A geographical analysis of ethnic distribution of jaw ameloblastoma in Nigerians

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Abstract

Introduction: Ameloblastoma is the most common odontogenic tumour in Nigeria. A definite geographic variation has been observed in the frequency of odontogenic tumors from different parts of the world. However, there is no study on the regional variations in Nigeria. Hence, this study was designed to document the ethnic and geographical distribution of jaw ameloblastoma in Nigeria.

Methods: Archival data on ameloblastoma from 10 health facilities were obtained. Global Moran's I detected geographic clustering in its distribution while Local Getis Ord indicated the location of ameloblastoma clusters. Chi-square tested associations between variables at 0.05 level of significance.

Results: A total of 1,246 ameloblastoma cases were recorded in Nigeria. Besides substantial state variations, a South-North gradient was noticed in its distribution. Significant positive spatial autocorrelation was observed in the three major groups while ameloblastoma hotspots were found in the SouthWestern and Northwestern Nigeria. The Igbos had a higher prevalence of ameloblastoma outside their home region than within.

Conclusion: The study hypothesized that the geographical distribution of ameloblastoma in Nigeria is the result of all or one of the following: the country's tropical climate, migration patterns and health seeking behavior. Hopefully, these claims should lead to further enquiry on the underlying causes.

Keywords: Ameloblastoma, ethnicity, spatial analysis, Nigeria.

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Introduction

Nigeria is located in West Africa between Latitudes 4^0 to 140 North and Longitudes 3^0 to 15^0 East, sharing boundaries with Niger Republic in the North, Benin Republic in the West, Cameroun and Chad in the East and the Atlantic Ocean in the South. It is the most populous country in Africa with an areal extent of 923,800 square kilometres and over 190 million inhabitants[1]. It is the largest black nation on earth and is ethnically diverse; with over 250 ethnic groups of which the Yoruba, Igbo and Hausa/Fulani form the majority. The country is divided into six geopolitical zones namely the NorthWest, North-central, NorthEast, SouthWest, South-South and SouthEast. Each zone contains about six states. Nearly fifty percent of the country's population live in urban areas[1].

Nigeria is witnessing a double burden of diseases: prevailing infectious diseases such as malaria, diarrhoea, cerebrospinal meningitis and a growing prevalence of non communicable diseases (NCDs) such as cardiovascular diseases, cancer, diabetes mellitus, violence, road traffic injuries and oral health disorders[2]. The country's healthcare system by design for many years has been overly emphatic on the prevention and control of infectious diseases while neglecting NCDs[3]. One of the most prevalent neoplasms under oral health disorders is ameloblastoma; this tumor is more common in Blacks than Caucasians[4].

Ameloblastoma is a benign odontogenic neoplasm exclusively sited in the jawbones. It is characterized by local invasiveness, with predisposition for gross facial deformity, tooth displacement, a high rate of recurrence, occasional metastasis and malignant change. It is the most common odontogenic tumour in Nigeria, accounting for 63% of all odontogenic tumours[5] from SouthWest Nigeria. From NorthWest Nigeria, Adebayo et al[6] reported that ameloblastoma constituted 73% of all odontogenic tumors in a five-year retrospective review[6]. Bassey et al[7], in an 11-year retrospective analysis of all maxillofacial tumors and tumor-like lesions in South-South Nigeria, found that ameloblastoma constituted 80.3% of odontogenic tumors and 36.3% of all benign maxillofacial tumors/lesions.

A definite geographic variation has been observed in the frequency of odontogenic tumors of the jaws reported from different parts of the world[8]. However, these studies compared frequencies internationally but no study has described the regional variations in Nigeria. Hence, this study was designed to document the ethnic and geographical distribution of jaw ameloblastoma in Nigeria.

Materials and methods

This was a retrospective study involving archival data on ameloblastoma nativity and topography from 10 hospitals/medical centers [Lagos University Teaching Hospital Lagos (LUTH), University College Hospital Ibadan (UCH), Obafemi Awolowo University Teaching Hospital Ife (OAUTH), Usman Danfodiyo University Teaching Hospital Sokoto (UDUTH), Ahmadu Bello University Teaching Hospital Zaria (ABUTH), University of Nigeria Teaching Hospital Enugu (UNTH), University of Port-Harcourt Teaching Hospital Port-Harcourt (UPTH), Lagos State University Teaching Hospital Lagos (LASUTH), Federal Medical Center Jigawa (FMC-Jigawa) and Federal Medical Center Gombe (FMC-Gombe) sited in five of the six geopolitical regions [SouthWest, South-South, SouthEast, NorthWest and NorthEast] of Nigeria. Data from the North-Central zone was unavailable. We noted the tribe, birthplace, current residence and geopolitical region of the patients. Biodata (age and gender) of these various groups was also noted. Data was analyzed using SPSS version 23 and tests of associations between variables were determined using Chi-square. The level of significance was set at $p < 5\%$.

Ameloblastoma cases were aggregated to respective states based on the residential addresses. Two spatial analytic techniques were adopted: Global Moran's I and Local Getis Ord. Global Moran's I is a tool used to indicate spatial autocorrelation (or the degree of spatial clustering) in geographic data. It simply tells how correlation exists among values of a given phenomenon. If its index value falls between -1 and +1, the spatial autocorrelation is positive. The corollary of that is similar values (either high or low) are bound together. On the other hand, if it is between -1 and 0; it means a negative spatial autocorrelation exists. These values of spatial units contrast one another.

It is mathematically expressed as:

$$I = \frac{N}{\varepsilon_i \varepsilon_j \epsilon_{ij}} \frac{\varepsilon_i\, \varepsilon_j\, w_{ij}(X_i - \bar{X})(X_j - \bar{X})}{\varepsilon_i\,(X_i - \overline{X})^2}$$

where N is the number of spatial units (which in this study are states)

X is the variable in question (which is ameloblastoma)

is the average of ameloblastoma

wij is the spatial weights matrix which expresses the degree of proximity between states i and j

The Local Getis (Gi*) statistic points out the location of the ameloblastoma hotspots or coldspots as the case may be. The resultant Z score values of the analysis at the 0.05 significance level indicate the presence of either a hotspot or coldspot. In this case, an ameloblastoma hotspot would exceed the threshold of 1.96, which would mean there is above average concentration of ameloblastoma while a coldspot would be below 1.96-below average concentration of cases. Any value near zero would suggest no cluster exists.

The formula is expressed below:

$$I_i = \frac{(y_i - \bar{y}) \sum_{j=1}^{n} w_{ij} \, (y_j - \bar{y})2}{m_2}$$

Where yi is the number of ameloblastoma cases in state i, n is the number of states.

wij is the spatial weights matrix which shows the spatial relationship of states i and j,

m^2 is the average of the squared deviations from the mean of ameloblastoma cases.

These two analyses were done using ArcGIS 10.5 version (ESRI).

Results

A total of 1246 ameloblastoma cases presented to 10 health facilities located in 5 geopolitical zones of the country from 1964 to 2017. The overall mean age was 32.51±14.54 years, with a range from 4-86 years. The overall male to female ratio was 1.2:1. The tribes with the highest number of lesions were Yoruba with 525 (42.1%) patients, Igbo with 352 (28.3%) patients and Hausa with 145 (11.6%) patients (Table 1).

Table1: Demographic distribution of tribes with more than 5 persons representing disease process

Tribe	Population	Percentage	Mean Age	Male: Female
Yoruba	525	42.1	33.35±14.97	1.2:1
Igbo	352	28.3	31.89±14.75	1.1:1
Hausa	145	11.6	31.28±12.16	1.4:1
Fulani	30	2.4	32.53±12.67	1:1.3
Edo	24	1.9	28.54±11.76	1.2:1
Ibibio	15	1.2	29.80±14.90	1.8:1
Efik	13	1.0	36.85±16.50	1.6:1
Tiv	9	0.7	37.00±14.06	1.3:1
Ibira	8	0.6	36.50±11.94	1.7:1
Igala	7	0.6	27.86±8.11	2.5:1
Idoma	5	0.4	35.75±17.58	1.5:1
Ijaw	5	0.4	31.60±14.98	1:4
Urhobo	5	0.4	34.80±8.93	1:4
Others**	50	4.0	NA	NA
Missing systems	53	4.3	NA	NA

**Tribes with less than 5 representatives: Waja, Ikwerre, Kalabari, Abua, Jara, Karekare, Babur, Tangale, Wurkun, Kamu, Tera, Ishan, Yakuur, Mwaghavul, Agatu, Bassa, Kataf, Berom, Nupe, Egede, Egon, Jaba, Bandan, Gbagyi, Bogerom, Kurama, Bajju, Zuru, Kambari, Kanuri, Isoko, Ogoni and foreigners living in Nigeria

NA=Not Applicable

Table 1 shows the tribal distribution of ameloblastoma patients. There was no statistically significant differences noted with respect to age and gender within the major tribes with ameloblastoma (p=0.081 and p=0.888) respectively (Figure 1). The three major ethnic groups in this study had the peak frequency of ameloblastoma occurrence in the third decade of life, but the Igbo ethnic group had the highest in this decade of life (Figure 1).

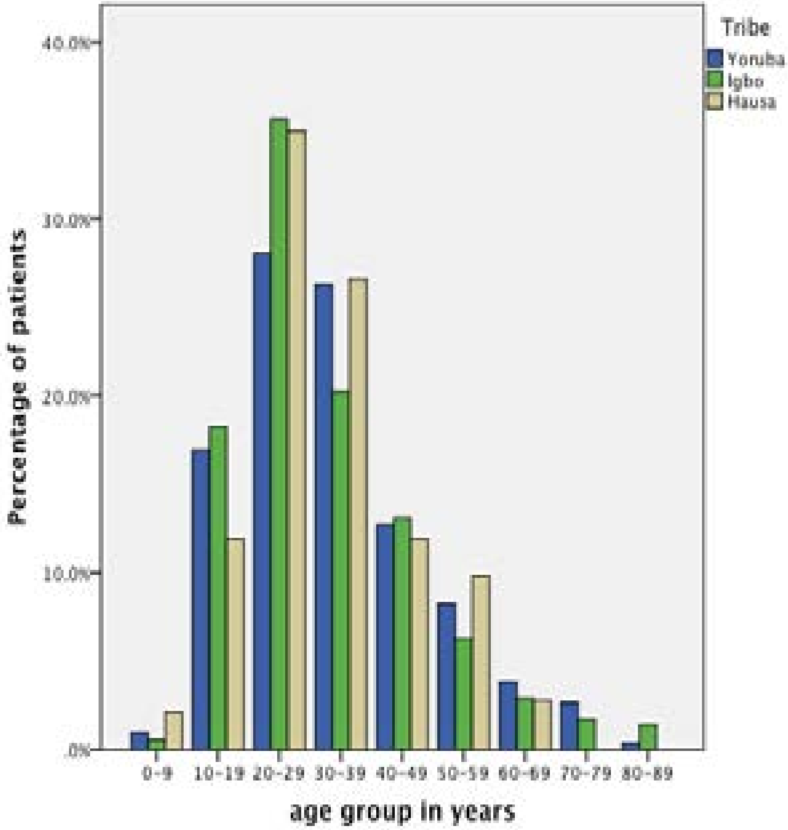

Figure 1 – Age group distribution of the major ethnic groups with jaw ameloblastoma

Figures 2 and 3 illustrate the geographical distribution of cases and groups with jaw ameloblastoma in the different states of Nigeria. There was a South-North divide in its distribution; the number of cases reduces Northward (Figure 2 and 3).

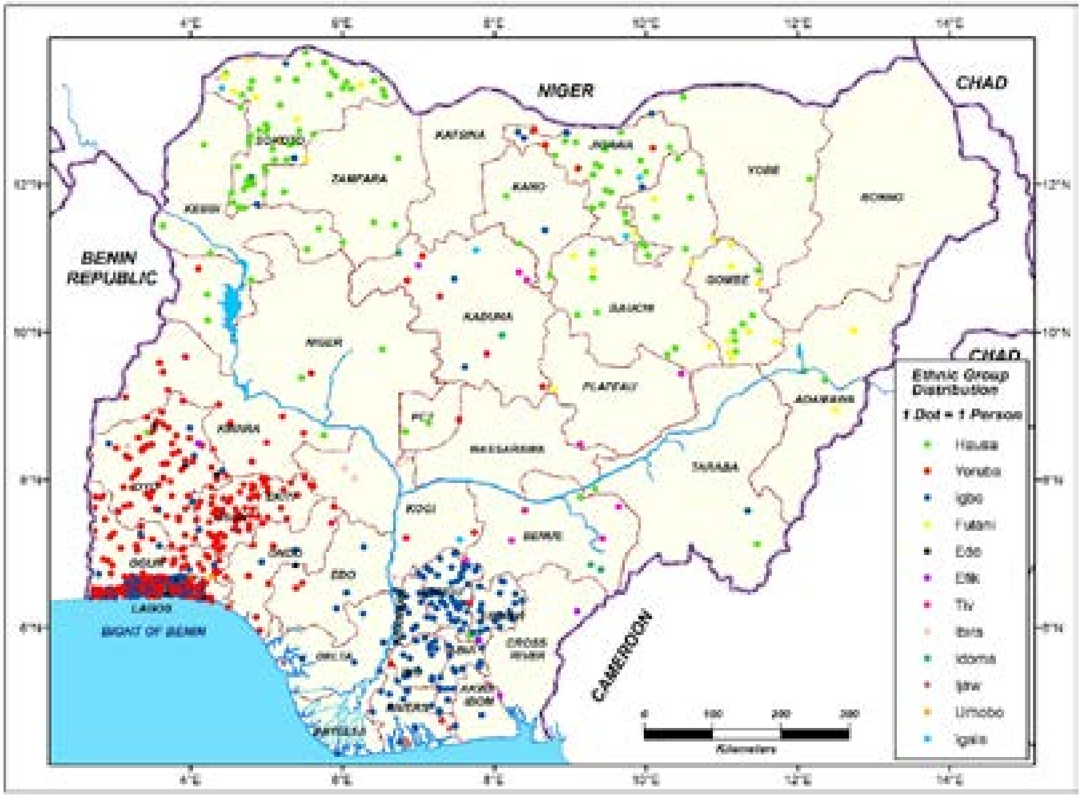

Figure 2- Geographical Distribution of jaw ameloblastoma in Nigeria by ethnic group

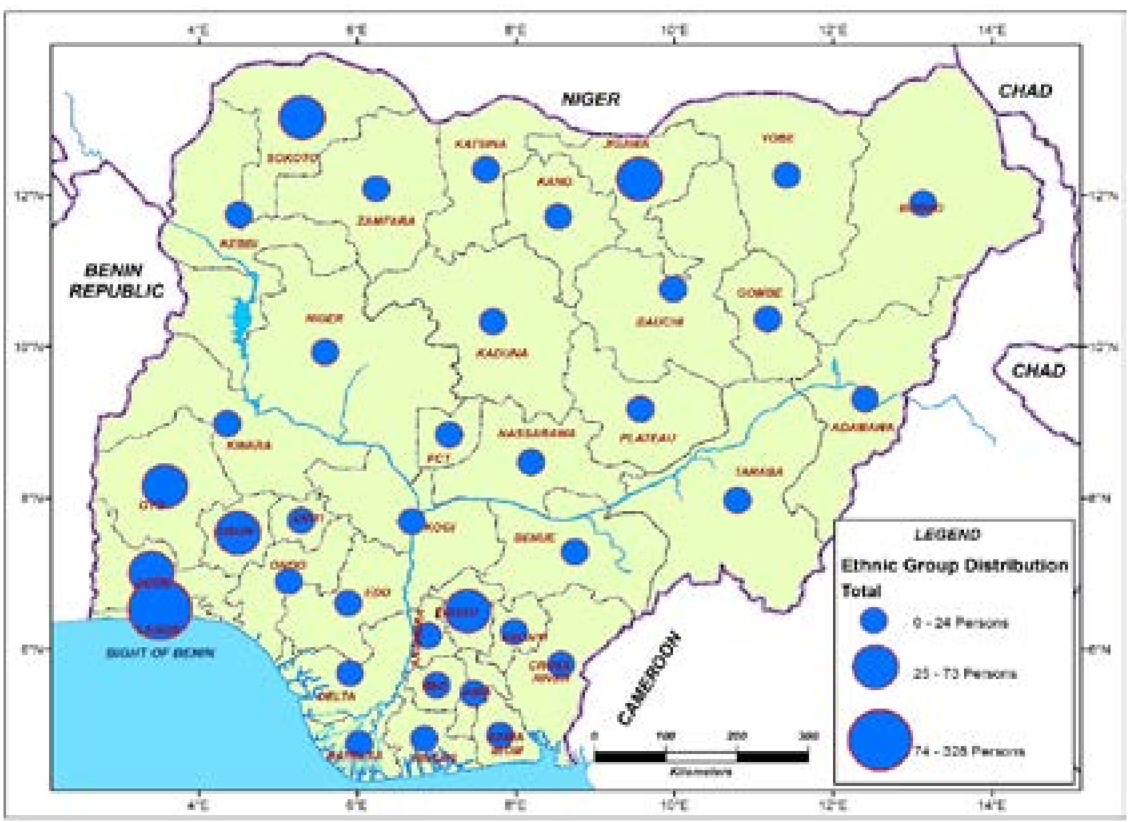

Figure 3: Spatial distribution of jaw ameloblastoma in Nigeria

The largest number of cases was found in Lagos (328) while zero was recorded in Borno, Katsina and Nasarawa. With respect to the Hausas, Sokoto had the largest number (47) and zero was seen in many Southern states. For the Yorubas, Lagos had the largest concentration of ameloblastoma (22) whereas many Northern states had zero cases. The spatial distribution of ameloblastoma with respect to the Igbos was quite interesting; this ethnic group had the largest number outside the SouthEast, its home region- Lagos (122), then followed by Enugu (49), Ebonyi (22) and Imo (17) all in the SouthEast zone.

All ethnic groups (including ethnic minorities) recorded significant positive spatial autocorrelation (Table 2). Geographic clustering was strongest among the Yorubas, followed by the Hausas and Igbos. The result of the local Getis Ord analysis revealed in all the ethnic groups except the Igbos had ameloblastoma hotspots (Table 3).

Table 2: Global Moran's *I* result

Ethnic group	Moran's *I*	*z* score	p value	Description
All ethnic groups (including ethnic minorities)	0.087477	2.198348	0.027925	Clustered
Hausa	0.127855	2.262713	0.023653	Clustered
Yoruba	0.194446	3.499388	0.000466	Clustered
Igbo	0.078914	1.741122	0.081622	Somewhat clustered

Note: Bold print for p values less than 0.05 alpha level

Table 3: States with ameloblastoma hotspots

All ethnic groups (including ethnic minorities)	*z* score	p value
Ogun	3.486613	0.00048
Lagos	4.361225	0.000013
Yoruba		
Oyo	4.436233	0.000009
Osun	3.541039	0.0003999
Ogun	4.376944	0.000012
Ondo	2.679399	0.007375
Lagos	4.376944	0.000012
Hausa		
Kebbi	4.193253	0.000027
Sokoto	3.525014	0.000423
Zamfara	2.892903	0.003817
Igbo		
-	-	-

The hotspots for the Yorubas were in Oyo, Osun, Ogun, Ondo, and Lagos states. Three contiguous states were hotspots for the Hausa patients namely Sokoto, Kebbi and Zamfara (Figures 4-6).

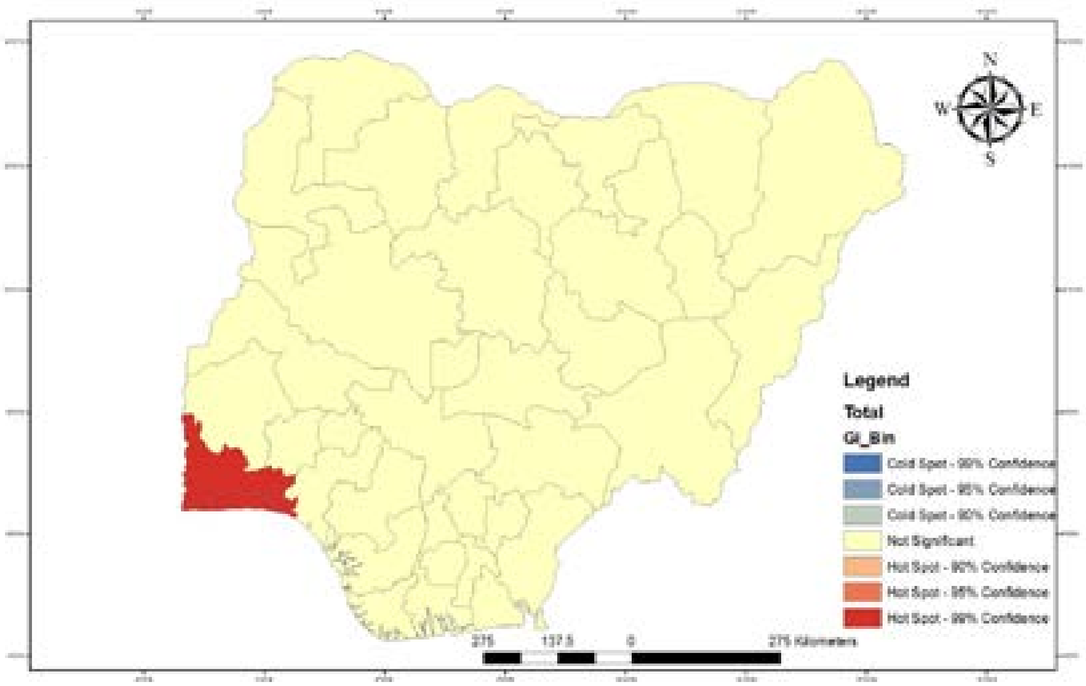

Figure 4- Ameloblastoma hotspots (all ethnic groups including ethnic minorities)

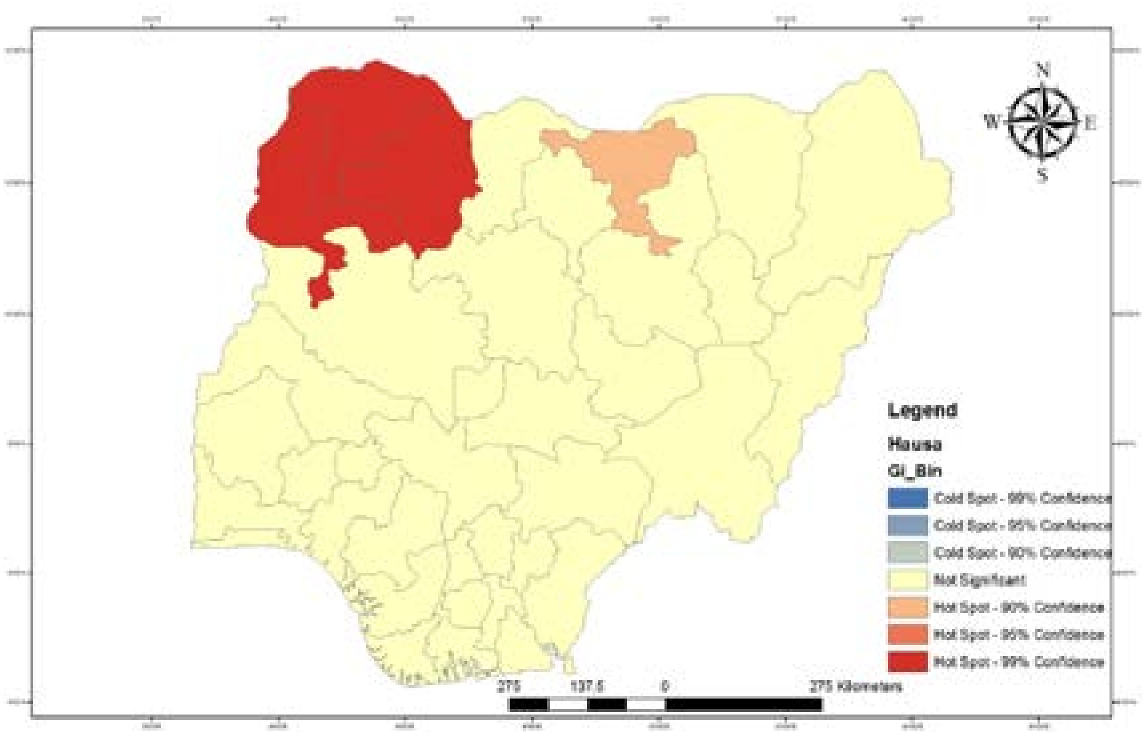

Figure 5: Ameloblastoma hotspots (Hausa)

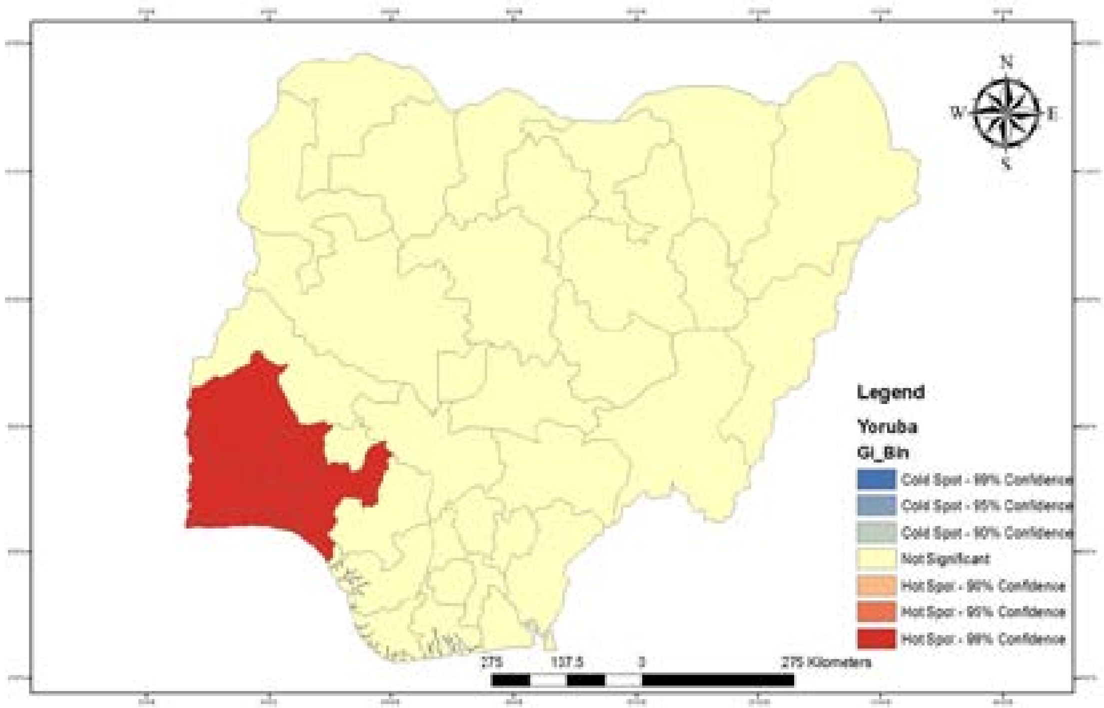

Figure 6: Ameloblastoma hotspots (Yoruba)

Discussion and conclusion

In a recent study by Ogundana et al[9], ameloblastoma cases from Nigeria constituted approximately 30.1% of all category A[10] odontogenic tumors in the sub-Saharan region of Africa, while other countries in this same region constituted 33.1% of category A tumors. This means that Nigeria alone bears 90.9% of the total ameloblastoma burden in sub-Saharan Africa. This underscores the importance of our study that focuses on the ethnic distribution of ameloblastoma of the jaws in Nigerians. Our aim to obtain a current approximate countrywide data useful for planning and management is also buttressed by a similar situation where South Africa had no standardized data for ameloblastoma amongst other odontogenic tumors[4].

The mean age documented in this study for jaw ameloblastomas was 32.51 years. Mean ages reported in Brazil[11], India[12], China[13], USA[14] and Australia[15] are 35.45, 32.75, 32.1, 53.0 and 43.0 years. The mean ages at presentation in countries with tropical or tropic-like climate are similar and patients are younger unlike those of non-tropical countries where age at presentation is older. A previous study already suggested that the prevalence of ameloblastoma is higher in Africa and China[13], particularly SouthWest China. Existing literature shows that countries with higher prevalence's of ameloblastoma also had tropical weather and higher estimated annual rainfall; countries with high ameloblastoma prevalence mostly had annual rainfall >1000Mm/year, while those with low ameloblastoma prevalence had annual rainfall <1000Mm/year[16].

In agreement with the above, our study shows large number of cases of the disease in Southern Nigeria especially the SouthWest and SouthEast parts of Nigeria that relatively receives higher rainfall amounts than the Northern part. Clearly, there are substantial geographical variations in the distribution of jaw ameloblastoma. There was significant spatial clustering of ameloblastoma in all ethnic groups (including ethnic minorities) and each of the major ethnic groups in Nigeria. Our data shows that more cases were recorded in the southwest when compared with the North, East or South-South. However, this number could be skewed because facilities for managing such tumors were not established at the same time in all parts of the country. The SouthWest facilities had been in existence long before health facilities in other regions had been established. Currently, most of the hospitals in these other regions are referral centers, and likely attend to and treat most of all the ameloblastoma cases in their respective regions. Hotspots were detected for all major ethnic groups except the Igbos. The identification of these hotspots could mean that there are environmental, behavioral or cultural triggers for this oral health problem in these locations; this could be explored in future research. The specific etiology of jaw ameloblastoma is yet to be elucidated. Studies have shown controversy regarding the role of Human Papilloma Virus in the etiology of ameloblastoma. Others have suggested non-specific irritation from extractions, dental caries, trauma, inflammation, and nutritional deficiencies as possible indirect causes of ameloblastoma[17].

A plausible explanation for the unique pattern of occurrence of ameloblastoma among the Igbos outside the southeast zone may be due to their age long migration record that has, in part, been attributed to an increasingly monetizing economy coupled with sparse land resource in eastern Nigeria[18]. A state like Lagos that is in SouthWest Nigeria shows almost an equal number of ameloblastoma cases in Yoruba and Igbo ethnic groups. Lagos is the commercial and financial hub of Nigeria, and this may account for the fairly large number of Igbo residents in Lagos, as Igbos are generally known for their commercial and entrepreneurial activity[19]. However, Igbo's also reside in other areas of Nigeria in large numbers to pursue these activities, so why does the disease appear to be prominent in the Lagos-based Igbo group? Could this be a reflection of health-seeking behavior, which results in migration/ family visits to Lagos where wealthy relatives could support expensive surgical health care for the jaw masses? Further studies on health behaviors and migration may provide additional insights. These outward movements, from their home territory are not peculiar to the Igbos, as the Yoruba and Hausa groups also engage in internal migration too, as seen in Figure 3.

The strength of this paper lies in its analysis of ethnic and state variations in the distribution of jaw ameloblastoma in Nigeria, and this could be considered a pioneer attempt at mapping and categorization. However, some limitations cannot be ignored. No doubt, this study is based on hospital visits by the patients and therefore may not completely reflect the full picture of the ethnic distribution of ameloblastoma among Nigerians. We could not include all health centers in all regions of the country but even for those included we encountered some incomplete documentation of required data in few of the participating health centers. Also, it is pertinent to note that four out of the included centers are from the South-West, which might have skewed the data. However we are still able to show, despite these limitations, that the incidence of ameloblastoma varies among the different ethnic groups of Nigeria.

Conflict of interest

None declared.

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