SPATIAL DISTRIBUTION OF PRIMARY HEALTH CARE FACILITIES IN KANO SOUTH SENATORIAL ZONE, KANO STATE, NIGERIA

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ABSTRACT

While PHC facilities are relatively uniformly distributed throughout Local Government Areas (LGAs) in Nigeria, the rural people tend to underuse the basic health services. Thus, the weakening of such public health services in terms of availability and the increasing demand of healthcare due to rapid population growth in the study area, might have placed PHC facilities in a deplorable situation. This study seek to analyze the spatial distribution of PHC facilities in some selected LGAs of Kano South Senatorial Zone, Kano State, Nigeria. These study locations were selected using systematic sampling technique. The study sites include Sumaila, Gaya, Ajingi and Rano LGAs. Data used for the study included: Administrative map and Google earth satellite imagery of Kano state, population data, coordinates of all the wards of the study area and the PHC facilities. Information on the number and addresses of the facilities were also used. These data were incorporated into ArcGIS 10.1 Software interface, mapped and analyzed using GIS Technique (Nearest Neighborhood) and descriptive statistics were also used. Results of the analysis showed that PHC facilities visually and descriptively within the study area, with Sumaila having the highest percentage (36.03%), while Rano had the least (12.61%). Furthermore, the Neighborhood analysis revealed similar distribution pattern of the facilities with less than 1% (0.01 significance level). Based on WHO criteria, the distribution of the PHC facilities with respect to population sizes of the different LGAs appeared to be inadequate (with a shortfall of 411 health posts, 32 health clinics and 6 primary health centers), where the existing coverage offers one facility to 8,833 people. Based on the results of the analysis, there is urgent need for all the stakeholders to invest more on PHC which should reflect the population density of the study area so that acute health problem could be minimized.

Key words: Distribution, Population Size, Primary Health Care Facilities, Spatial Pattern

INTRODUCTION

Soon after political independence in the 1960s, a major concern of most countries in Africa was the provision of adequate healthcare systems to meet the needs of their people particularly where such services were grossly insufficient (Federal Ministry of Health [FMOH], 2009). Partly based on this development, every successive government in collaboration with other multinational and international agencies devoted substantial part of their annual budgets to health care provision and delivery (Olawuni, 2007).

In Nigeria, health planning did not start until 1946 with the launching of the 1946-56 ten year development plans. At the end of the plan period, not much had been achieved because common indicators of health revealed a deplorable situation. In addition, the problems of inadequate and lopsided distribution of these institutions favoured the urban areas and neglect the rural areas (FMOH and United Nations Fund for Population in Africa (UNFPA), 2008).

Prior to the 1978 Alma-Ata declaration, the country had set the ball rolling with the implementation of the Basic Health Services Scheme (BHSS) (1975-1980), which was Nigeria's first serious attempt at the implementation of Primary Health Care (PHC). This scheme concentrated on the provision of health facilities, training of health workers and paying little attention to community participation, intersectoral cooperation or use of local technology (Obionu, 2007). Another attempt at implementing PHC was between 1980 and 1985. During this period, the government began the implementation of the various programme components of PHC without any attempt to integrate the services and without any clearly mapped-out plans and objectives. This led to fragmentation of services with both the states and the federal government pursuing different objectives (Obionu, 2007).

In order to ensure the sustainability of PHC in Nigeria, the Federal Government by decree number 29 of 1992, set up the National PHC Development Agency (NPHCDA). This body was charged with the responsibility to mobilize support nationally and internationally for PHC programme implementation (FMOH, 2004; Raids, 2008; Magawa, 2012). The Federal Government using FMOH is responsible for national health policy formulation as well as management of tertiary health facilities, state government operate secondary healthcare facilities, while local government councils (LGCs) manage the PHCs (FMOH, 2009). Despite these efforts, much of the underlying weaknesses and constraints of the health sector persist. The vision of becoming one of the leading 20 economies of the world by the year 2020 which is closely tied to the development of its human capital through the health sector has become a dream (FMOH, 2009).

The world health report ranked Nigeria as the 197th of 200 member nations for its health systems performance (WHO, 2010). This poor performance could be attributed to convoluted and poorly coordinated roles and responsibilities with regards to both the governance structure and the provider system. Nigerian health system according to Universal Health Coverage (2013) is operating in a complex and rapidly-changing environment, and has made a great deal of progress, but there are still substantial strides to be made. Thus, often times, in planning for healthcare services, sector approaches are adopted, without giving much thought to the spatial dimension of the facilities provided. This often brings about lopsidedness in the spatial distribution of these facilities, with one section of an area experiencing glut, while other part(s) suffer lack.

Unfortunately, for some of the rural dwellers in Kano state, the general hospitals, which are the major avenues for health care delivery, are located very far away in the headquarters of the Local Government Areas (LGAs). So, while the urban areas have other alternative hospitals, either privately or government owned, only a few of the rural areas can boast of PHC facilities (Ariyo and Datong, 1996; Kibon and Ahmed, 2013). Previous works on healthcare distribution in Nigeria revealed that PHC facilities were not equitably distributed in most parts of the country (Nengak and Osagbemi, 2011; Abbas, Auta and Na'iya, 2012; Musa and Abdulhamid, 2012; Abubakar and Ibrahim, 2013; Kibon and Ahmed 2013). This was also justified in the study of

Adetunji and Adeyinka (2013), where findings revealed that healthcare facilities were unevenly distributed in Ilesa Southwestern Nigeria. Health trips were skewed towards zones with more health services. Likewise, in Lokoja, Kogi State of Nigeria, "Nearest neighbor analysis" indicated a weak random distribution of healthcare facilities (Michael, 2011). To summarize the picture, Lekan (2010) examined the distribution of healthcare facilities in the thirty LGAs of Osun State, Nigeria. Findings indicated the existence of gaps in access to healthcare facilities, because the facilities were unevenly distributed.

These studies and many more have made effort to unravel the situation in Nigeria, yet, it is still not known whether PHC facilities in particular are adequate, evenly distributed and harmonized with certain recommended standards within the various LGAs of Kano south senatorial zone, Kano State, Nigeria, because none of these studies have attempted to explore the potential use of GIS technique and the universal accepted standards, such as those set by WHO (1997), to analyze the existing situation in the study area. It is against this backdrop that this study is interested in the use of Geographic Information System (GIS) to determine locations and spatial pattern of PHC facilities, and examine their distribution with respect to population sizes in the study area.

THE STUDY AREA

Kano south is a senatorial zone located in Kano state northwestern Nigeria. The zone lies between latitude 10° 35´46´´N - 12° 49´19´´N of the equator and longitudes 7° 38´32´´ E - 9° 23´8´´E of the Greenwich meridian. It covers about 11554 Km^2 land area. Bordered to the north by some LGAs of Kano north senatorial zone, to the north-east by Jigawa state, to the south-east by Bauchi state, Kaduna state to the south-west and to the north-west by some part of Katsina sate. The zone encompasses all the sixteen LGAs; Bunkure, Kibiya, Rano, Tudun-Wada, Doguwa, Rogo, Karaye, Bebeji, Kiru, Sumaila, Garko, Takai, Albasu, Gaya, Ajingi, and Wudil (Fig. 1). The study area is an ancient traditional area inhabited by the dominant indigenous Hausa community with a population of 3,028,169 people as at 2006 (National Population Commission [NPC], 2009). It is estimated that, this figure grew to 3,864,339 as at 2015.
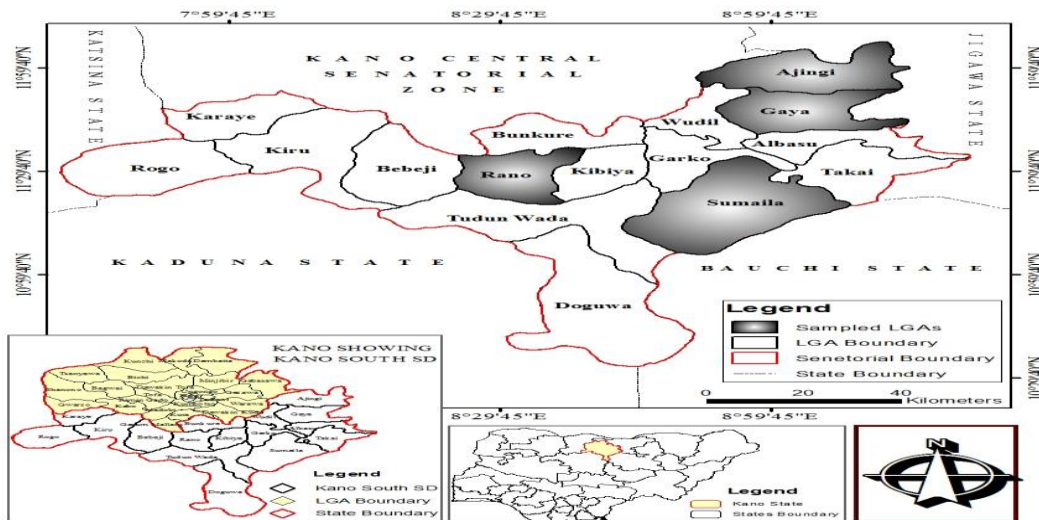

Figure 1: The Study Area
Source: Modified from Administrative Map of Kano State

MATERIALS AND METHODS

Sources of Data and Processing

Data used for the study were sourced via primary and secondary methods. These consist of collection of the coordinate of the PHC facilities using Global Position System (GPS) and information about their number and addresses collected from Kano state PHC Management Board, which were used to create a spatial database of the facilities in MS excel environment. Obtained from Kano State Ministry of Land and Physical Planning (KMOLPP) center of GIS were: the vector layer of road network data, the coordinates of wards and the administrative map of Kano state, which with the aid of the State's boundary and the control points extracted from Google earth satellite imagery, were geo-referenced, projected, vectorized and clipped (using clip analysis in ArcGIS) to create map of the study area and the base maps as well as shapefiles of the selected LGAs. Population data of both 2006 and 1991 were collected from NPC (2009) and projected to the year 2015: $[Po=P1 (1+r)^n]$, at 3% growth rate and tabulated.

Sampling Technique and Sample Size

The most common form of systematic sampling is an equal-probability method. This approach was adopted in selecting the LGAs within the study area. Thus, all the 16 LGAs were written each on a sheet of paper and tossed, one sheet containing Sumaila LGA was selected at random. All the LGAs were then listed in hierarchy of population in descending order. By computing: $K = N/n$. Where: k is the sampling interval, n is the sample size and N is the population size, every k^{th} element was chosen from the selected starting point (Sumaila LGA) (Ken, 2004). The sampled LGAs which were selected hierarchically are as follows: 2nd (Sumaila), 6th (Gaya), 10th (Ajingi) and 14th (Rano) respectively, with Sumaila LGA having the highest population figure while Rano had the least population size.

Techniques of Data Analysis

The spatial database of the PHC facilities was imported into the ArcGIS 10.1 software interface. As such, all the shapefiles holding the relevant data layers were then spatially overlaid to create a combination of thematic map of point, line and polygon feature classes. Thus, the x and y spontaneously displayed the location of each PHC facility in space, along with road network and electoral wards as reflected in their attribute tables. This aided to visually appreciate and examine the data. Therefore, the NNA inferential statistical tool in ArcGIS 10.1 was computed to explore the spatial pattern that exist in the data. A negative Z-score indicates clustering, while a positive score means dispersion or evenness. Moreover, the Z-score usually returns a range of values between -2.58 to 2.58. A negative Z-score less than -2.58 indicates a significant clustering. A range of scores between both -2.58 to -1.96 and -1.96 to -1.65 shows that there is tendency towards a cluster pattern. However, a range of Z-scores between -1.65 to 1.65 indicates a random distribution. But then again, if the Z-score lies between both 1.65 to 1.96 and 1.96 to 2.58 then it is obvious that there is tendency towards a regular pattern. On the other hand, a positive Z-score greater than 2.58 indicates a significant regularity or dispersal (Getis and Ord, 1998).

The population data and that of the number of PHC facilities were computed and analyzed descriptively base on the WHO (1997) recommended standards which suggested that: Dispensary and health post (HP) should serves a population of 2,000, health clinic (HC) should serve a population of 20,000, while primary health (PH) centres should serve a population of 40-50000. Therefore the gap between the required and the available facilities was obtained by dividing the total number of each category by the threshold population of the ward it serves. Likewise, the existing PHC coverage was achieved by dividing the total number of the facilities by the total population of the selected LGAs.

RESULTS AND DISCUSSION

Spatial Distribution of PHC facilities in the Selected LGAs

The result of the data set for the PHC facilities is displayed in Table 1, showing the type, number and percentage of the PHC facilities in the selected LGAs.

Tables 1: Distribution of PHC facilities in the Selected LGAs

Selected LGAs	Type of PHC Facilities			Number of PHC Facilities	Percentage (%)
	HP	**HC**	**PHC**		
Sumaila	32	1	7	40	36.03
Gaya	19	4	5	28	25.23
Ajingi	20	5	4	29	26.13
Rano	7	6	1	14	12.61
Total	78	16	17	111	100

Acronyms: HP: Health Post, HC: Health Clinic, PHC: Primary Health Centre
Source: Field Survey, 2015

From Table 1, it could be seen that, Sumaila LGA had the highest share of PHC facilities at (40) 36.03%. Also according to the types of the facilities, the LGA is endowed with 32 health posts, 7 primary health centres and only 1 health clinic. Ajingi LGA had 29 facilities, with 5 health clinics, 4 primary health centres and 20 health posts, representing 26.13%, as shown in Table 1. Further, 28 facilities (4 health clinics, 5 primary health centres and 19 health posts) are distributed in the communities of Gaya LGA, representing 25.23%. Rano LGA had the least share of the PHC facilities at (14) 12.61%. According to the types of the facilities however, the LGA has 6 health clinics, 7 health posts and 1 primary health centre as shown in Table 1. However, the facilities were mapped within the ArcGIS, in order to understand visually the spatial distribution of the different categories.

Fig. 2 shows the spatial distribution of PHC Facilities in Sumaila LGA. From the figure, the available health clinic in Sumaila LGA is located at the northern part of the area in Gala ward and the majority of the health posts are located mostly to north-eastern part of the region around Garfa, Rumo, Kanawa, Magami, Gediya and Sumaila communities, while the rest are dispersed to the south-west at Massu, Sitti and Gani wards. Moreover, the available primary health centres in the LGA are also distributed majorly to the south-west and some to the south-eastern part of the LGA at Magami and Rimi wards respectively. This implies that, every ward has at least one category of PHC facility, but only some have primary health centres.
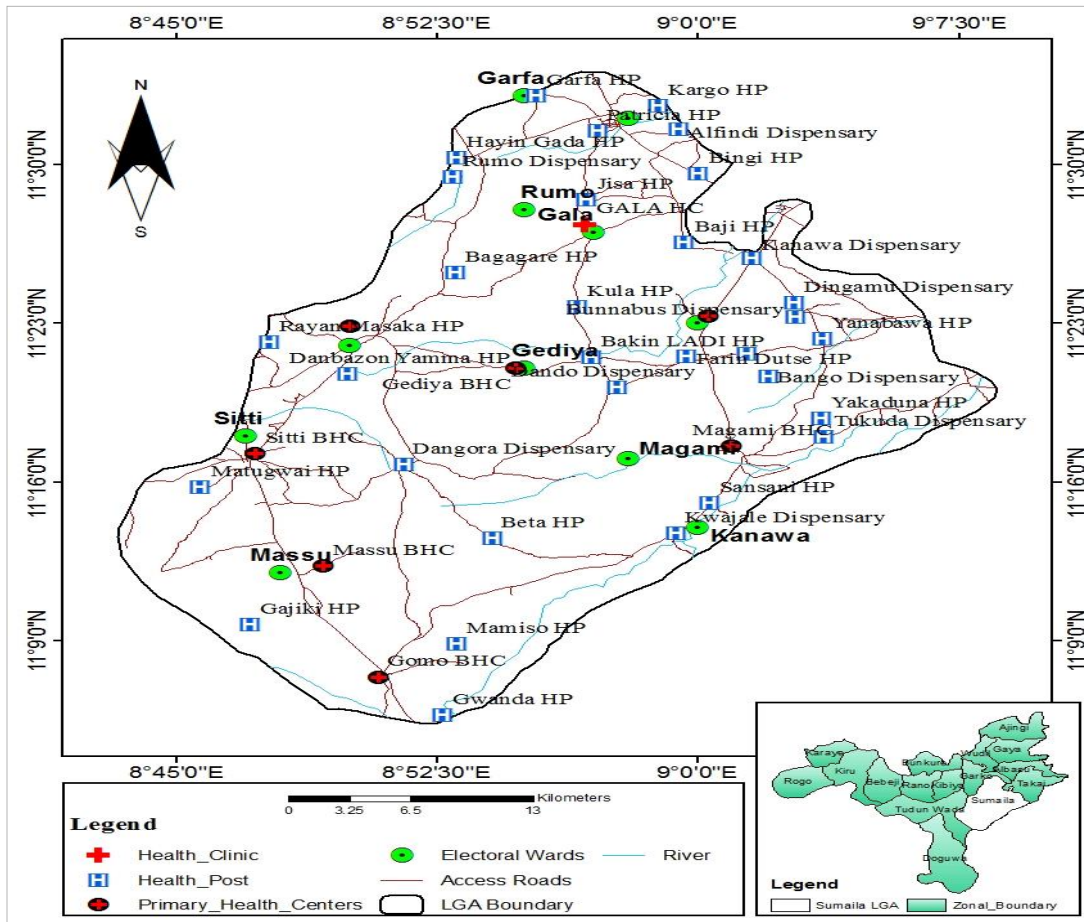
Figure 2: Spatial Distribution of PHC Facilities in Sumaila LGA
Source: GIS Analysis, 2015

Fig. 3 shows the spatial distribution of PHC Facilities in Gaya LGA. From the figure, the existing health clinics in Gaya LGA are dispersed at the north and north-eastern part of the area around Gamarya, Balan, Maimakawa, Gaya-South and Gaya-North wards. Also the available health posts are dispersed majorly to the western part of the area, while the rest to the south-east in virtually all the communities except Gamarya and Gaya-south. Moreover, the existing primary health centres are distributed to the north-west and north-eastern part of the region at Maimakawa, Kazurawa, Balan, Shagogo, and Kademi wards. This shows that each ward had at least one category of the facility in this area.
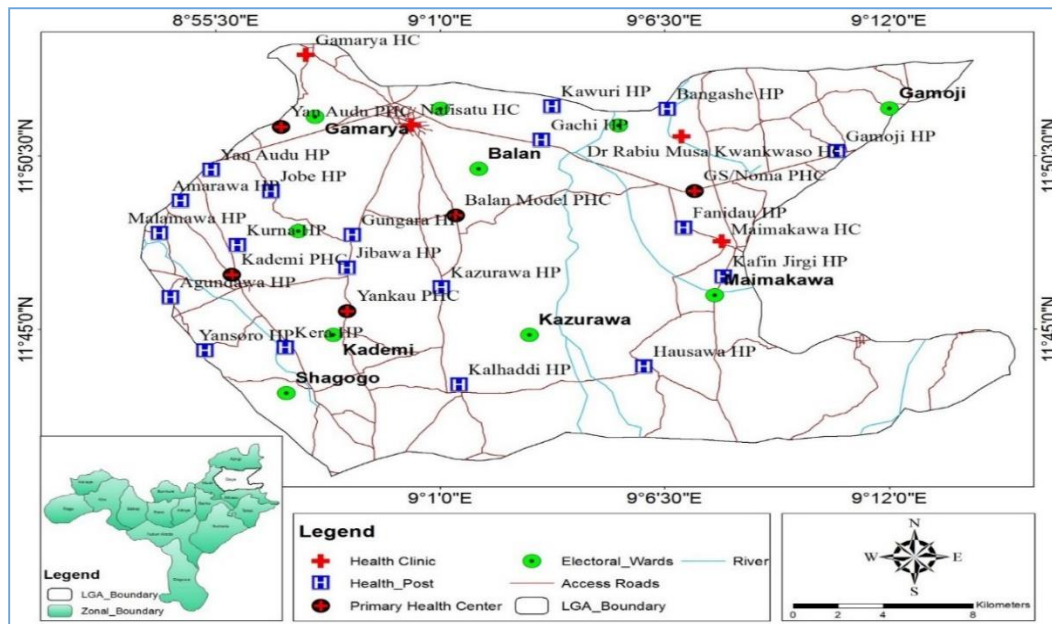
Figure 3: Spatial Distribution of PHC Facilities in Gaya LGA
Source: GIS Analysis, 2015

In Ajingi LGA, some health clinics are dispersed at the centre of the LGA in Gafasa and Kunkurawa while the rest which are mostly health posts are located at the north-western part around Unguwar-Bai, Gurduba, Balare, Chula, Dabin-Kanawa and Dundun communities as shown in Fig. 4. Also, all the primary health centres are located at the centre of the LGA particularly in Ajingi, Maimakawa and Balare and except for one which is isolated at the southern part of the region in Toranke ward. This means that, each ward had at least one category of PHC facility, but only some have primary health centres.

It could be seen in Fig. 5 that, the health clinics are distributed across the area particularly around Rurum Sabon gari, Rurum Tsohon gari, Zinyau, Saji and Dawaki. Also, the existing health posts are located in the LGA to the south and north-eastern part, these locations are within the communities of Zurgu, Yalwa, Lausu, Madachi and Rurum Tsohon gari. The only existing primary health centre is situated in Rurum Sabon -gari ward at the western part of the study area. A look at the distribution of the facilities suggests that, all the wards have at least one category of PHC facility except Rano ward which has none at all. In terms of primary health centre, Rano LGA is served with only one facility.
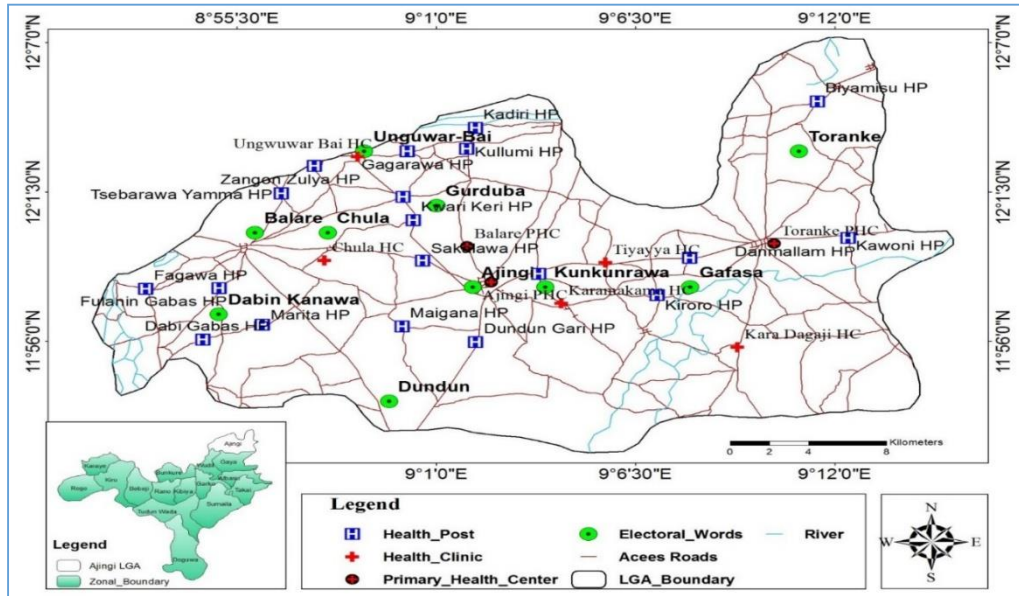
Figure 4: Spatial Distribution of PHC Facilities in Ajingi LGA
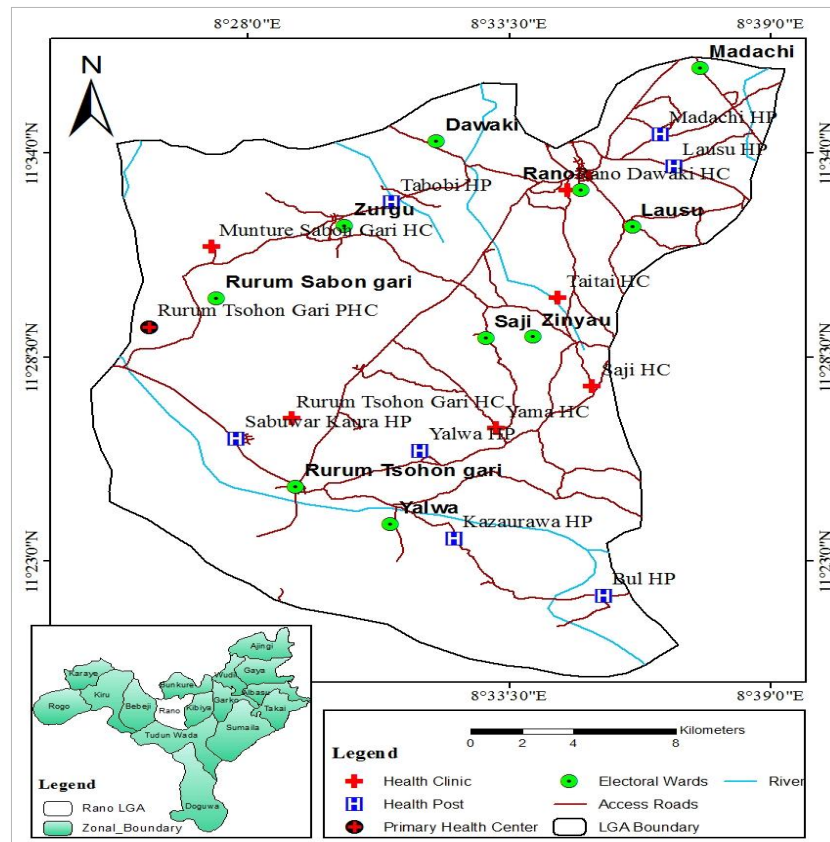Source: GIS Analysis, 2015

Figure 5: Spatial Distribution of PHC Facilities in Rano LGA
Source: GIS Analysis, 2015

Therefore, all the LGAs have three existing types of PHC facilities as at present, these include health post, health clinics and primary health centers. However, these facilities in the selected LGAs were not equally allocated. Thus, Sumaila has the utmost share, followed by Ajingi, Gaya, and then Rano LGAs respectively. Moreover, a high percentage of the facilities is recorded in Sumaila while a low percentage is found in Rano LGAs. When this is disaggregated according to types of the facilities, the highest number of health posts and primary health centres are distributed in Sumaila LGA with Ajingi ranking second followed by Gaya and subsequently Rano having the least. On the contrary, Rano has the highest number of health clinics, followed by Ajingi, then Gaya with Sumaila having the least. This represent dissimilarity in the distribution of the facilities which could be due to series of locational factors. Thus, according to Luo and Qi (2009), the factors may include: population size, easy access to facility from other nearby settlements, availability of approachable roads, mode of transport or impediment like water bodies, forests, rugged terrain and others. Otherwise, the facilities were rather distributed at random.

A similarity can be drawn with a study conducted by Mai-bukar (2016), where it was revealed that, healthcare facilities in Maiduguri LGA of Borno state Nigeria, were not consistently distributed across the wards, with Maisandari having the highest share at (8) 15.7%, Lamisula having the least at (1) 2.0%, while Gomboru and Bulabulin have no facility at all. Likewise, in Kano metropolis, Kano State Nigeria, Kibon and Ahmed (2013) discovered that, Dala and Fagge LGAs had equal number of 9 health care facilities (HCFs), likewise Municipal and Gwale LGAs had equal number of 12 HCFs and Nassarawa LGA had 17 HCFs while Tarauni had 10 HCFs as at the year 2012. This means that even within the metropolitan Kano, HCFs were not equally distributed across the LGAs.

Consequently, this scenario discloses that, the facilities have been provided almost everywhere, but not consistently distributed at ward level in the selected LGAs, because some communities had higher than others with Rano ward (Rano LGA) having no facility at all. Furthermore, the dominant type of the existing ones serving the communities at present are health posts. This category of health care provide mostly preventive services with little or no clinical care (KSMOH, 2010). Therefore, as compared to the other types of PHC facilities, most of the communities had few health clinics and not all the political wards had primary health centres. This contradicted one of the itemized objective of Kano state's health development plan which was by the year 2011, complement of preventive and curative health care services in all electoral wards would be provided, such as those offered at primary health centres (KMOH, 2010).

Similar variation in terms of availability of healthcare facilities could be traced in the study of Muhammad, *et al.* (2014) which revealed inequality in the distribution of health care facilities within the communities of Giwa and Tofa LGAs of Nigeria. Whereby areas in the north eastern parts bordering other LGAs in Giwa have lower number of the facilities as compared to the other areas. It was also observed that the wards at the extreme southwestern part of Tofa LGA have lower number of the facilities than the other parts.

Spatial Pattern of PHC facilities in the selected LGAs

The locational pattern of PHC facilities in the selected LGAs is presented in Table 2. The Table shows the Average Nearest Neighbour summaries, the significant levels (P-Value) and critical values (Z-Score).

Table 2: Average Nearest-Neighbor Summary

LGAs	Z-Score	P-Value	Remark
Sumaila	2.779848	0.005438	Dispersed
Gaya	4.424630	0.000010	Dispersed
Ajingi	3.101713	0.001924	Dispersed
Rano	2.814758	0.004881	Dispersed

Source: GIS Analysis, 2015

In Sumaila LGA, the critical value is apparently positive (2.779848) and this confirmed that the locational pattern of PHC facilities in the area is dispersed at 0.005438 probability level. Gaya LGA, with positive z-score of 4.424630 shows a dispersed pattern at 0.000010 probability level. Likewise in Ajingi LGA, the positive z-score of 3.101713 at 0.001924 probability level revealed a dispersed pattern. The same goes to Rano LGA with (2.814758) critical value at 0.004881 probability level (Table 2).

Since the Z-score in the corresponding LGAs is greater than standard critical value of 2.58 agreeing to Getis and Ord (1998), therefore the locational pattern of PHC facilities in the study area is said to be significantly dispersed with less than 1% (0.01 level of significance) likelihood that the pattern could be the result of random chance. This agrees with Muhammad *et al*. (2014) whose study revealed that, locational pattern of health facilities in both Giwa (Kaduna State) and Tofa (Kano State) LGAs of Nigeria is dispersed as shown by the Average Nearest Neighbour analysis. It also goes in line with Kibon and Ahmed (2013), who discovered that, pattern of healthcare facilities in Kano Metropolis Kano State, Nigeria is clustered and haphazardly distributed. Likewise Musa and Abdulhamed (2012), whose findings revealed that health care facilities in Jigawa state, Nigeria are unevenly distributed. Also, Adetunji (2013) revealed that health facilities in Ilesa Southwestern Nigeria were unevenly distributed. This contradict Michael (2011) who discovered that healthcare facilities in Lokoja, Kogi State of Nigeria were randomly distributed.

Distribution of PHC facilities with respect to population sizes in the Selected LGAs

Figures 6, 7, 8 and 9 shows the available and required PHC facilities as well as the gap between them in the study area.
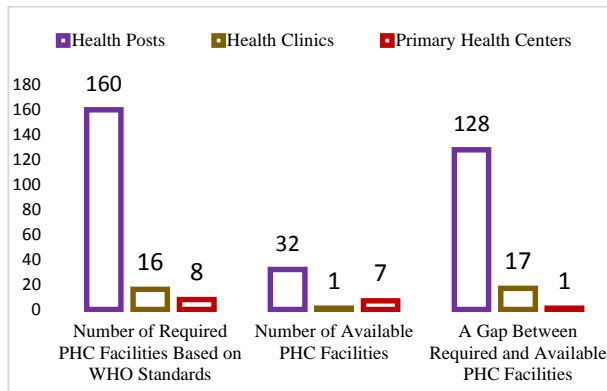
Fig. 6: Difference in Required/Available PHCFs in Sumaila LGA
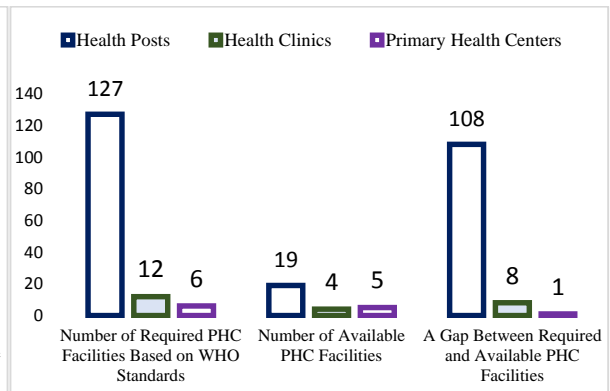Source: Author's Computation, 2016

Fig. 7: Difference in Required/Available PHCFs in Gaya LGA
Source: Author's Computation, 2016

From Fig.6 it could be observed that, Sumaila LGA with the highest population of 321, 347 had a shortfall of 17 health clinics, 128 health post and 1 primary health centre. A look at these shortages suggest that, the neighboring communities of Gala and Rumo where the only available one health clinic is located are more advantaged in terms of health clinic services over the rest of the areas including the LGA capital (Fig, 2). Gaya LGA with a population figure of 254,654 has a shortfall of 8 health clinics, 108 health post and 1 primary health centre (Fig. 7).
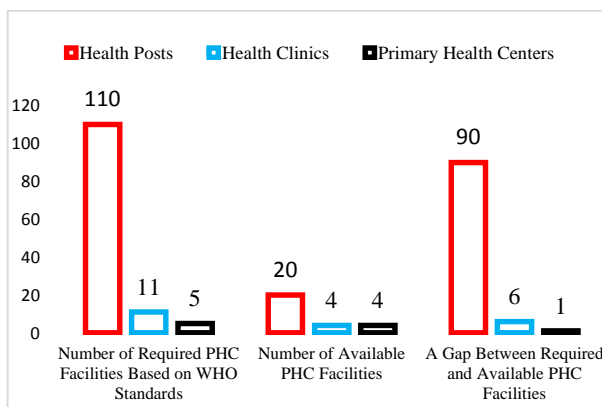

Fig. 8: Difference in Required/Available PHCFs in Ajingi LGA
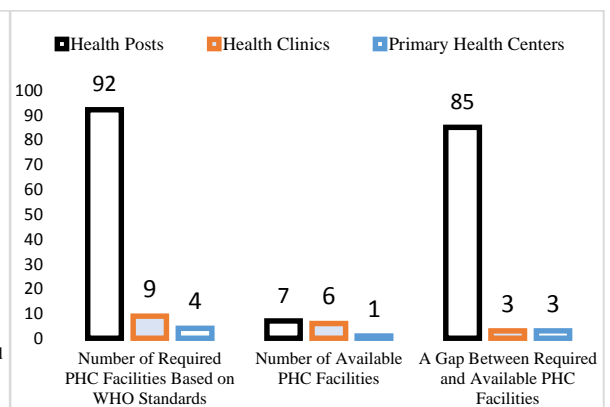Source: Author's Computation, 2016

Fig. 9: Difference in Required/Available PHCFs in Rano LGA
Source: Author's Computation, 2016

Also, a shortfall of 6 health clinics, 90 health posts and 1 primary health centre is also discovered in Ajingi LGA. The area has a population of 220,245 (Fig. 8). Fig. 9 further shows that, Rano LGA with population figure of 184,247 has a deficit of 3 health clinics, 85 health posts and 3 primary health centres. As compare to the rest of the LGAs however, Rano is considered to be severely underserved in terms of primary health centre. However, the distribution of PHC facilities as discovered in this study, did not adequately portrayed the required supply of the services to serve the needy populace. This confirms KSMOH (2010:16) that "we have already seen that the PHC system is indeed weak in terms of coverage in Kano State".

The weakness of public health services in terms of availability could be mainly as a result of inability of the concerned authority to respond as quickly as possible to increasing demands for health facilities to match the rapid population growth rate of the study area. This agrees with

KSMOH (2010:18) which lamented that, "There is one weakness that is not actually new but did not receive attention in Kano State Economic Empowerment and Development Strategy (KSEEDS); that is the observation that it is the most disadvantaged in society who seek- and get - the least share of health care. It is proposed that this must be a priority consideration in health care strategy for Kano State". Though, the KSEEDS contained a proposal that "there should be a health facility for any settlement with 500 people in Kano State (KMOH, 2010)". Five years after, the selected LGAs still had a deficit of 411 health posts, 32 health clinics and 6 primary health centres, where the existing coverage offers one facility to 8,833 people. This scenario to some extent corroborates the lamentation of KSMOH (2010:14) that; "Out of a national range of states where PHC coverage offers one facility to just over 2,000 persons up to others where it offers only one to around 13,500 persons, Kano comes in the bottom category with only one facility for somewhere between 9,000 and 13,500 persons.

It is possible to deduce that the disproportionate coverage of primary health centers in Sumaila, Gaya and Ajingi LGAs is being slightly enjoyed since both lacks only one of such category. In contrast, the LGA with the lowest population (Rano) is sadly getting the smallest share with only one primary health center serving the entire population. Generally, there persists shortfalls of mostly health posts and health clinics in all the study areas, with Sumaila (most populated) having the worst. So, looking not only at the improved in the spatial coverage of primary health centres in the study area, but also at the population concentration and growth rate of the area, it is possible to surmise that the distribution of this type of facility were overburdened serving large population as per the norms. Consequently, this situation reflects a shortage and imbalanced distribution of as well as reflection of unfair distribution between the high and low populated LGAs.

CONCLUSION

The study recognized dissimilarity in the distribution of PHC facilities within the selected LGAs, which might be attributed to the differences in terms of population sizes as a major determining factor of healthcare location. Though, effort was made to locate one or more category of the facilities in virtually every community within the selected LGAs but, on a community-wide scale, such pattern would include not only the location of the facilities, but also how densely populated a particular area using the facilities is. Therefore, looking at both the population sizes and the categories of the facilities distributed poses real time challenge in the study area. Thus, most facilities in Sumaila, Gaya and Ajingi LGAs are primary health centres but the lowest health clinics and health posts, serving large population as per the standards. This might have poses population pressure on the individual facility, depending upon the patronage pattern and level of service delivery as well as efficiency. Similarly, majority of the facilities in Rano LGA are health clinics with generally very few health posts but serving the least population that is only marginally better than that for these three mentioned LGAs. Also, the only available primary health centre in this area is overburdened, serving the entire population.

Therefore, all the communities are themselves not well served in terms of PHC facilities based on their population sizes. As noted, it has now become clear to conclude that the communities in this area are not well served in terms of availability. Now with increase in population and rapid urbanization, the present number of the facilities in Kano south senatorial district are inadequate and are not marching the available demand. It was so recommended that, more of health post and

health clinics should be provided in all the communities with additional one primary health centre for each in Sumaila, Gaya and Ajingi and three more in Rano LGAs. Also, analysis of spatial accessibility of PHC facilities should further be carried out in the study area.

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