

Original Research Article

SPATIAL AND TEMPORAL VARIATIONS OF MATERNAL DEATHS IN BORNO STATE OF NIGERIA: AN INSTITUTIONAL BASED STUDY

Abstract

Aim: *The aim of the study is to describe and explain the spatial and temporal variations of maternal mortality between different regions of Borno State, Nigeria.*

Method: *This is a retrospective patient record study, which included antenatal attendance, hospital deliveries and maternal deaths over a ten year period (2001-2010). The data was collected from the Health Information Management System (HIMS) unit of the Borno State Ministry of Health and at the record departments of thirty one (31) selected general hospitals across Borno state. The state was stratified into three senatorial zones for the purpose of data collection, namely Central Borno, Northern Borno and Southern Borno,*

Results: *It was identified that Central Borno in comparison to the other zones recorded the highest antenatal care attendance and hospital delivery because of the high concentration of health facilities and easy accessibility. Over the 10 year period, more antenatal care visits were recorded in 2008, while hospital deliveries were highest in 2004. Maternal Mortality Ratios (MMR) computed over the 10year period indicated 1630 maternal deaths in 146,829 deliveries, yielding an MMR of 1110/100,000. The spatial pattern of MMR observed revealed that Northern Borno had the highest MMR of 1373/100,000, suggestive of the extent to which maternal mortality is a major health problem in the state.*

Conclusion: *The study concluded that maternal deaths remained one of the major health challenges in the state. It is thus recommended that both government and international agencies should put more effort in the underserved areas of the state.*

Key words: Maternal, Mortality, Spatial, Temporal, Variations, Borno, Nigeria

34 1.0 INTRODUCTION

35 The International Statistical Classification of Diseases and Related Health Problems (ICD-
36 10), defined maternal death as the death of a woman while pregnant or within 42 days of
37 termination of pregnancy, irrespective of the duration and the site of the pregnancy, from any
38 cause related to or aggravated by the pregnancy or its management but not from accidental or
39 incidental causes ^[1]. Maternal mortality remains a major public health challenge, not only in
40 Nigeria but in the developing world in general, and it remains a key indicator for maternal
41 health ^{[2][3]}. Women in developing countries often face serious health risks during pregnancy,
42 either for themselves or children ^{[2][4]}. The risk of a woman dying as a result of pregnancy or
43 childbirth during her lifetime is about one in six in the poorest parts of the world compared to
44 one in 30,000 in Northern Europe. Such a discrepancy poses a huge challenge to meeting the
45 5th Millennium Development Goal (MDG) to reduce maternal mortality by 75% between
46 1990 and 2015 ^{[5][6][7][8]}. Although, dramatic achievements have been made in other countries
47 but Sub-Saharan African countries like Nigeria remains the least in terms of achieving this
48 goal ^{[9][10][11]}.

49 Failure of the MDG to address the aforementioned inequalities in maternal mortality, the
50 United Nations' Sustainable Development Goals (SDG) and the Global Strategy for women,
51 children & adolescent health introduced in September 2015, consider maternal
52 health/inequality as priorities ^{[12][13]}. Similarly, the effort to lower maternal death rate in
53 Nigeria has become a high government priority. This informed the launching of the National
54 Programme for the Prevention of Maternal deaths. The aim was to expand and strengthen
55 advocacy projects for safe motherhood ^[14]. A number of studies have looked into the causes
56 of maternal death in Nigeria, specifically Northern region, where maternal mortality remain
57 highest in the country ^{[5][15][16][17][18][19][20][21]}. However, few looked into the variation of the
58 mortalities across a given region in Nigeria, with no published study at the time of conducting
59 this study looked at the variation patterns in Borno state. This study therefore aims to
60 describe the spatial and temporal variations of maternal mortality across Urban and Rural
61 areas in Borno State of Nigeria.

62 2.0 METHODS

63 **2.1 Research Design** – A retrospective patient record study was adopted in this research. It
64 explores the spatial and temporal patterns from 2001 to 2010 with respect to ante natal visits,
65 hospital deliveries and number of maternal deaths in the study area. Furthermore, interviews

were conducted with the health personnel of the respective hospitals to explain the differences from their experiences.

2.2 Research Setting and Sampling – The state has 27 Local Government Areas (LGAs), which were stratified according to the three senatorial zones that form each Nigerian state, namely Central Borno, Northern Borno and Southern Borno (Figure 1). Out of these, three LGAs, one from each of the three Senatorial Districts constituted the Urban Study Area. In each of the three LGAs, the largest settlements in terms of population and social amenities were selected. Three villages, one each from the remotest LGAs in the three Senatorial Districts form the Rural Study Area. The average distance of the three rural settlements from Maiduguri, the state capital is about 180km each. Each of the rural settlements has a total population of approximately 4,500, which places them under the rural category in line with the specification of Nigerian National Population Commission ^[22], which states that any settlement less than 20,000 are considered rural. Finally, a total of six settlements (three (3) urban and three (3) rural) were selected for this study. The urban areas include Biu (Southern Borno), Maiduguri Metropolitan Council (central Borno) and Monguno (Northern Borno), while the rural settlements are Gashagar (Northern Borno), Gulumba (Central Borno) and Kubo (Southern Borno). Thirty one (31) secondary health facilities across the three senatorial zones of the state (Table 1) were selected. Health facilities in Borno State are zoned and that is why we resolved into using the senatorial zones as the spatial frame of analysis. With the ten (10) year data, it is possible to attempt a temporal analysis and the spatial frame facility observation, discussion and comparison of the spatial pattern of deliveries, antenatal attendance and maternal deaths between the selected urban and rural areas.

2.3 Data collection - Secondary data were collected and used for this study. It includes first hand hospital data, health facility based data and supplemented with representative published/unpublished data.

- i) First hand data – initially, we resolve to collect state representative hospital based data as the major data source for this study, however there were problems of inconsistencies and underreporting as observed with the data provided by the HMIS Unit of Borno State Ministry of Health, especially at the LGA level, thus we resorted to and collected facility based data from thirty one (31) General Hospitals in twenty one LGA's of the state.
- ii) Other Published/Unpublished data - Published data include the Nigerian Demographic and Health Surveys (NDHS, 2013), Borno State Government Strategic Health

99 Development Plan. In addition to this are peer reviewed journals, thesis, books,
100 and online open access journals as necessary.

101 Questionnaires for the facility based data were designed according to the specifications of the
102 Health Management Information System (HIMS) and distributed to the thirty one (31) health
103 facilities across the three senatorial zones (Table 1). The required information from the health
104 records departments were filled in by the record officers of the respective hospitals, then
105 certified and stamped Medical Directors before they were collected. Additionally, in-depth
106 interviews were conducted with the health personals to seek for further explanation about the
107 raw data collected.

108 **2.4 Data Analysis**

109 The raw data collected was coded and imputed into Microsoft Office Excel (2007) and
110 transferred to Statistical Package for the Social Sciences (SPSS, Version 16.0). Subsequently,
111 the data was subjected to descriptive statistical analysis in form of tables, simple percentages,
112 line graphs and pie charts.

113 The following formula was used in calculating Maternal Mortality Ratio (MMR).

$$\frac{\text{Number of maternal deaths in the year}}{\text{Number of live birth in the year}} \times 100\,000$$

114 While Arc View Arc GIS (Version 9.2) was used to produce chloropleth maps presented in
115 this study.

116 **2.5 Ethical considerations**

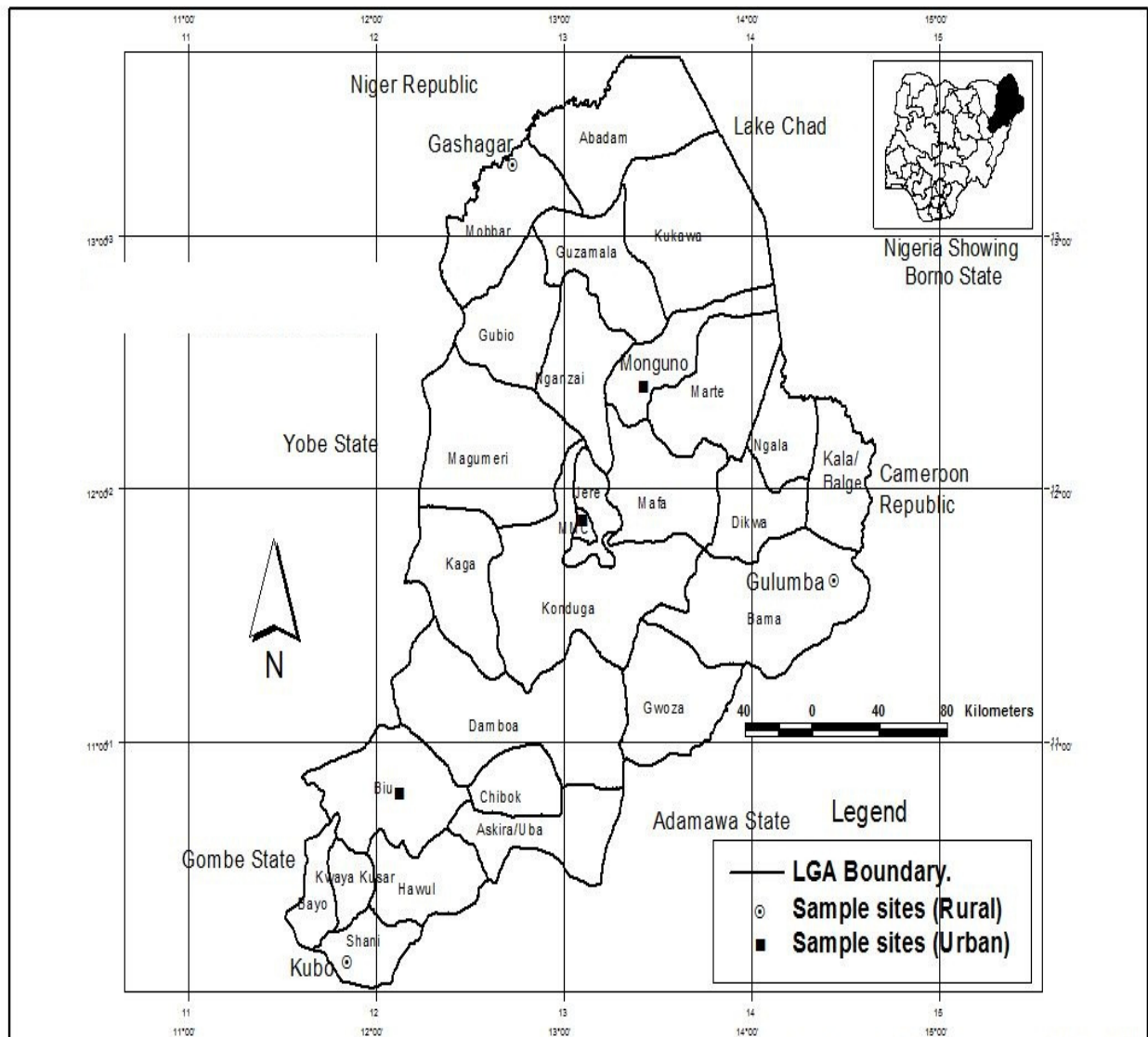
117 Before the commencement of the research, application was written to the Borno State
118 Ministry of Health and the Hospitals Management Board seeking permission to collect data at
119 the facility level. A written permission was granted. In addition, verbal informed consent was
120 obtained from all those interviewed.

121 **Table 1: Field Data Collection Locations.**

S/No	Southern Borno	Central Borno	Northern Borno
1	Askira/Uba	Bama	Abadam
2	Biu	Konduga	Damasak
3	Damboa	Dikwa	Kaga
4	Gwoza	Kala Balge	Kukawa
5	Kwaya Kusar	Mafa	Marte
6	Marama	Ngala	Magumeri
7	Kirawa	Fatima Ali Sheriff	Monguno
8	Uba	Umaru Shehu UMH	Nganzai
9	Lassa	State Specialist Hospital SSH	
10	Azare	Nursing Home	

11	Ngoshe	Bolori MCHC	
12	Shani		
Total	12	11	8

Source: Field work 2011



Source: Carto. Lab, Dept. of Geography BUK (2012)

Figure1: Borno State Showing sampling sites

3.0 RESULTS AND DISCUSSION

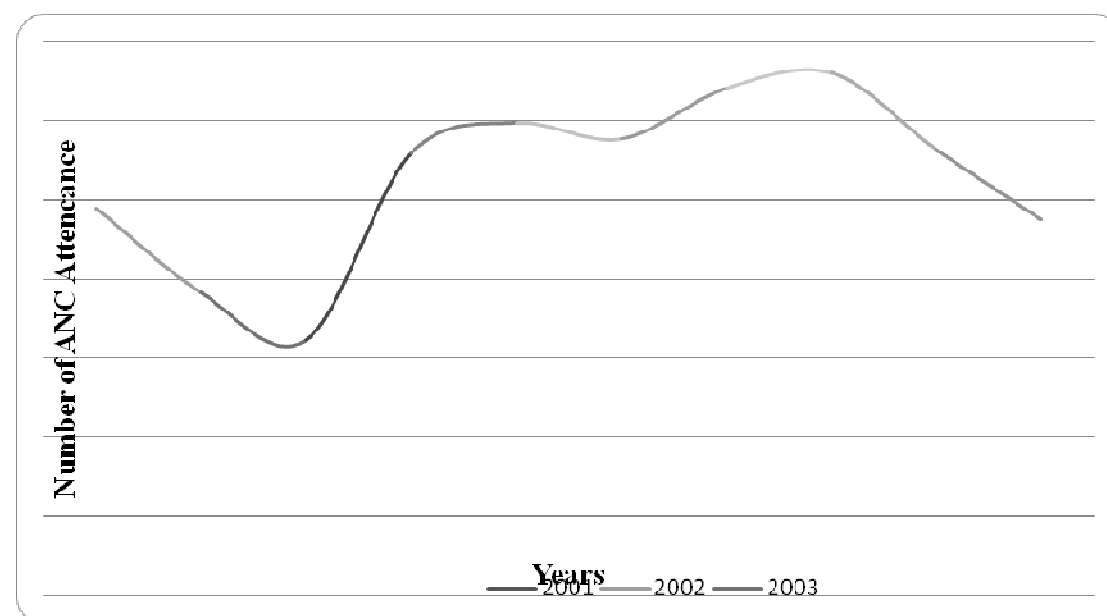
3.1 Temporal Patterns

Table 2: Temporal Patterns of Antenatal Care Visits

Year	Antenatal Attendance	% of Total	Increase/decrease	% Change
2001	24498	9.3	-	-
2002	19114	7.1	-5653	-23.7
2003	16147	6.1	-2836	-15.5
2004	27928	10.6	12665	82.5
2005	29845	11.4	1023	3.6
2006	28877	11	-929	-3.1
2007	32055	12.3	3099	11.0
2008	33024	12.6	462	1.4
2009	28222	10.7	-4641	-14.6
2010	23756	8.9	-4054	-15.0
Total	263,466	100%		

Source: Field work, 2011

Figure 2: Line graph depicting the trend of ANC over a ten year period (2001-2010)



Source: Field work 2011

3.1.1 Temporal Patterns of Antenatal Care Visits

The decline in ANC attendance in 2003 (Figure 2) was due to strike by health workers which resulted in closure of all public health facilities in the state. While the steady increase from 2006 to 2008 was mainly as a result of free maternal health services provided by the then Government of the State. The free services covered only 6 health facilities spread across the three Senatorial Districts, each comprising of one general hospital and one maternal health care centre. These include State Specialist Hospital (SSH), (Borno central), General Hospital Biu and Maternal and Child Health Centre (MCHC) Gwoza, (Borno South) and General

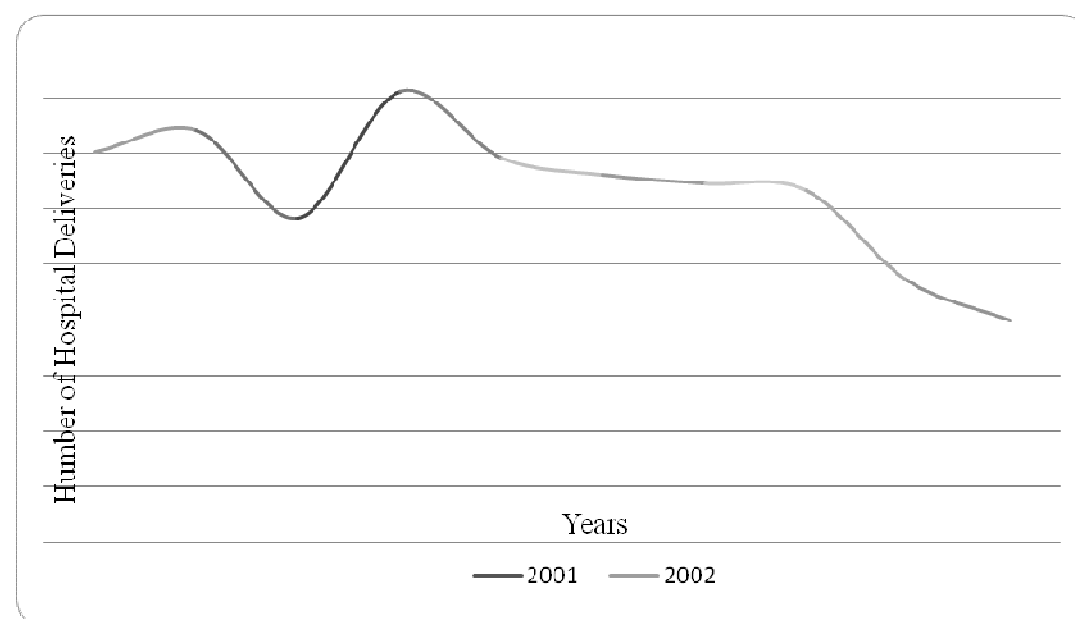
hospital Monguno and MCHC Damasak, (Borno North). This indicates that provision of free maternal health services encourage utilization of antenatal services by pregnant women. This is in line with the findings of Kolo et al.,^[23] who identified a positive correlation between free maternal health services and use of antenatal services in Yobe State of Nigeria.

Table 3: Temporal Patterns of Hospital Delivery.

Year	Total Deliveries	%	Increase/Decrease	% Change
2001	16023	11	-	-
2002	16833	11.5	- 810	5.0
2003	13658	9.3	3175	-18.8
2004	18216	12.4	4558	33.3
2005	15837	10.7	2379	-13.0
2006	15226	10.3	611	-3.8
2007	14953	10.1	320	-1.8
2008	14665	9.9	241	-1.9
2009	11430	7.7	3235	-22.0
2010	9988	6.8	1442	-12.6
Total	146,829	100%		

Source: Field work, 2011

Figure 3: Line graph showing patterns of hospital delivery over a ten year period (2001-2010)



Source: Field work, 2011

3.1.2 Temporal Patterns of Hospital Deliveries

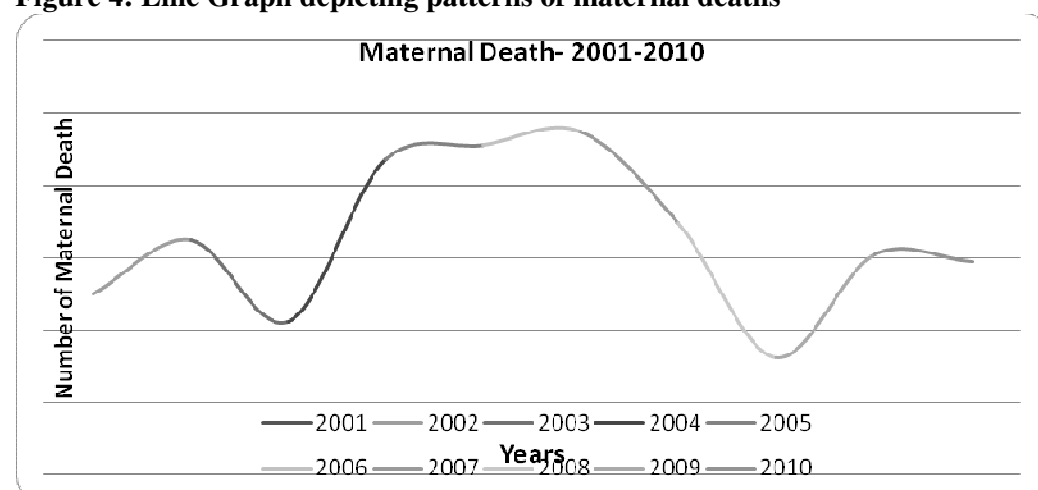
The percentage change in hospital delivery in Borno State shows variations over time (Figure 3). Despite the free maternal health programme introduced in 2007, the rate of hospital delivery keeps decreasing, which was due to lack of proper funding for the programme (as speculated by a health personnel). Furthermore, the poor security situation erupted in the region coincides with greater declining trend of hospital delivery from 2009 to 2010. Similarly, reduction in hospital delivery through skilled attendant between 2005-2007 in Ghana was linked to underfunding as well as health workers strike of 2007 ^[24]. The general declining trend may also be attributable to the presence of a tertiary health centre (University of Maiduguri Teaching Hospital) and the increasing number of private health facilities which leaves patients with alternative health care services. Despite the presence of health facilities, home deliveries also constitute a high percentage of total deliveries in Borno state. Additional studies are needed in this area to determine number of home deliveries. Previous studies in other parts of Nigeria by Kisekka et al.,^[15] Luka,^[25] Idris et al.,^[26] and Maru et al.,^[27] have indicated that most women in northern Nigeria prefer to deliver at home, although many in the urban areas prefer hospital delivery.

Table 4: Temporal Trends of Maternal Deaths

Year	Maternal Deaths	Percentage
2001	125	7.6
2002	162	10
2003	106	6.5
2004	218	13.3
2005	228	14
2006	237	15
2007	174	11
2008	81	5
2009	152	9.3
2010	147	9
Total	1,630	100%

Source: Field work, 2011

Figure 4: Line Graph depicting patterns of maternal deaths



Source: Field work, 2011

3.1.3 Temporal Trends of Maternal Deaths

The temporal patterns of maternal deaths also depict a similar trend (Figure 4). Less number of deaths was recorded in 2003 compared to the two previous years mainly due to the closure of hospitals as a result of the general strike. There was a steady rise in maternal deaths in 2004 and another in 2009 that coincide with the Boko Haram crises. The impact of the introduction of the free maternal health care programme by the Northern Governors and implemented in Borno state resulted in a steady decline in institutional maternal mortality in 2007. Similar pattern was identified in Yobe state of Nigeria following introduction of free maternal services^[23].

Table 5: Temporal Trends of Antenatal Care Visits, Hospital Deliveries, Maternal Deaths, & MMR.

Year	Antenatal Care visits	Hospital Deliveries	Maternal Deaths	MMR/100,000
2001	24498	16023	125	780
2002	19114	16833	162	962
2003	16147	13658	106	776
2004	27928	18216	218	1196
2005	29845	15837	228	1439
2006	28877	15226	237	1556
2007	32055	14953	174	1163
2008	33024	14665	81	552
2009	28222	11430	152	1329
2010	23756	9988	147	1471
Total	263, 466	146,829	1,630	Average: 1,110

Source: Field work, 2011

3.1.4 Temporal Trends of Antenatal Care Visits, Hospital Deliveries, Maternal Deaths Maternal Mortality Ratio (MMR), 2001 to 2010.

Most studies about MMR in Nigeria are coming from the statistics compiled from a hospital record^{[28][29][30]}. This study on the other hand adopted a wide institutional based study using different hospital records from rural and urban areas. During the study period, total numbers of antenatal care visits were 263,466, hospital deliveries reported were 146782, while maternal deaths recorded over the period were 1630. The cumulative MMR was 1110 per 100,000 live births. Highest MMR of 1556 was in 2006 while the least of 552 was in 2008 (Table 5). This MMR can be an underestimation of actual figures as the reported data does not cover all general hospitals of the state. The other reason can be the miss reporting of some maternal deaths which may have been missed.

A downward trend was observed for all the variables in 2003 which is mainly attributable to the statewide strike by health workers which kept all public health facilities closed for a reasonable period of time. This has affected the use of such facilities resulting in poor records. The steady rise in antenatal care visits figures from 2006 coincided with the period when free maternal health care was introduced by the then Borno state government. Due to lack of policy to back up its existence and sustainability, the project could not last^[31]. Two years later, in 2008, all the hospital based maternal health statistics demonstrated a downward trend. Other contributing factors include the security challenge that prevails in the state as well as the continued patronage of private health facilities as speculated by some health workers interviewed.

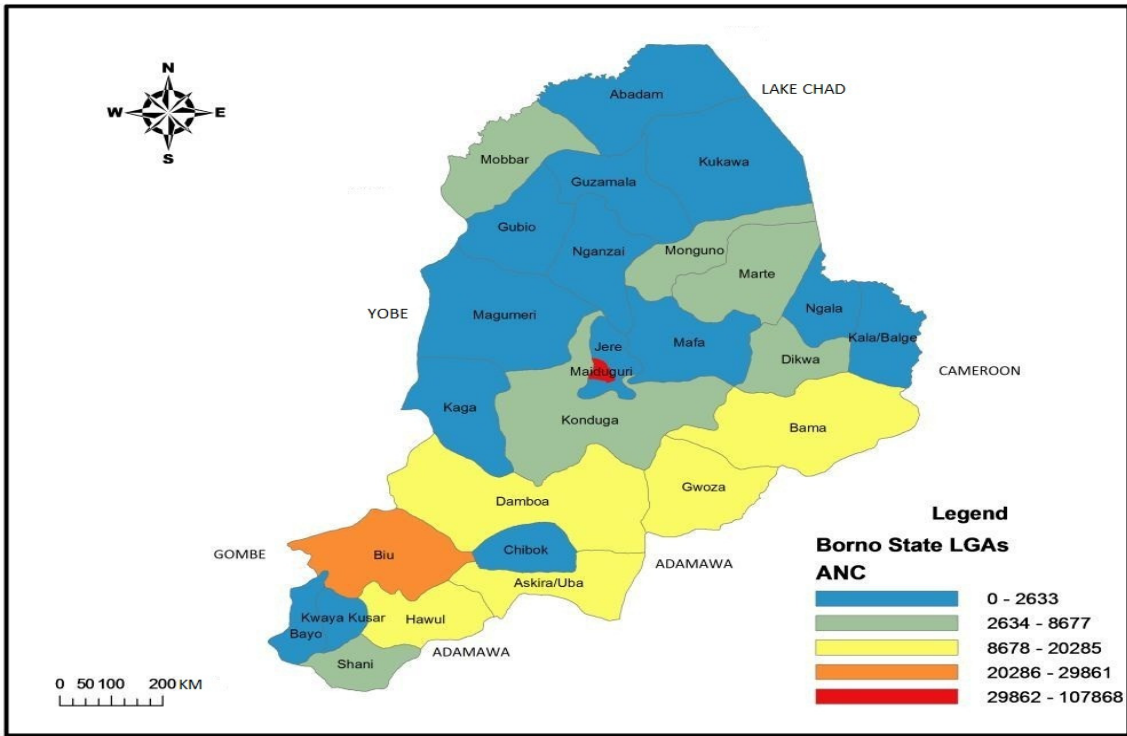
3.2 SPATIAL PATTERNS

Table 6: Spatial Patterns of Antenatal Care (ANC) Visits

	Southern Borno		Central Borno		Northern Borno	
S/No	LGA	ANC	LGA	ANC	LGA	ANC
1	Askira/ Uba	13869	Bama	20285	Abadam	1161
2	Biu	29861	Dikwa	4734	Kaga	1984
3	Damboa	11663	Kala/Balge	605	Kukawa	800
4	Gwoza	16964	Konduga	4717	Magumeri	2633
5	Hawul	11622	Mafa	1179	Marte	3650
6	Kwaya Kusar	2282	MMC/Jere	107868	Mobbar	8677
7	Shani	3907	Ngala	605	Monguno	7369
8					Nganzai	1748
	Total	90,168		139,993		28,022

Source: Field work, 2011

Figure 5: Spatial patterns of Antenatal care visits



Source: Field work, 2011

3.2.1 Spatial Patterns of Antennal Care Visits

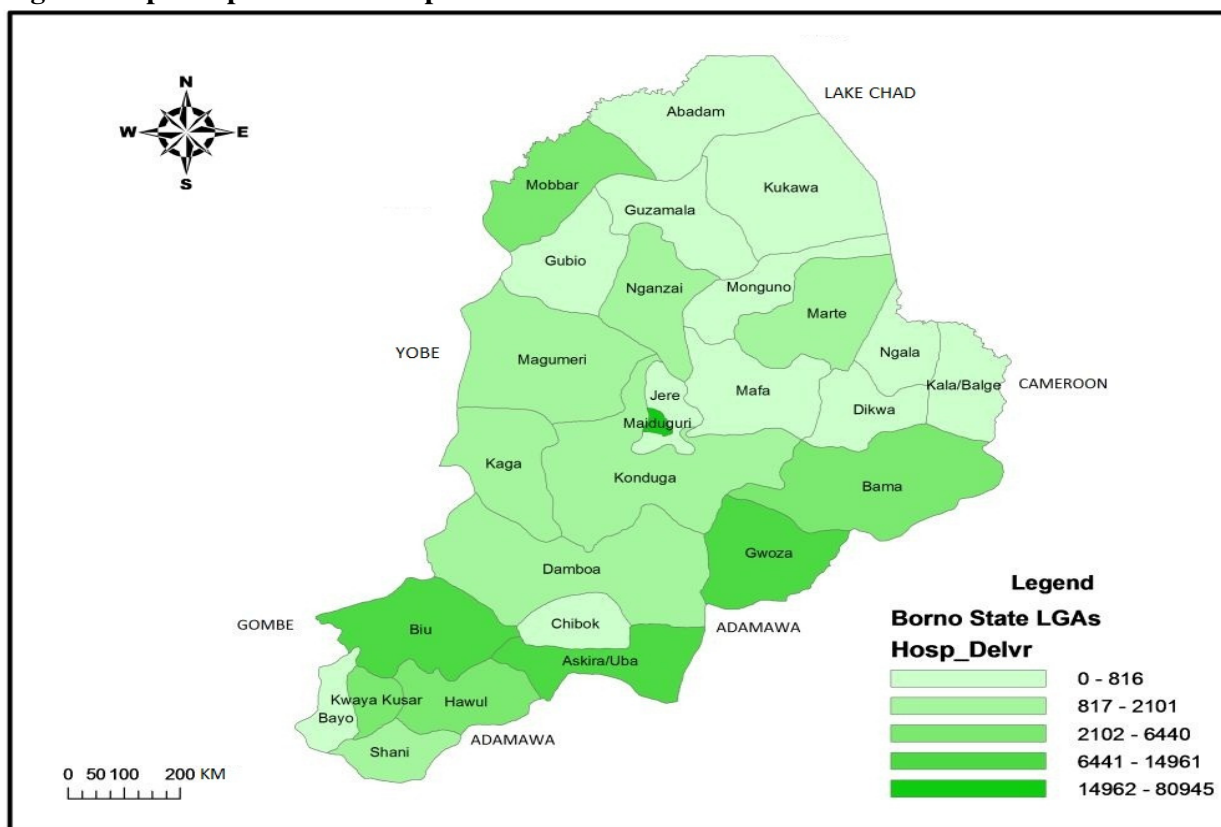
Spatial pattern of antenatal attendance in Borno State over the 10 year period is presented in table 6. Central Borno has the highest antenatal care visits (147276) accounting for 55% of the total. This is due to the concentration of higher number of health facilities and also, those living in the urban areas are more aware and informed of issues relating to health as compared to rural areas. In addition to this, the issue of easy accessibility and affordability also played a role because antenatal care and delivery by a skilled health worker or in a health facility had a pro-rich coverage^[32]. Northern Borno has the lowest number of antenatal care visits because the region has the lowest number of secondary health care facilities, which are widely spaced making accessibility to such facilities very difficult. Because of their proximity to the Republic of Niger border, patients from Abadam and Mobbar LGAs in Northern Borno prefer going to Diffa across the border for their antenatal care needs. This practice has also contributed to the reduction of the total number antenatal care visits.

240 **Table 7: Spatial Patterns of Hospital Deliveries.**

S/No	Southern Borno		Central Borno		Northern Borno		Total
	LGA	Hospital deliveries	LGA	Hospital deliveries	LGA	Hospital deliveries	
1	Askira/Uba	11156	Bama	6445	Abadam	149	17750
2	Biu	14961	Dikwa	510	Kaga	1175	16646
3	Damboa	2101	Kala/Balge	282	Kukawa	225	2608
4	Gwoza	9081	Konduga	1216	Magumeri	1226	11523
5	Hawul	4036	Mafa	531	Marte	1882	6449
6	Kwaya Kusar	3440	MMC/Jere	80945	Mobbar	3283	87668
7	Shani	1707	Ngala	816	Monguno	657	3180
8					Nganzai	1010	1010
	Total	46,482		90,745		9,607	146834

241 Source: Field work, 2011

242 **Figure 6: Spatial patterns of Hospital Deliveries**



244 Source: Field work, 2011

245 3.2.2 Spatial Patterns of Hospital Deliveries

246 Zonal distribution of total deliveries in public hospitals in Borno State from 2001 to 2010 is
 247 shown in Table 7. A total of 90,745 deliveries took place in central Borno. Southern Borno

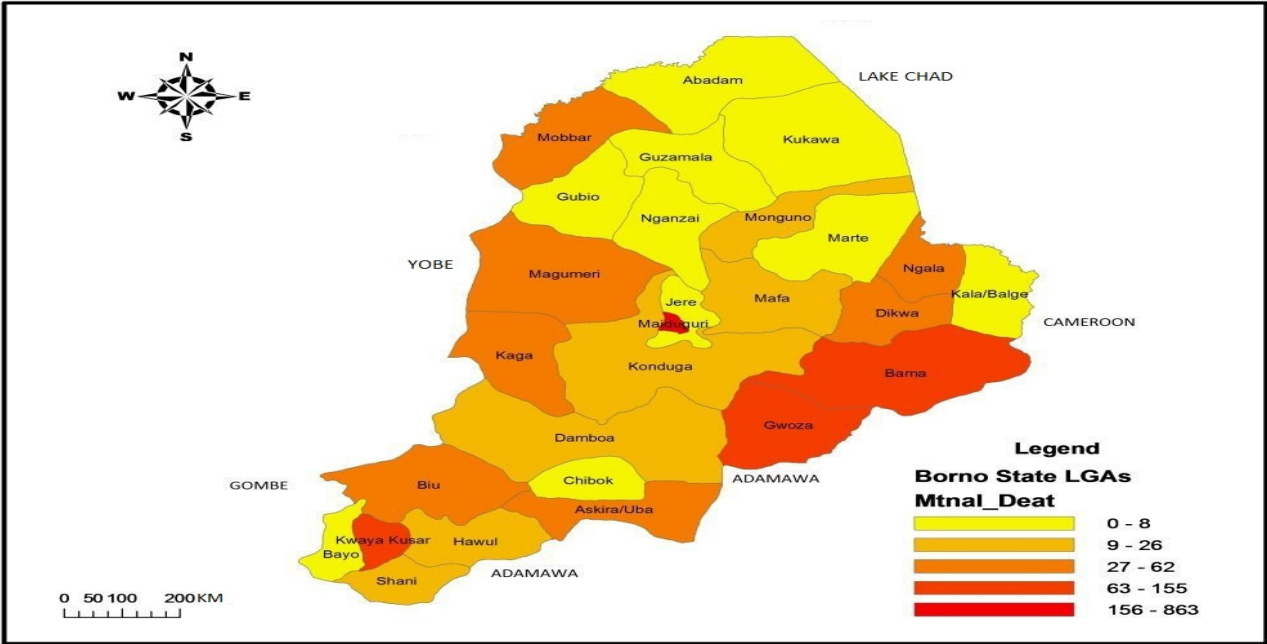
has 46,482, while northern Borno accounted for 9,607 deliveries. Despite these figures, a greater number of deliveries take place at home in Borno state considering the estimated crude birth rate in the state ^[22]. This is in line with the study of Luka, ^[25] who found that most women in northern Nigeria prefer to deliver at home with or without a skilled attendant. Similarly, the Nigerian Population Commission (NPC) estimated that majority of women in Nigeria deliver without a skilled attendant with only 35% delivering at health facilities. Up to 22% are delivered by traditional birth attendants, and only 42% received postnatal check-up after delivery ^[22].

Table 8: Spatial Patterns of Maternal Deaths

	Southern Borno		Central Borno		Northern Borno	
S/No	LGA	Maternal deaths	LGA	Maternal deaths	LGA	Maternal deaths
1	Askira/Uba	45	Bama	104	Abadam	0
2	Biu	62	Dikwa	35	Kaga	35
3	Damboa	16	Kala/Balge	4	Kukawa	1
4	Gwoza	103	Konduga	26	Magumeri	37
5	Hawul	19	Mafa	10	Marte	8
6	Kwaya Kusar	155	MMC/Jere	863	Mobbar	33
7	Shani	16	Ngala	30	Monguno	18
8					Nganzai	0
	Total	416		1,072		132

Source: Field work, 2010

Figure 7: Spatial Pattern of Maternal Deaths



Source: Field work, 2010

3.2.3 Spatial Patterns of Maternal Deaths

From 2001 to 2010 (Table 8), 1620 maternal deaths were reported from government hospitals in Borno state. These deaths occurred in the health centers where patients were either receiving or about to receive care. In addition to these documented deaths, there is the possibility that many more of such women might have died at home whose cases are not reported. Despite such challenges, the record available from the health facilities have given some insight into the problem of maternal deaths in Borno State. Central Borno is urban in nature and as a result, women in the area have more access to maternity services than in the other zones. They may also be relatively more informed about the advantages and relevance of modern health care services compared to their counter parts in the other two zones. Zonal differences also occur with respect to Maternal Mortality in other parts of Nigeria. The 1999 multiple indicator cluster Surveys (MICS) revealed that there were significant urban/rural and zonal disparities in the MMR. For example, maternal mortality was more than twice as high in the rural areas (828 per 100,000 live births) than in the urban areas (351 per 100,000 live births)^[22]. The North East Zone has the highest MMR (1,549/ 100,000), which is almost ten times higher than in the South West (164/100,000)^[22].

Table 9: Spatial Patterns of Hospital Deliveries, Maternal Deaths and MMR (2001-2010)

ZONES	Total Deliveries	Total Maternal Deaths	MMR/100,000
Southern Borno	46482	416	894
Central Borno	90745	1072	1181
Northern Borno	9607	132	1373
Total	146,829	1,620	3448

Source: Field work, 2011

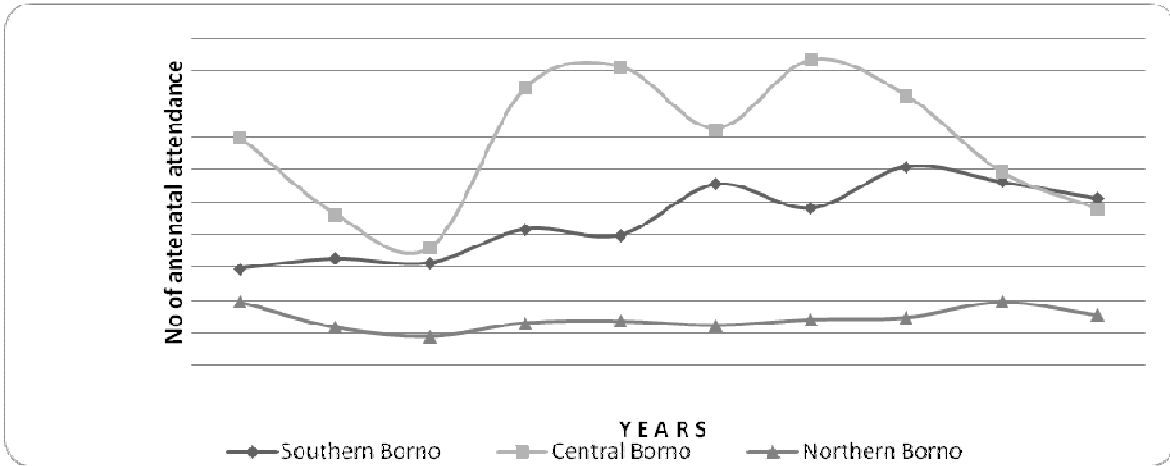
3.2.4 Spatial Distribution of Maternal Mortality Ratio (MMR)

Spatial distribution of maternal mortality ratio for the three zones is shown in Table 9. Northern Borno accounted for the highest MMR of 1373/100000 followed by Central Borno with 1181/100,000 while Southern Borno has the lowest, with 849/100,000. Therefore, the computed average MMR in Borno state is 1149/100,000. Poor accessibility to obstetric care service may be the reason for the very high maternal mortality ratio in northern Borno. Galadanci et al.,^[20] in their study in Kano and Kaduna states of Northern Nigeria found an inversely proportional relationship between total number of deliveries and maternal mortality ratio. That may explain the reason why northern Borno has low hospital delivery but higher maternal mortality ratio as compared to southern and central Borno. Generally speaking,

these figures are revealing and disturbing when talking about maternal health situation in Borno state. A lot need to be done in order to ameliorate the situation state wide.

3.3 SPATIO-TEMPORAL PATTERNS

Figure 8: Spatio-Temporal Patterns of Antenatal Care Visits in Borno State



Source: Field work, 2011

3.3.1 SPATIO-TEMPORAL PATTERNS OF ANTENATAL CARE VISITS

In Figure 8, it was clear that Central Borno State led with the highest total number of antenatal attendance followed by Southern Borno with Northern Borno trailing behind. The low antenatal care visits in Northern Borno may be related to care access; health facilities are few and widely spaced and border towns prefer crossing to Niger Republic for their maternal health care needs.

Table 10: Spatio-Temporal Patterns of Hospital Deliveries.

Year	Southern Borno	Central Borno	Northern Borno	Total
2001	4386	10732	905	16023
2002	4039	11913	881	16833
2003	3763	8780	1115	13658
2004	4253	13067	896	18216
2005	4605	10336	896	15837
2006	4604	9721	901	15226
2007	5080	8953	920	14953
2008	5019	8668	978	14665
2009	5819	4557	1059	11435
2010	4914	4018	1056	9988
Total	46,482	90,745	9,607	146,834

Source: Field work, 2011

3.3.2 SPATIO-TEMPORAL PATTERNS OF HOSPITAL DELIVERIES

Table 10 compares the number of women that have delivered in public hospitals in Borno State between 2001 and 2010 according to the three zones. A total of 64437 deliveries took place in the central Borno zone. Next is southern Borno with 44382, while northern Borno accounted for 9607 deliveries. This coincides with the antenatal rate in the three regions, which indicates a similar pattern.

Table 11: Spatio-Temporal Patterns of Maternal Deaths.

Year	Southern Borno	Central Borno	Northern Borno	Total
2001	47	68	10	125
2002	53	93	16	162
2003	33	57	16	106
2004	43	160	15	218
2005	37	186	5	228
2006	40	186	11	237
2007	32	132	10	174
2008	44	19	18	81
2009	36	97	19	152
2010	51	74	12	137
Total	416	1072	132	1620

Source: Field work, 2011

3.3.3 SPATIO-TEMPORAL PATTERNS OF MATERNAL DEATHS

Table 11 depicts the spatio-temporal pattern of maternal death in the study area. The pattern compares the 10 year temporal trends with spatial distribution across the three zones. Central Borno accounts for the highest number of deaths, which is followed by southern Borno and then Northern Borno. This also coincides with both the antenatal attendance record and total number of hospital deliveries in the regions.

4.0 CONCLUSION

Based on the findings generated in this study, it was concluded that maternal mortality is widely spread in Borno state, with Northern Borno having the highest MMR (1373/100,000), even though it had the lowest number of women who delivered at health facilities. This is followed by central Borno, which is also very high and as well account for the highest total number of deaths in the state. Southern Borno recorded the lowest MMR (894/100,000), which is significant compare to other regions in the country. Despite the security challenges facing the state, the estimated average MMR in the state (1149/100,000) almost double the country's estimated MMR of 576/100,000 based on the Nigerian Demography and Health

Survey, 2013.³³ This is a clear indication that maternal deaths remained one of the major health challenges in the state. It is thus recommended that both government and international agencies should put more effort in the underserved areas of the state.

Competing Interests

We declare that there is no conflict of interest between the authors throughout the conduct of the study.

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