

GEOSPATIAL ANALYSIS OF PRIMARY HEALTHCARE FACILITIES IN PERI-URBAN AREA OF MINNA, NIGER STATE, NIGERIA

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ABSTRACT

The mapping of primary healthcare facilities in peri-urban areas of Minna, Niger State was carried out. The objectives were to identify the location of primary healthcare facilities, to evaluate the distribution of primary healthcare facilities in relation to the spatial population pattern of the study area and their corresponding distance, assess the capacities of the primary healthcare facilities in relation to the standards of World Health Organization. GPS coordinates of primary healthcare facilities and questionnaire information were the sources of data for this study while GIS software and Statistical package for social sciences were used in analyzing the data. The results of the coordinate points plotted in ArcGIS 10.5 map revealed the spatial distribution of primary healthcare facilities and their corresponding distance, the results of nearest neighbor analysis indicated that the healthcare facilities are dispersed, it also showed on the capacity level that the equipment's in the primary

Introduction:

Peri-urban areas are zones of transition from rural to urban land uses located between the outer limits of urban and regional centers and the rural environment. The boundaries of peri-urban areas are porous and transitory, as urban development extends into rural and industrial land Adetunji (2010).

Accessibility coverage measures how healthcare facilities are physically accessible to the teaming population. Often time, facilities might be available but inconveniently located, therefore hindering physical access. Leapfrogging growth of physical development and disordered distribution of health facilities may have

healthcare facilities in the study areas are in relation to WHO standard. The Geospatial mapping, Nearest Neighbour Analysis as well as administered questionnaire provides information on the closeness of one primary healthcare to another and to the residents.

Keywords: *Peri-urban areas, Primary healthcare facilities, Global Positioning System, ArcGIS and Nearest Neighbor Analysis*

Likely imposed an undesirable consequence on the access to qualitative healthcare service and the environment at large. According to Haggertya, Robergeb, Levesque, Gautheir and Loignon (2014), the issue of equality of access to health care has become a research priority in many countries. As a broad principle, Aregbeyan (1992) reported that the greater the distance between two points, the lower the probability of these points being functionally related. He further expressed that most studies maintained that there is a regular decline in accessibility to health facilities with increasing distance on the trip to hospitals. The significance of using GIS in site selection and distribution of health care centers is to enhance decision-making. The use of GIS for measurement of physical distribution is well established and has been applied in many areas including retail site analysis, transport network planning and analysis, emergency services, and healthcare services Wilkinson (1998).

Every year, governments work with other Non-Governmental agencies by allocating substantial part of their annual budgets to improve health sector. Despite this financial commitment, many citizens are denied easy access to good healthcare services mainly, because of the inability of the government to respond quickly to increasing demands for health facilities to catch up with the rate of urbanization Olawuni (2007), Adetunji (2010).

Adewara (2011) opined that distribution of primary healthcare services in Nigeria is characterized by substantial disparity. He added that such disparity is obvious in the ways some medical facilities are concentrated in one geo-political region at the expense of others. This often resulted in spatial inequality that typifies Nigeria's socio-political landscape. Though government has shown serious commitment towards addressing these inequalities, much is still expected in the areas of technical expertise. Many households in the urban area in developing cities do travel over long distances and spend significant

proportion of their income in order to procure healthcare services elsewhere Adetunji (2010).

Statement of the Research Problem

Development is part of everyday activities of a man's life, as development get to even the most rural part of an area, the need for basic infrastructure becomes imperative. One of those infrastructures is the Health Care and most importantly the Primary HealthCare, the primary healthcare in this case becomes important because it is the one that is easily available and accessible for rural dwellers and those living in peri-urban areas. This has resulted in high maternal and infant mortality rate because of lack of access to primary healthcare facilities to treat the most basic ailment as it affects women and children in peri-urban areas of Minna.

Over the years most of this Primary Healthcare facilities as most not spatially distributed, hence the need to carry out this research, i.e. The Spatial analyses of location and distribution of health care facilities are important as suburban expansion influences the way healthcare facilities are located and accessed. Spatial expansion of suburb area is partly influenced by population dynamics. Therefore investigation of distribution of public healthcare facilities in relation to demographic characteristics forms an important scope of concern in research Msami (2011).

Study Area

Minna, the capital of Niger State is situated between latitude 09°36'45"N and longitude 06°31'12"E. Minna has a population of 291,905 as at 2006 population census count making it the biggest city in Niger State. Minna is about 135km away from the Federal Capital Territory and 300km away from Kaduna city. Within Niger State, Minna is about 86km away from Bida, 100km away from Suleja and about 130km from

Kotangora by road. The town lies on a relatively high land with as light height of between 240m-270m above sea level. It is surrounded by a range of hills that stretch from north east westward towards Bosso and Tudun Fulani.

The town is dissected at the lower part by River Suka and its tributaries. The Southeast part of the town is occupied by River Chanchaga which has been dammed to provide water for the greater part of the town. According to Sprinter

(2018) minna peri-urban residential areas exhibit similar characteristics in term of pattern of development, infrastructure inadequacy and development of squatter's settlements. It is based on this development that this study sets to examine scientifically, the physical characteristics of the peripheral residential neighborhoods. The knowledge of distinctiveness and similarities in physical conditions of the peri-urban environment will help planners and relevant stakeholders saddled with the responsibility of urban management and planning in decision making.

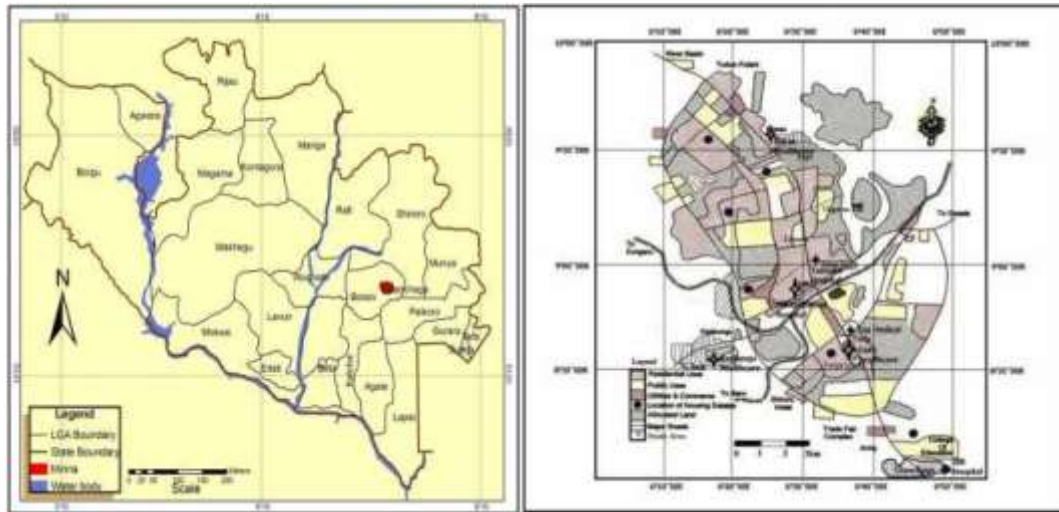


Figure 1: Minna, the Study Area

Source: Department of Geography, F.U.T. Minna (2018)

Literature Review

The number and quality of health facilities in a country or region is one common measure of that area's prosperity and quality of life. In many countries, health facilities are regulated to some extent by law, licensing by a regulatory agency is often required before a facility may open for business. Health facilities may be owned and operated for profit businesses, nonprofit organizations, governments and in some cases by individual, with proportions varying by countries Ahmadi, Seyedi, and Syam (2017).

Several models have been developed for locating static and mobile facilities. They include health care delivery models and nearest neighbor analysis model. Three typical models are evident in health care delivery models.

Firstly, politically driven healthcare delivery operates five levels of health care facilities, provided in a hierarchical order of dispensaries at village level, health centers at ward level, district hospitals at district level, regional hospital at regional level, and national hospital at national/zonal level Msami (2011). Its organizational structure forms a pyramidal like structure where dispensaries are at the bottom, health centers at the middle and hospitals at the apex.

Secondly, the centralized model of healthcare operates on specified standards for locating and distributing community facilities such as health and education, which are provided in master plans on a threshold of population and planning units, on neighborhood, community, district, and central business levels Msami (2011).

Thirdly, the Public-Private Health Care Service Delivery Model driven by neo-liberalism theory and decentralization notion. It is an effort to bridge the gap of health care delivery left by the first two models Msami (2011).

Agaja and Unueroh (2012) findings were basically on locations of primary health care in Ughelli North and Warri South local government area of Delta state. The result from findings indicated that the primary health care was clustered.

Usman and Ahmed (2013) created a data base map that could be used to analyze the type and spatial distribution of primary health care facilities in Kano metropolis in Kano state, population projection was not taken into consideration as it has a very big effect on health facilities.

Abubakar and Ibrahim (2013) looked at the spatial distribution of health facilities and their attribute location in Yola local government area of Adamawa state. It was a big step in spatial mapping because it created a data base and visual map of these facilities in the study area.

MATERIALS AND METHOD

To identify the location of primary healthcare facilities in the study area

Reconnaissance survey to the study area was done to have first-hand knowledge of location of the Primary Health facilities in the study area. Thereafter, Global Positioning System (GPS) was used to obtain coordinate points of health facilities in Peri-urban areas of Minna like Maikunkele, Maitumbi, Chanchaga, Gidan Mangoro and Gidan Kwano. The point that was derived from GPS was inserted into ArcGIS 10.5 for Georeferencing and digitizing.

First, a Google earth image of the study area was acquired and imported into ArcGIS environment. The essence of Georeferencing was to make sure the points on the image is same as what was obtainable on ground, the coordinate of each Primary Healthcare facility was imported for easy identification of location features. After that, digitization of each of the Primary Healthcare facility on the map was done, a shape file was created signifying the varying feature on ground also proximity index was created to determine people access to primary health care.

To evaluate the distribution of primary healthcare facilities in relation to spatial population pattern of the study area and their corresponding distance

The method that was used to achieve this objective is questionnaire. Questionnaires were administered to the residents of the study area in a randomly distributed manner. Statistical Package for Social Sciences (SPSS 17) was used to analyze the data obtained from the questionnaire. Also, Nearest Neighbor Analysis (NNA) was used to determine the spatial distribution of Primary health facilities and their corresponding distance to the residents.

The software that was used to process and analyze the data obtained from the questionnaire is Statistical Package for Social Science (SPSS). Nearest Neighbor Analysis was used. Nearest neighbor analysis is a statistical model developed to measure the spatial distribution of a phenomenon, in accordance with the population of the study area, the nearest neighbor analysis helped to know if the distribution of the population around the primary healthcare facility is sparse, coarse or clustered. Nearest neighbor analysis examines the distances between each point and the closest point to it, and then compares these two expected values for a random sample of points from a CSR (complete spatial randomness) pattern. CSR is generated by means of two assumptions: that all places are equally likely to be the recipient of a case (event) and all cases are located independently of one another.

Which should contain N rows of X, Y coordinates, this coordinates were obtained from the field, which was plotted with values In ArcGIS to determine the proximity of spatial population pattern in relation to the location of the Primary Healthcare facility in the Study Area and W values. Make all W values equal to 1, representing points. The null hypothesis of CSR is tested using the Z statistic (standard normal variate). A negative Z score indicates clustering; a positive

score indicates dispersion or evenness. The Z statistic is calculated using the formula below: The mean nearest neighbor distance

$$\bar{d} = \frac{\sum_{i=1}^N d_i}{N}$$

Where:

N = the number of points. d_i = the nearest neighbor distance for point

Assess the capacity of the primary healthcare facilities in relation to the standard of World Health Organization (WHO)

According to the documents titled "Minimum Standards for Primary Health Care in Nigeria published by the

National Primary Health Care Development Agency (NPHCDA, 2012) which was drafted from World Health Organization Standard, it was opined that the estimated average population a Primary Health Center should cater for is around 2,000 – 5,000. The data was obtained from questionnaires that were administered to the medical personnel of the study area during field survey.

The method that was used to achieve this objective is Analysis of Variance (ANOVA) to check if the Primary Healthcare facilities met the standard as prescribed by NPHCDA and WHO, where there is the dependable variable and in dependable variable. Primary Healthcare facility was the dependable variable while the population of the study area was the in dependable variable. The data collected from the field was analyzed using SPSS and some of the Analysis carried out was ANOVA and descriptive statistics, the result was presented using table, chats, figure, diagrams and maps.

A comparative analysis was carried out using SPSS to check if the collected data on the field met the required standard as prescribed by World Health Organization (WHO) internationally and National Primary Health Care Development Agency (NPHCDA). Analysis of Variance (ANOVA) is a collection of statistical models and their associated estimation procedures (such as the "variation" among and between groups) used to analyze the differences among group means in a sample. In this research, it was used to compare the proximity of Primary Healthcare facilities and how accessible it was for people living around the area. The secondary data that was obtained from the field was imported into SPSS 17 to run the statistical analysis in other to see the variance

between the two variables at hand. In this research, it was tested on dependable and non-dependable variable; the dependable variable in this research was the PHC while the population was the non-dependable variable. The methodology followed to obtain a group of items suitable for evaluating some essential attributes of Primary Healthcare facilities from the perspective of the population.

RESULTS AND DISCUSSION

Identify the Location of Primary Healthcare Facilities in the Study Area

Table 1: Location of Primary Healthcare facilities in the study area

S/N	Area	Longitude	Latitude	Elevation
1	Maikunkele	9°41'14"N	6°29'16"E	249m
2	Maitumbi	9°37'27"N	6°32'13"E	317m
3	Chanchaga	9°35'53"N	6°33'21"E	421m
4	Gidan Mangoro	8°55'01"N	7°33'49"E	571m
5	Gidan Kwano	9°34'16"N	6°27'54"E	535m

Source: Authors field work, 2019

Table 1 showed the coordinate of the locations of the primary healthcare in the study area. The table revealed the latitude and longitude as well as the elevation.

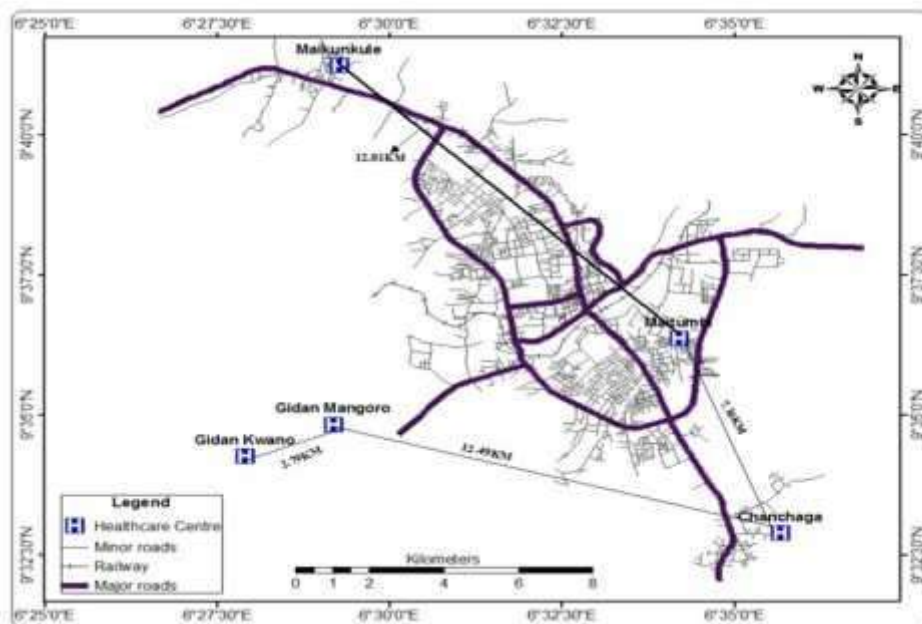


Figure 2: Geospatial Distribution of Primary Healthcare Facilities in the study area Source: Authors work, 2019

Figure 2 showed the geospatial distribution of the study area, it revealed the precise location of the primary healthcare facilities. The road network and as well as their relative nearness to residents were also unveiled. The distance of primary healthcare facility from maikunkele to maitumbi is 12.81km, from maitumbi to chanchaga is 7.10km, from chanchaga to gidan mangoro is 12.49km and from gidan mangoro to gidan kwano is 2.79km, this implies that only the primary healthcare facility between gidan mangoro and gidan kwano met the required distance coverage which is 5km according to World Health Organization (WHO).

Evaluate the distribution of Primary Healthcare Facilities in relation to the spatial population pattern of the study area and their corresponding distance

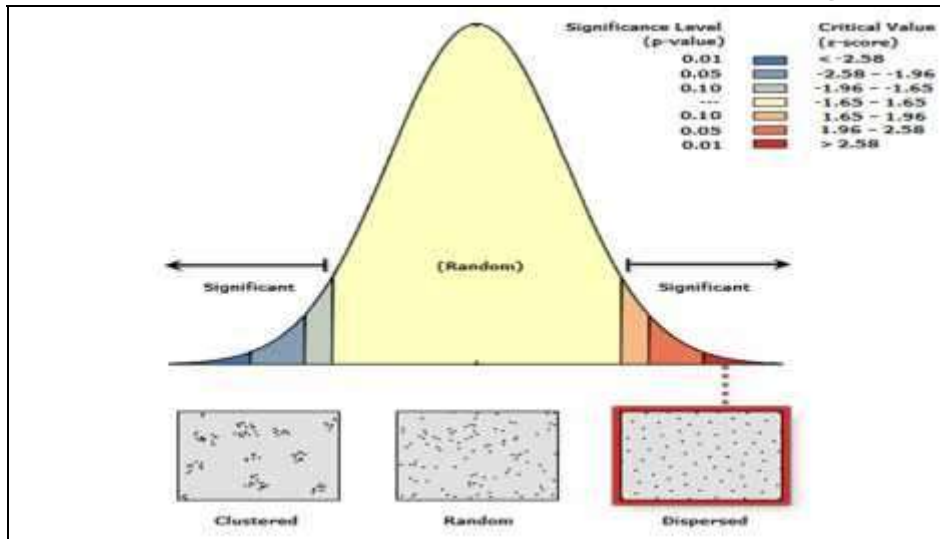


Figure 3: Analysis of Nearest Neighborhood of the Primary healthcare Facilities
Source: Authors work, 2019

The figure 3 showed the spatial distribution of Primary healthcare facilities and their corresponding distance to the residents. It revealed that the primary health facilities are evenly dispersed in the study area with positive z-score value > 2.58 . This implies that the primary healthcare facilities are evenly located in the study area. Hence, signifies accessibility of primary healthcare facilities by patients in the respective community.

Frequency count and mean response of residents on distribution of Primary Healthcare Facilities in relation to the spatial population pattern of the study area and their corresponding distance

Table 2: Frequency count and mean response of residents on distribution of Primary Healthcare Facilities in relation to the spatial population pattern of the study area and their corresponding distance

Statements	SA (5)	A (4)	UD (3)	DA (2)	SDA (1)		Remark
There is Primary healthcare facility in this community	477	150	27	14	2	4.62	Agree
The Primary healthcare facility is close to your house positively. You receive the treatment for all your health problems from	144	269	67	115	75	3.44	Agree
this Primary healthcare facility/ The Primary healthcare facility treats all your health problems	18	109	102	324	117	2.38	Disagree
You communicate with the doctors and nurses efficiently/ it is not difficult to communicate with the doctors and nurses	219	376	1	52	22	4.07	Agree
The structure of the Primary healthcare facility in this community is in good condition	125	332	68	118	27	3.61	Agree
You frequently receive counselling and education at the facility	142	215	34	102	177	3.06	Agree
The Primary healthcare facility has all the necessary equipment	13	212	2	345	98	2.55	Disagree
The Primary healthcare facility provides the basic services	146	335	92	53	44	3.73	Agree

Source: Authors field work, 2019

The table 2 showed that there are primary healthcare facilities in the communities and the Primary healthcare facility are not close to some of the resident's house, with the mean values above the average of 3.00 as well other statements indicating acceptance of the residents. Although the

mean value that they receive the treatment for all health problems and the Primary healthcare facility has all the necessary equipment are closed to the average mean with 2.38 and 2.55 respectively showing that the residents disagreed with the statement.

Assess the capacities of the primary healthcare facilities in relation to the standards of World Health Organization (WHO)

Table 3: Capacity of Primary Healthcare Facilities in the study area

Statements	SA (%)	A (%)	UD (%)	DA (%)	SDA (%)
The doctors, nurses and/or other health workers are trained on regular basis on non-communicable disease (NCD) management	3 (12.0%)	7(28%)	4(16%)	9(36%)	2(8%)
This building has at least five rooms, walls and roof in good condition with functional doors and netted windows	15(60%)	8(32%)	2(8%)	0(0%)	0(0%)
This building has constant electricity	0(0%)	1(4%)	4(16%)	15(60%)	5(20%)
Injections are provided at the facility	15(60%)	10(40%)	0(0)	0(0)	0(0)
There is a safe disposal unit for used needles available	21(84%)	4(16%)	0(0%)	0(0%)	0(0%)
Patient counselling and education units are available at the facility	3(12%)	8(32%)	7(28%)	5(20%)	2(8%)
Blood pressure measuring devices, Oxygen cylinders (full), Weighing machines are available for managing major non-communicable diseases (NCDs)	3(12%)	12(48%)	3(12%)	7(28%)	0(0%)
Blood pressure measuring devices (BPMDs) are often calibrated and checked for accuracy	25(100%)	0(0%)	0(0%)	0(0%)	0(0%)
Obsolete or damaged equipment are usually maintained and repaired	13(52%)	5(20%)	2(8%)	3(12%)	2(8%)
Medicines are purchased directly by the facility for distribution to patients	15(60%)	10(40%)	0(%)	0(%)	0(%)

The total number of visits to this health facility for outpatient services is based on record/register	7(28%)	6(24%)	10(40%)	2(8%)	0(0%)
You can refer patients to another institution in the event of a chronic disease emergency	19(76%)	6(24%)	0(0%)	0(0%)	0(0%)
The facility has an ambulance	1(4%)	3(12%)	0(0%)	15(60%)	6(24%)
Patients with non-communicable diseases (NCDs) can be referred for a second opinion/specialist consultation	12(48%)	13(52%)	0(0%)	0(0%)	0(0%)
Patients do have access to the facility by walk-in only	7(28%)	10(40%)	0(0%)	6(24%)	2(8%)
This facility keeps a record of patient	23(92)	5(8%)	0(0%)	0(0%)	0(0%)
Records are kept in patient's files	24(96%)	1(4%)	0(0%)	0(0%)	0(0%)
Patient's files are retrieved and consulted each time they visit this facility	15(60%)	10(40%)	0(0%)	0(0%)	0(0%)
This facility have stock card or log books for medicine and consumables (e.g. syringes, bandages)	23(92)	5(8%)	0(0%)	0(0%)	0(0%)
Patients pay for medication in this facility	23(92)	1(4%)	3(12%)	0(0%)	0(0%)
Patients pay for consultations in this facility	0(0%)	7(28%)	7(28%)	10(40%)	1(4%)
Patients pay the facility for diagnostic tests	18(72%)	7(28%)			
The amount for medicines, consultations, diagnostic tests are subsidized	23(92)	5(8%)	0(0%)	0(0%)	0(0%)
There is an active community activities to support non-communicable disease (NCD) services provided in this primary healthcare (PHC) facility	1(4%)	2(8%)	14(56%)	8(32%)	0(0%)

Source: Authors field work, 2019

Table 3 showed to the capacity level of the primary healthcare in the study. The capacity measures are in relation to the WHO standard.

Analysis of Variance Test for Significance Difference between Capacity of Primary Healthcare facilities in the Study Area and NPHCDA and WHO Standard

Table 4: Analysis of Variance Test for Significance Difference between Capacity of Primary Healthcare facilities in the Study Area and NPHCDA and WHO Standard.

	Sum of Squares	Df	Mean Square	F	P
Between Groups	30.324	2	15.162	27.147	0.080
Within Groups	149.124	21	23.559		
Total	179.448	23			

Source: Authors field work, 2019

Table 4 revealed the rating of the capacity of the primary healthcare facilities in relation to the NPHCDA and WHO standard. The p-value of $0.080 > 0.05$, indicated that there is no significance in the capacity rating of the primary healthcare in the study area as compared to the NPHCDA and WHO standard.

Discussion of Results

The aim of the study was to evaluate the spatial distribution of primary healthcare facilities in Peri-urban areas of Maikunkele, Maitumbi Chanchaga, Gidan Mangoro and Gidan Kwano of Minna, Niger State, using geospatial analysis. The coordinates point of primary healthcare facilities was taken in order identify and ascertain various locations of the facilities. A structured questionnaire was also administered to affirm the result obtained from the geospatial analysis and also revealed the capacity and quality of services of the primary healthcare facilities in the study area.

The result revealed the spatial distribution of the healthcare facilities in respective location of the study area, the map shown in figure 2 gives the extensive distribution of the healthcare facilities in the study area by unveiling the road network as well as its position to resident. The result obtained from the nearest neighborhood analysis as shown in figure 3 revealed the nearness of those health facilities from one another as well as their relative position to the resident. A positive Z score value of >2.58 was obtained which indicated that the healthcare facilities are dispersed which was not in line with the response gotten from the residents on availability and closeness of the primary health facilities to their respective household with over 80% of the residents' recognition.

Taking from the resident's response on various questions, this revealed their perception on quality of services provided by the primary healthcare facilities to be on average, with slight average mean response above average of (3.0). It was discovered from the findings of the study that the primary healthcare facilities is restricted to treatment given to patients; treatment such as non-communicable diseases are rarely treated. Hence, only basic services are offered to the patients. The result obtained from assessment of the capacities of the primary healthcare facilities in relation to the standards of World Health Organization (WHO), table 4 revealed the healthcare facilities medical practitioner response on various WHO requirements. The numerous questions namely; regular training of the doctors, nurses and/or other health workers on non-communicable disease (NCD) management, quality of infrastructural/services, availability of equipment and medicine, utilization of the services, referral of patient, record keeping, financing and administration and community link. It was unveiled that most of the capacities required by WHO are met, however, there are poor medical personnel's training on non-communicable diseases and community link in regards to the proper development and infrastructure growth of the primary healthcare facilities in the study area. The result of the primary healthcare facilities was assured with the outcome of the ANOVA p-value of $0.080 > 0.05$, these indicated no significance difference between the primary healthcare facilities capacity and NPHCDA and WHO Standard.

Conclusion

In conclusion, geospatial approaches have proven to be useful as it provides information about the spatial distribution of healthcare facilities in the study area. The Geospatial mapping, Nearest Neighbour Analysis as well as administered questionnaire provides information on the closeness of one primary healthcare to another and to the residents. The quality of services offered to the people was also determined to be at average.

The capacities in the primary healthcare facilities in the study area were discovered to be in line with the requirement set by World Health Organization. However, the findings emanated from the study showed that there is need for expansion of services or perhaps need for more healthcare services in the study area, serious attention should be given to the medical personnel's for offering

treatment on Non-Communicable Diseases by primary healthcare in the study area as well as community link for it propagation.

Recommendations

The following are recommendations of the study

1. The primary healthcare facilities should be expanded and increased to meet the population trend of the community.
2. The medical practitioners in the primary healthcare facilities should be given proper training and also equipped on the treatment of non-communicable diseases.
3. Strict measure should be taken on billing of patient on services offered to them.
4. Community link should be encouraged to improve and develop the standard of services offered in the primary healthcare facility.
5. Government should pay more attention to improve the status of the primary health facilities as they serve as first hand medical service provider in every community.

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