

A Spatial Analysis of the Distribution Patterns of Healthcare Facilities in Katsina State, Nigeria

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ABSTRACT

Access to healthcare is an important predictor of the overall success of a healthcare delivery system and has a direct impact on disease burden, especially in the developing world. This has also been shown to positively influence health systems in various populations (Macinko, 2005). This paper examines healthcare facility distribution trends in Katsina State from a social justice perspective. The study included both primary and secondary data. The primary data contained the geographic coordinates of all healthcare facilities in the state, whilst the secondary data had a list of all healthcare institutions in the state. These healthcare facility coordinates were entered into a shape file, and the scanned administrative map of Katsina State was imported into Arc GIS 10.4.1 software, where the Arc map extension was used to map all of the healthcare facilities in the state. Geographic Information System (GIS) analytic methods like nearest neighbour ratio (NNR), buffering, overlay, and query were also used to examine the data. 1832 healthcare institutions in the State were identified by the study, falling into four categories: primary (603, 65.6%), private (262, 28.5%), secondary (51, 5.6%), and tertiary (3, 0.3%). Secondary and tertiary healthcare facilities showed random distribution patterns, whereas primary and private healthcare facilities showed clustered patterns of distribution. The study's buffer zone analysis revealed that the Katsina senatorial district is favoured in the distribution of healthcare facilities because it appears to be the area that is well served in terms of primary, secondary, and private health facilities in the state. The study found inequities in the spatial distribution of healthcare services in the study area. The implication is that many individuals and families in the most vulnerable communities cannot attain minimum standards of living due to very poor access to supportive and Lifesaving health facilities.

Keywords: Healthcare Facilities, Distribution Patterns, GIS, Social Justice, Katsina State.

1. INTRODUCTION

Health is a universal human right that is at the centre of social and political debates globally. According to a 2008 WHO assessment, significant progress in health has been mostly uneven over the world, with convergence towards improved health in many areas. A significant number of countries were falling behind, with growing health disparities within countries (Gauld, 2012). According to the principles of equality and health, equity in health care is founded on the principle of making high-quality health care available to all (Whitehead, 2000). Most

health-care systems are based on the premise that available resources should be allocated fairly and equitably for the benefit of the entire community. Health services should be based on equal expenditure per capita; according to this concept, an equitable allocation would be achieved if the available health service budget was allocated equally among geographical areas based on population size (Whitehead, 2000). The aim of this paper is to examine distribution patterns of healthcare facilities in Katsina State from a social justice perspective.

Access to health care is an essential determinant of a healthcare delivery system's overall success, as well as a direct impact on illness burden, particularly in poor countries. This has also been found to improve health systems in many communities (Macinko, 2005). Measuring access to health care adds to a more comprehensive knowledge of health system performance (Kibon and Ahmed, 2013; Abdelhafiz and Abdel-Samea, 2013). Unfortunately, healthcare services are not equally available to all individuals, and this remains a significant impediment to realising the aim of universal health coverage (Perry and Gesler, 2000). Humans' well-being depends on their ability to get healthcare services. According to studies, the location of healthcare facilities does not necessarily correspond to the demands of the population in the majority of Nigerian states. This has led to inadequate healthcare delivery. Overt emphasis has also not been paid to the requirement for equal distribution of these facilities, which are necessary for good healthcare delivery (Atser and Akpan, 2009); (Fadahunsi, 2017); (Darda'u, 2021). Katsina State is an area that is known to suffer from poor access of health services (Mani 1998 and Darda'u, 2011) partly due to the sparse distribution healthcare facilities in many areas within the state. Such areas with difficult physical terrain and facing challenges of insecurity, such as banditry and kidnapping and so on. What also appeared to be happening in Katsina is akin to Lineberry's underclass hypothesis, which states that the distributive impacts of municipal locational decisions and public policy in general tend to favour those with power to influence the process. That is to say, the wealthy and the privileged in the society have the ability to manipulate the bureaucratic machinery to attract disproportionate share of public services, such as healthcare in their favour. Because the political elites of Katsina Senatorial district are known to have been ruling the state right before its creation until recently when for the first time in the history of the state, the current Governor emerged from the Funtua Senatorial district. As a result Katsina Central has been favoured in the provision of many public services, healthcare inclusive. Therefore, there is a need for a thorough investigation to proffer a lasting solution to these problems.

2. CONCEPTUAL FRAMEWORK

The investigation assessed the World Health Organisation (WHO) threshold of 5 km of walking distance to be moderate. Since one hour is the maximum trip duration indicated by Brabyn and Skelly (2002). Abbas and colleagues (2012) advocated 2km, 4km, and 16km of buffered service area away from the health post, primary health clinic, and general hospital, respectively. According to Fatih and Istvan (2013), the service area distance is 1 km walking and 3 km driving in 30 minutes, in line with Rovali and Kiivet (2006). Similarly, in

their study on physical accessibility and utilisation of health services in Yemen, Al-Ta'iar et al. (2010) used 1-4.5km for straight line distance, 2-12km for driving distance, and 10-29 minutes for driving time from participants' homes to the nearest health centre. Modupe (2014) defined 1-5km as a modest walking distance to primary health facilities and 10-20km as a moderate driving distance to the hospital. It is crucial to emphasise that in this study, Modupes' criteria for assessing physical accessibility to health services were used because they take into account all of the other variables and are also in line with global standard. However, according to the National Health Policy (2016) in Nigeria the standard for location of healthcare facility is based on population or area size. Consequently, whenever there is a village or neighbourhood of about 500 persons, group of villages/ neighbourhoods with about 2,000 – 5000 persons, ward, LGA and State. You provide those areas with 1 Health Post, 1 Primary Health Clinic, 1 Primary health centre, 1 General hospital and 1 Teaching/Tertiary hospital respectively. So it's not out of place to say in this case that the national and the global standard of healthcare provision are correlated, because all primary health facilities could be found within the 5 km range, while the secondary and tertiary could be located within the 20 km distance accordingly.

Because walking continues to be a popular mode of transportation in developing countries such as Nigeria, particularly in rural areas, it is critical to locate primary health facilities within walking distance in order to assist in the management of a wide range of prevailing health problems and to encourage the use of these (primary health) facilities specifically. The maximum walking distance for primary health institutions was set at 5 km based on a one-hour trip time. Since the average walking distance is 5 kilometres per hour. It then suggests that persons residing within the buffer zone travel between 12 and 60 minutes to primary health care services (with the exception of some impediments such as geography). It should also be observed that the values of Nearest Neighbour Analysis, R , fall between two theoretical extremes: 0 and 2.1491. The more tightly the points are packed together, the closer the value of R is to 0. The closer R gets to 1, the more randomly scattered the points are, and the closer the value of R is to 2.1491, the more uniformly spaced the data are.

3. MATERIAL AND METHODS

According to the concepts of the principles of equity and health, equity in health care is based on the principle of making high quality health care accessible to all (Whitehead, 2000). Underpinning most health care systems is the belief that there should be a fair and equitable deployment of available resources for the benefit of a whole population. Health services should be based on equal

expenditure per capita; by this definition an equitable allocation would be achieved if the available health service budget were divided equally amongst geographical areas based on the size of the population in each area (Whitehead, 2000).

The study included both primary and secondary data. The primary data contained the geographic coordinates of all healthcare facilities in the state, whilst the secondary data had a list of all healthcare institutions in the state. These healthcare facility coordinates were entered into a shape file, and the scanned administrative map of Katsina State was imported into ArcGIS 10.4.1 software, where the Arc map extension was used to map all of the healthcare facilities in the state. The data were further examined utilising Geographical Information System (GIS) analysis techniques such as Nearest Neighbour Ratio (NNR), buffering, overlay, and query. The study identified 1832 healthcare institutions in the state, divided into four categories: primary (603, 65.6%), private (262, 28.5%), secondary (51, 5.6%), and tertiary (3, 0.3%). Primary and private healthcare institutions showed clustered distribution patterns, but secondary and tertiary care centres showed random distribution patterns.

Study Area: Location Size and Population.

Katsina State is situated between latitudes 11°08'N and 13°22'N and longitudes 6°52'E and 9°20'E, covering an area of 23,938 square kilometres (NBS, 2011). The state shares boundaries with the Niger Republic in the north, Jigawa and Kano States in the east, Kaduna State in the south, and Zamfara State in the west. According to the 2020 population forecast, the total population of Katsina state is eight million six hundred thirty two thousand, one hundred and seventy three (8,632,173). This statistic included the male population of 4,402,408, and the female population of 4,229,765.

4. RESULT AND DISCUSSION

4.1 Distribution Pattern of Healthcare Facilities in Katsina State

The Nearest Neighbour Ratio tool in ArcGIS 10.4.1 was used to analyse the distribution patterns of existing healthcare facilities in Katsina State. Using primary healthcare facilities as an example, the nearest neighbour ratio of 0.12 is less than one, indicating that the distribution of facilities is clustered, while there are evidence of a shift towards a regular distribution. The z-score of -52.9 falls between -1.96 and +1.96, and the p-value of 0.19 is greater than the 0.05 critical level, indicating that the pattern is clustered. Similarly, secondary healthcare has a clustered structure, but tertiary and private healthcare have dispersed and random patterns, respectively. The Nearest Neighbour Ratio (NNR) results for tertiary, secondary, primary, and private healthcare facilities are shown in Figures 2, 3, 4, and

5, respectively. It demonstrates that primary and secondary healthcare institutions had clustered distribution patterns, but tertiary and private healthcare facilities displayed random and dispersed distribution patterns. The spatial pattern observed in this analysis indicated a disordered and inefficient distribution of healthcare services in Katsina State. This can result in high new-born and maternal mortality, illness dissemination, self-medication, and the use of quackery due to a lack of better health-care options.



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Figure 1: Study Area

4.2 Buffer Zone Analysis

Walking Distance for Primary Healthcare Facilities in Katsina State

Figure 6 shows that Katsina State is dotted with primary health facilities, with the exception of the forested areas of Rugu forest in the western part of Katsina state, which are located in Safana and Danmusa local government areas, and this could be due to the lack of human settlement in the area. There are also unoccupied patches in the local governments of Ingawa and Dutsi, both of which are in the Daura Senatorial District. Furthermore, Kankara and Faskari LGAs in Funtua senatorial districts show several unoccupied areas without health services, which is a strong indicator of

Table 1: Summaries of the distribution of healthcare facilities in Katsina state.

Types of healthcare facilities	Number of healthcare facilities	Nearest neighbour ratio (R)	Z-Score	P-value	Pattern
Tertiary	2	120.761145	324.01254	0.00000	Dispersed
Secondary	18	1.09192	0.861483	0.388972	Random
Primary	1711	0.115742	-52.983942	0.00000	Clustered
Private	97	0.473081	-9.927968	0.00000	Clustered

Source: Fieldwork 2024

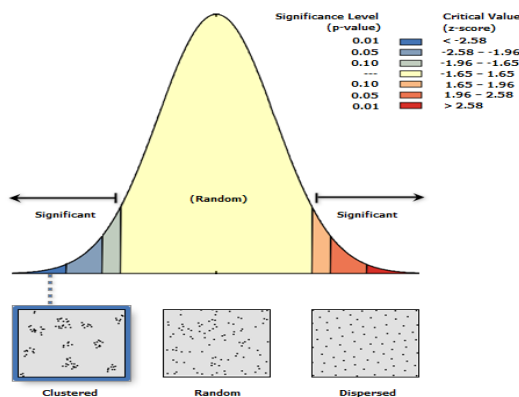


Figure 2: Average nearest neighbour for primary healthcare facilities in Katsina State.

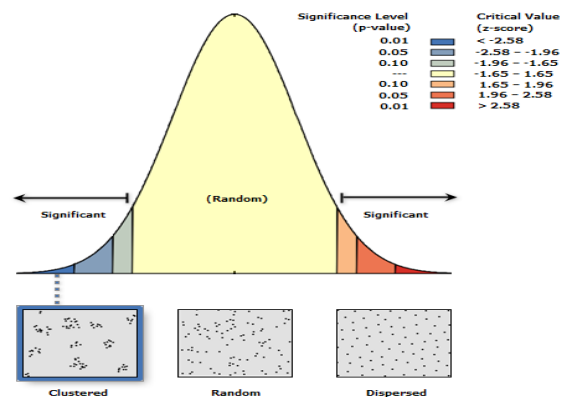


Figure 3: Average proximity to secondary healthcare facilities in Katsina State

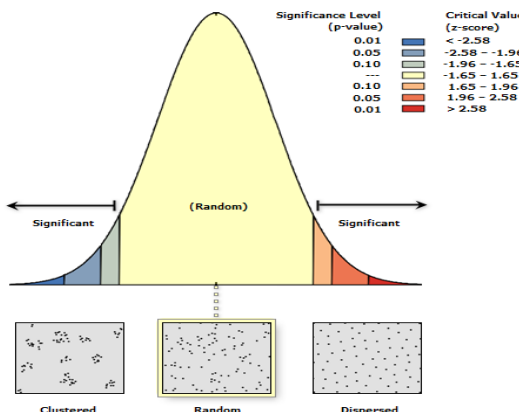


Figure 4: Average nearest neighbour for private healthcare facilities in Katsina State.

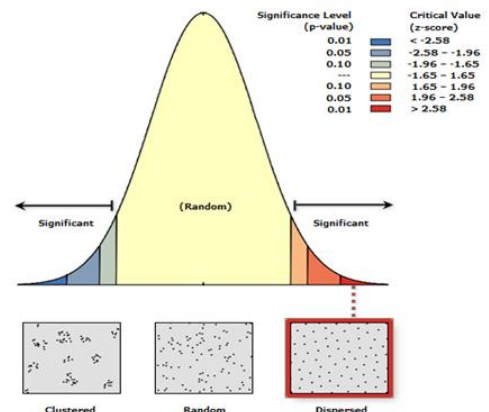


Figure 5: Shows the average distance between tertiary healthcare facilities in Katsina State.

marginalisation, as such locations appear to have high population densities clamouring for these life-saving facilities. Figure 6 also shows the maximum walking distance between primary health facilities in Katsina State. Any region on the map that is blue is well serviced by health services, while those coloured yellow are considered underserved in the study area. Primary healthcare, as the initial stage in patient consultation and closer to the people, should be properly dispersed throughout the state to reduce the problems connected with healthcare injustice.

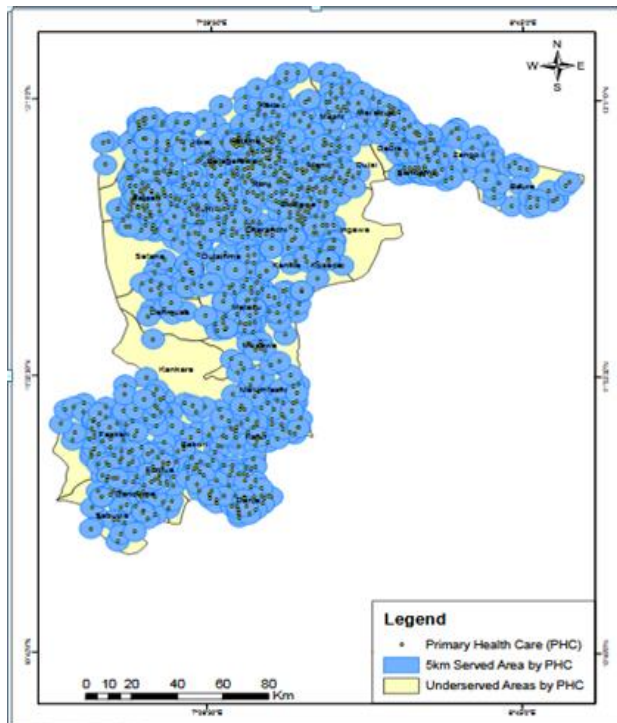
Driving Distance to Secondary and Tertiary Health Facilities in Katsina State

The buffered service zones (an area of equivalent distance produced from a feature of interest) were generated in Katsina State at a distance of 20 kilometres from both secondary and tertiary healthcare facilities, as suggested by WHO. The result obtained from Figure 7 indicates that Katsina zone is well served with secondary health facilities, while Daura and Funtua zone are left underserved, with large empty spaces without health facilities, which means a lot of people residing in these two

underserved zones have to travel a long distance to get access to health facilities, and as we all know, they may likely not use them because proximity is one of the important factors for healthcare utilisation. As a result, the government and other stakeholders in the state must work together to ensure justice and fairness in the distribution of these life-saving health services.

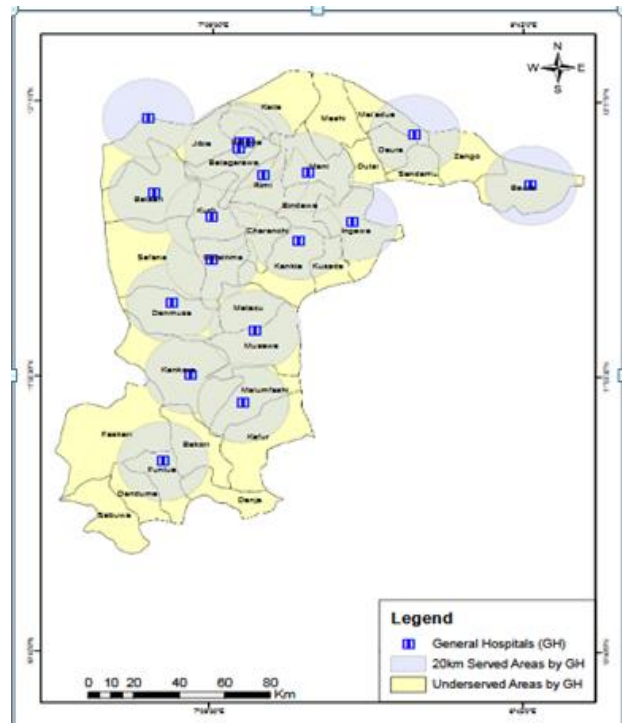
Walking Distance for Private Healthcare Facilities in Katsina State

Figure 8 is showing 5km walking distance from Private health facilities in Katsina State. Private persons in Katsina offer the majority of these private health facilities. The majority of these private health institutions are located around Katsina State's cities,



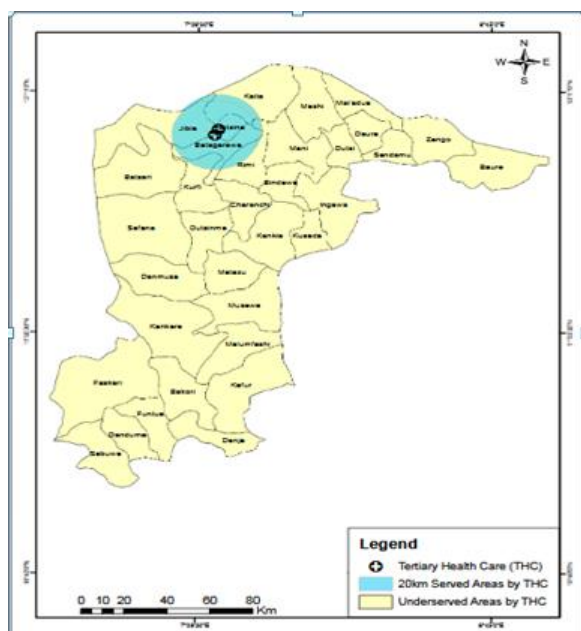
Source: Fieldwork 2024

Figure 6: Location within 5km walking distance from the Primary healthcare centre in Katsina State.



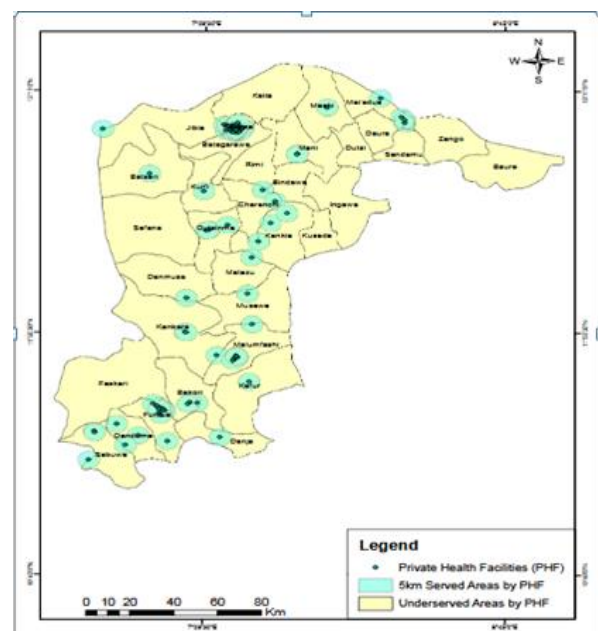
Source: Fieldwork 2024

Figure 7: Shows locations within 20 km of secondary healthcare facilities in Katsina State.



Source: Fieldwork 2024

Figure 8: Maximum driving distance of 20km for tertiary health facilities in Katsina State



Source: Fieldwork 2024

Figure 9: Shows the 5km service area for private health institutions in Katsina State.

which cannot be separated from the question of patronage, i.e. the majority of those who can afford their services live in the state's towns and cities. However, one would completely dismiss the government's assistance and encouragement for the owners of these institutions. So, looking at Figure 8, one can see that Katsina city in Katsina zone has the highest share of these private healthcare facilities, followed by Funtua town in Funtua zone, and Daura zone has the fewest number of private health facilities, exacerbating the issue of marginalisation in healthcare distribution in the study area. The distribution of private health facilities has exacerbated the issue of marginalisation in some areas of the state, as the majority of private health facilities are located in urban areas of the state, owing to market patronage and government support, which means that some people will not have access to these facilities. In order to reduce and minimise the effect of inequality and marginalisation of health facilities in the state, the government has to make a deliberate attempt and give encouragement to these private healthcare owners to locate their facilities in rural areas of the state, especially those situated in the hard to reach settlements of the state. It also has to go to the extent of giving incentives to those that already site their facilities in those undeserved areas.

included, the state's imbalance becomes clear, putting those LGAs and zones who lack these life-sustaining health services at a disadvantage. However, when looking at the allocation of tertiary healthcare facilities in Katsina figure 10, we cannot say that there is a disparity because, according to the Federal Ministry of Health, one tertiary health facility is enough to serve the entire state, and Katsina has two, namely the Federal Medical Centre at Katsina (now converted to a teaching hospital) and the National Fistula Centre, both of which are located in Katsina town. Furthermore, people in the Funtua zone are served by Ahmadu Bello University Teaching Hospital (ABUTH), while those in the Daura zone are served by Aminu Kano Teaching Hospital (AKTH) and the newly established Federal Medical Centre Daura, which was previously located in the Katsina Senatorial District. As a result, we may conclude that there is no geographical deprivation in Katsina State's tertiary healthcare institutions between zones and LGAs.

The study's buffer zone analysis revealed that the Katsina senatorial district is favoured with the majority of healthcare facilities because it appears to be the area that is well served in terms of primary, secondary, and private health facilities in the state. While Daura and Funtua senatorial districts are



Source: Fieldwork 2024

Figure 10: Depicts the 20-kilometer served area for specialised health facilities in Katsina State.

When it comes to maternal and child health, specialised hospitals play an important role, so the distribution must be at every place where births occur in Katsina State, but as shown in Figure 10, only Katsina and Malumfashi are allocated with these facilities. Although all 18 general hospitals in the state include maternity facilities, when the two specialised hospitals in Katsina and Malumfashi are

underserved, with many empty areas lacking supportive health facilities, many individuals and families in the most vulnerable communities are unable to achieve basic living standards due to a lack of access to supportive and lifesaving health care. Thus, the state exhibits a distinct imbalance in the ratio between LGA population and number of healthcare institutions. However, this finding is

consistent with previous studies by Fatih and Istvan (2013), Al-Taiar *et al.* (2010), Abdulkarim *et al.* (2017), Rovali and Kiivet (2006), and Hamza (2014), all of which reported marginalisation in the distribution of health facilities in underserved communities in their respective areas of study.

5. CONCLUSION

The analysis found inequalities in the allocation of public and private healthcare facilities. Katsina senatorial district has an advantage over the Daura and Funtua districts in terms of healthcare delivery/services. However, there was unequal distribution of healthcare between Katsina State's rural and urban areas. Besides, the government should use a population threshold as a yardstick for healthcare facility distribution, as this is the only way to ensure equity and social justice in the allocation of healthcare and other essential services in the state.

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