5% significance level. This means that there is a greater than 5% chance that the observed relationship between two variables could have occurred by chance, so there is no strong evidence that the relationship actually exists in the population.

4. Conclusion

Based on the research results, researchers drew several conclusions regarding the spatial analysis of the impact of population density on health facilities in Nanggalo District, Padang City as follows:

1) The total distribution of health facilities in Nanggalo District is 17 units consisting of 11 pharmacies, 4 clinics and 2 health centers. Coordinates are taken directly in the field to find the exact location using the Global Position System (GPS) application.
2) The population density level of Nanggalo sub-district is 7438 people/km² with an area of 8.07 km². Tabiang Banda Gadang Village has a density of 7007 people/Km², Gurun Lawas Village has a density of 4352 People/Km², Kampung Olo Village has a density of 11242 People/Km², Kampung Lapai Village has a density of 15911 People/Km², Surau Gadang Village has a density of 8776 People/Km². km² and Kurao Pagang Village has a density of 4851 people/km²
3) The results of this study indicate that the distribution of health facilities in Nanggalo District, with a total of 17 units, only has an influence of 11% on population density. This means that, although there are variations in population density in each sub-district, the number of existing health facilities is not comparable or not too affected by the level of population density in the area. Therefore, there is an imbalance in the distribution of health facilities that should be adjusted to the needs of a denser population.

5. Acknowledgement

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