Seasonal Patterns of Facility-Based Deliveries in Vital Registration System: Evidence from Kogi State, North-central Nigeria

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Abstract

Despite the massive investment in maternal care over the last three decades, Nigeria still has the highest home deliveries in sub-Saharan Africa. This study utilized live birth and socio-economic data compiled in 2018 by the National Population Commission (NPC), Nigeria to understand seasonal patterns of births in Lokoja, North-central Nigeria. The monthly reported health data was collected from 12,589 reproductive aged women in 13 health facilities for five years (2014 - 2018). Analysis of Variance was employed to examine significant variations in birth seasonality, while student's t-test was used to compare birth rate in urban and rural areas. The results showed that a total of 38,696 live births was recorded from 2014 – 2018. Majority (90.75%) of the reproductive aged women was 20-39years, 70 percent of whom were educated with at least primary education, and 84.2 percent gave birth in the hospital. There was no significant statistical difference in male and female births ($t = 0.271$, $p>0.05$). The highest births were recorded in December, July, and August (47.48%), while the lowest births occurred in March and February (9.67%). Conception was higher in April (22.5%) and lower in July (4.66%). Urban areas recorded more deliveries in the hospitals. There was a significant upward pattern in live births from 2014 to 2018, with 29.6 percent increase. It is recommended that sexual and reproductive health related interventions should focus more on the influence of socio-economic and seasonal barriers. This is to enable reproductive women better able to plan their pregnancies to control fertility rate.

Keywords: Conception, Fertility, Live Birth, Seasonality

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Introduction

Despite the massive investment in contraceptive use and family planning over the last three decades, Nigeria still has the highest fertility rate in sub-Saharan Africa (SSA). Reduction of fertility and access to sexual and reproductive health care therefore remains a major component of the Sustainable Development Goals (SDGs). This has become imperative because high fertility rate is associated with poverty, low educational attainment, teenage childbearing and child abuse. A potentially striking but relatively understudied area for birth control is seasonality of birth. Seasonal influences in the frequency of births in the human race have been pronounced within the last few decades. This phenomenon reflects the behavioural and biological determinant of reproduction. Research has shown that during the first half of the 21st century, human population has rapidly increased; and in societies with high fertility and poor birth control like Nigeria, seasonal timing of childbirth and contraceptive use (Armitage & Babb, 1996) tends to matter more for active choices and behaviours associated with sexuality, conception and birth. There are seasonal patterns of birth in different socio-economic groups (Bariagabera & Keetilea, 2016), and in much of the developed countries, there have traditionally tended to be more births in spring and fewer towards the end of the year (Erhardt et al.,1971).

Various seasonal patterns of birth have been reported for different countries of the world and there seems to be no consensus on the drivers, with an array of interlinking social, environmental and cultural factors, all playing a key role (Kihlbom & Johnson, 2004; Izugbara & Eze, 2010; Morosow & Kolk, (2017). Studies have shown that the annual timing of birth peaks in regions of the world correlates with its latitude. Places in the northern hemisphere experience a birth peak in June or July, while more southern areas see more births in October or November. The pattern

holds even as the overall birth rate varies in different countries. In some populations, seasonality of births could be driven by socio-demographic and cultural factors (Kihlbom & Johnson, 2004; Izugbara & Eze, 2010; Dahlberg & Anderson, 2018), and rural populations tend to have a more dramatic seasonal birth pulse than urban populations. Among the cultural factors, local customs may constitute major determinants. For example, the traditional calendar festivities in Nigeria would affect the number of women at risk of conception, and thus result in seasonal changes in birth rates at the turn of the second quarter of the succeeding year.

Many fertility studies have shown the association between merrymaking seasons and conception (Kihlbom & Johnson, 2004; Cagnacci et al. 2003). In modern societies, however, social status and changes in the standard of living also affect birth seasonality (Ononokpono & Odimegwu, 2014). It is likely that the probability of conception depends more on the choice of the time of pregnancy, probably related to the use of contraception (Cagnacci et al., 2003) than on environmental conditions or seasonal weddings.

Recent empirical studies on fertility have also noted that the causes of these seasonal changes are not fully understood (Dahlberg & Anderson, 2018). It is thought that these variations may be partly due to seasonal changes which may affect sperm quality, ovulation and coital frequency (Ko et al., 2018), but may also be related to social and cultural factors (Ibor et al. 2011; Mberu & Reed, 2014). Elsewhere, perhaps attention is given to local environmental factors (Irving et al., 2008; Bobak & Gjonca, 2010). Day-length and temperature have the potential to influence human fertility and it does seem to explain the pattern of births seasonally in some places. It has been suggested that environmental factors like these could influence not only human sexual behaviour, but may also affect the quality of semen, frequency of coitus, or length of menstrual

cycle, and thus the ability to conceive (Centola & Eberly, 1999; Gyllenborg et al., 1999; Izugbara & Ezeh, 2010). Other scholars like James, (1990) and Kaba, (2015) have proposed that hormonal changes, if seasonally dependent, may underlie the seasonality of births.

From the foregoing, it is clear that hardly any previous study reports on changes in the seasonality of births using vital registration data. Yet, monthly reported birth rates vary differently from place to place and for the rest of northern Nigeria, the pattern is unclear. This pattern appeared to be connected with season of conception and socio-demographic factors of women. This study contributes to the existing body of literature on fertility in population geography by looking at evidence-based seasonal analysis of birth patterns in a part of north central Nigeria. With this understanding, reproductive women are equipped with appropriate reproductive health information on seasons more favourable for childbirth and therefore better able to plan their pregnancies so that fertility is not overachieved or conception does not result in unintended pregnancies with its attendant unplanned births. This study may offer important insights on contraceptive use and help sexually active women be able to take precautionary measures against unwanted pregnancies with their associated socio-economic, health and psychological consequences.

Literature Review

There is consistent evidence that there are significant fluctuations in the number of live births globally (Armitage & Babb, 1996; Bariagabera & Keetiles, 2016). Urquia, Ray, Wanigarantne, Moineddin and O'Campo (2016) assessed variations in the male-female infant ratios among births to Canadian-born and Indian-born mothers according to year of birth, province and

country of birth of each parent. The study reported negligible fluctuations in birth order among the Canadian-born mothers, with male-female ratios of 1.05. Among Indian-born mothers, the overall male-female ratio at the third birth was 1.38, and 1.66 at the fourth or higher-order births. Little variability was reported in the ratios between province and couples involving at least one [1] Indian-born parent, which had higher than expected male-female ratios at the second and higher-order births, particularly when the father was Indian-born. The deficit in the expected number of girls among Indian immigrants to Canada in the study period was estimated to be 4472. This suggests that fewer than expected girls at the third and higher-order births have been born to Indian immigrants across Canada since 1990. Further evaluation of the outcome of the study demonstrates that this pattern was also seen among couples of mixed nativity, including those involving a Canadian-born mother and an Indian-born father, suggesting that fathers should be considered when investigating sex ratios at birth.

Some studies have shown that ratios at birth appear to be significantly higher in the advanced countries than those for African regional states and corresponding countries and for Latin American, Asian, European, and other major countries (Bariagabera and Keetiles, 2016; Urquia et al., 2016). Bariagabera and Keetiles (2016) compared human sex ratios of live birth among African population with global levels and observed that sex ratio at birth stands at an average of about 103 males per 100 females for African regional countries with the exception for North African region where the sex ratio is about 105. At country levels, the study reported that ratios were generally about 103 except for North African countries ranging between 104 and 107; Sudan in IGAD region (105); Chad and Rwanda in Central Africa (104 and 102, respectively); Mauritius (105), Mozambique (102), South Africa (102) and Zimbabwe (102). Furthermore, the

study noted that a large number of ECOWAS countries recorded between 104 and 105. These variations were attributed to incidence of high wastage during fertilization and conception for African women as compared with those in the developed countries, Asian and Latin American countries where antenatal, pregnancy, and delivery health services used to be better than those in the African continent.

Kaba (2015) lamented over the rapid increase in Nigeria's sex ratio at birth from 1.03 boys born for every 1 girl born in each year in 1996-2008 to 1.06 in each year from 2009-2014, second only to Tunisia in Africa at 1.07. The average sex ratio at birth in the world in 2014 was 1.07. In most Black African nations or Black majority nations, it is 1.03 or less. Among the factors responsible for this development are historical fluctuations of sex ratio at birth, geography and ethnicity, male preference for a son, age of parents, high death rates of male infants and males in general, and wealth/socio-economic status. The study noted that the potential implications are that young and poor men in Nigeria may not be able to find brides and form families due to a potential shortage of females; second, emigration of young and poor Nigerian men to West Africa and elsewhere to seek brides and form families; third, immigration of marriage aged women from West Africa and around the world to Nigeria to seek husbands; and low contraceptive use and high fertility rates in Nigeria.

Socio-economic Factors and Birth Rate

A lot of studies have shown that socio-economic and demographic factors together determine the number of children that a woman can produce (Corvalan, 2010; Bobak & Gjonca, 2010; Ibor et al., 2011; Dahlberg & Anderson, 2014). These factors influence the woman's exposure to

intercourse and her ability to conceive a child, as well as the interval at which she may wish to give birth. This suggests that many socio-economic factors are important influences on fertility and these factors are sometimes indirectly related. Previous empirical evidence has shown that birth rate is much more common in some particular socio-economic groups at different spatial and temporal scales. Hertwig, Dawis and Sulloway, (2002) used data on live births registered in the Czech Republic in 1989-1991 to examine whether birth seasonality is influenced by socio-demographic factors. In the multivariate study, socio-demographic variables contributed significantly to seasonal variation including disparity in pregnancy loss and cultural factors. The study reported marked differences in the size of the seasonal variation in births by socio-demographic factors. The seasonal variation was highly pronounced in mothers who were 25 to 34 years old, had higher education, were married, and were pregnant with their second or third child. On the other hand, birth seasonality was weak in mothers who were <19 years or >35 years old, unmarried, had low education, and expected their first or fourth or higher birth order.

It has been well acknowledged that education, age and occupation or labour force participation has a strong correlation with levels of fertility (Buckles & Hungerman, 2013; Kihlbom & Johansson, 2004). But sometimes it is difficult to determine direct causation. One must therefore be careful not to confuse causation with correlation. Some factors may be merely related to fertility rates, and other unknown factors may be the real cause of different levels of fertility among different women in different societies. Generally, the age at which a woman first marries is directly related to the number of children she will bear because it affects the length of time she will be at risk of becoming pregnant. Houghton, Bedwell, Forsey, Baker and Lavender, (2008) noted that maternal education, the mother's age, parity and instances where the mother has re-

partnered between subsequent births affected birth seasonality during the second half of the 20th century. The study noted that decline in birth rates during the last quarter of the year became particularly pronounced among highly educated mothers from 1980s onwards. But seasonal variation among first-time mothers declined steadily and has almost disappeared over the past 72 years.

Similarly, Hesketh, and Xing, (2006) documented large changes in maternal characteristics for births throughout the year under review; but that winter births were disproportionately common among teenagers and the unmarried. The study observed that family background controls explained nearly half of season-of-birth's relation to adult outcomes, suggesting that seasonality in maternal characteristics was driven by women trying to conceive; but no seasonality was reported among unwanted births. Buckles and Hungerman (2013) has established the association between season of birth and later outcomes of women with a view of providing a new explanation to variations in maternal characteristics. This study has shed light on the fact that prior seasonality-in-fertility focus on conditions at conception but that expected conditions at birth drive variation in maternal characteristics while conditions at conception are unimportant.

Studies have shown that season of birth has direct relationship with many aspects of somatic and mental disorders, development and social adaptation (Ko et al. 2018; Kihlbom & Johansson, 2004). Bobak, and Gjonca, (2010) demonstrated that in a sample of young Swedish men, corresponding roughly to a one-year birth cohort, where the results of intelligence tests, psychologists' ratings of psychological function, school achievement, body height, weight and self-reported health during childhood, were found to be correlated with month of birth, and--more strongly--father's socio-economic status. The study pointed out that these outcomes were

more favourable for men who were born during March-May (the period of highest birth rate), and whose fathers were of higher socio-economic status than for those born in November and December (the period of lowest birth rate), and whose fathers were in the lower socio-economic group. It appears reasonable to deduce from this study and previously reported ones that these so-called 'birth-date effects' are determined by varying and often interacting biological and psycho-social factors other than socio-economic factors and the grouping of children into one-year age classes therefore produces an unfair lack of equality of possibilities in the outcome of the study.

Variations in Birth Rate

A number of studies have shown that the rate of natural increase of a population depends on birth and death rates, which are strongly influenced by the population age structure and there is consistent evidence that growth through natural increase occurs when the birth rate exceeds the death rate (James, 1990 and National Population Commission (2019). James (1990) wrote that during the first half of the 21st century, the seasonal pattern of births in European countries showed a major peak in the spring and a minor peak in the autumn. In contrast, the pattern in the US was of a minor peak in spring and a major peak in autumn. Over the last 20 years, the pattern in England and Wales has changed to resemble the US pattern, and the same seems to be true of several other European countries. Based on this observation, James (1990) set out to account for the difference between the European and the US patterns and for the change from one to the other in some countries. The magnitude of seasonality correlated with latitude, suggesting that this is partially consequent on variation in luminosity. The study discovered that over the last 20 years the pattern in England, Wales and other European countries has changed to a US birth rate

pattern which has only 1 broad peak from the summer to early fall. Bobak and Gjonca, (2010) observed that the number of births vary markedly by season, but the causes of this variation are not well understood. Many hypothesized factors may affect seasonal birth rates. Recent scholars claimed a new hypothesis which expounds a festival effect of Thanksgiving to Christmas, where couples that were separated by work or choice often make time to be together and therefore improve coital frequencies.

Dahlberg and Anderson (2014) studied changing seasonal variation in births in Sweden and reported that between 1940 and 1999, Swedish birth rates showed the typical seasonal variation with high numbers of births during the spring, and low numbers of births during the last quarter of the year. However, during the 21st century, the seasonal variation in fertility declined so that only minor variation in birth rates between February and September now remains. Notwithstanding, the pattern of low birth rates at the end of the year also remained and has even become more pronounced from the 1980s onwards. This suggests that the characteristic 'Christmas effect' that used to be visible in September has vanished over the last 30 years.

Births and Sex Ratios

There is a growing body of knowledge on sex patterns of birth across the world (Han et al. 2011). Roche, Lewy, Hoey and Laron (2003) studied the monthly rhythm of birth and clinical onset in 303 children with Type-1 Diabetes Mellitus (DM1) aged 0-15 years, born between 1980 and 1996 in Ireland and compare to 951,717 infants born in the general population during the same period. Using the cosine fit for rhythm and t-test between the seasons of the year, the study reported that whereas the males showed a rhythmic pattern of month of birth, peaking in the

summer, similar to that in the general population, the females showed no seasonal differences in either month of birth or month of onset. A mirror image pattern, nadir in spring and summer was observed in month of clinical onset, but only in males. If we assume a viral infectious etiology of DMI, the study concluded then that females would be less susceptible than males to the environmental infectious influences.

Some studies have calculated time of conception by the last menstrual period recall and confirmed or redefined ultrasound cases to stratify sex ratios in developed countries. Cagnacci, Renzi, Arangino, Alesandrini and Volpe (2003) conducted a study to test whether sex ratio (male-female ratio) of vital pregnancies is higher in seasons more favourable for reproduction. The study stratified the sex ratio of 199,454 pregnancies, which had occurred in the Modena County from 1936-1998 according to the month of birth. Sex ratio of institutional deliveries was 0.511 and was identical to that obtained from the County registry. Sex ratio at birth did not show a significant seasonal variation. By contrast, sex ratio calculated at time of conception showed a seasonal rhythm, with amplitude of 2.4 percent and peak values in October. The rhythm was in phase with the rhythm of conception that showed peak values in September and amplitude of 7 percent. The study concluded that the superimposition of the phase of sex ratio and conception rhythms supports the contention that more males than females are conceived in seasons with more favourable reproductive conditions.

In the retrospective cohort study, Ononokpono and Odimegwu, (2014) used the records of all deliveries in a specialist hospital to determine secondary sex ratio (SSR) in the wet and dry seasons in Edo State, Nigeria. The study reported that the total number of live births during the 10-year period under review was 13,702 and this consisted of 7,007 males and 6,695 females,

resulting in a secondary sex ratio of 104.6:100. In general, the monthly distribution of births was bimodal with a greater peak in May and a lesser peak in October with the highest and lowest SSRs in the months of June and March respectively. In the dry season, the study noted that the proportion of male births was higher than the proportion of female births. In contrast, in the wet season, the proportion of male births was lower than the proportion of female births. However, the SSR was higher in the dry season (1.04) compared with the wet season (0.99), but the number of male births tended to be higher than female births during the dry seasons.

Study area and Methodology

Lokoja, the capital of Kogi State is located between latitude 7º45'N-7º51'N and longitude 6º41'E-6º45'E. Its altitudes range from 45-125metres above sea level. It is situated on the western bank of the River Niger at its confluence with the River Benue. It is sandwiched between the River and Mount Patti (Figure 1). These physical features have streamlined the settlement to a linear pattern and have a major effect on the distribution of telecommunication infrastructure. The town which straddles strategic roads is a gateway to five geopolitical zones out of the six such zones in the country. These are the dry season and rainy season. A wet season from April to October, and a dry season from November to March with the wettest month June. Average annual precipitation varies from 1,770 mm (70 inches) in the west to 4,310 mm (170 inches) along the east coast, and to 470 mm (50 inches) in the central areas. Temperature varies according to seasons of the year as with other lands found in the tropics. The rainy season brings in cooler weather to the region as a result of an increased cloud cover that acts as blockage to the intense sunshine of the tropics. The dry season is a period of little cloud cover in the southern part of Nigeria to virtually no cloud cover in the northern part of Nigeria. The sun shines through

the atmosphere with little obstructions from the clear skies making the dry season a period of warm weather conditions with temperatures as high as 44^{oc} (111.2^{oc}). The prevailing winds are the rain bearing south westerlies and the hot dry and dust laden Harmattan from the Sahara Desert in the northeast. Average temperature ranges are from 23 degrees Celsius (73 degrees Fahrenheit) to 32 degrees Celsius (90 degrees Fahrenheit) all year. The two major seasons in Nigeria are likely to have implications for sexual behaviours among the people. Ibor et al. (2011) noted that seasonal variation in sexual behaviour is more likely to be associated with environmental stimuli than physiological response.

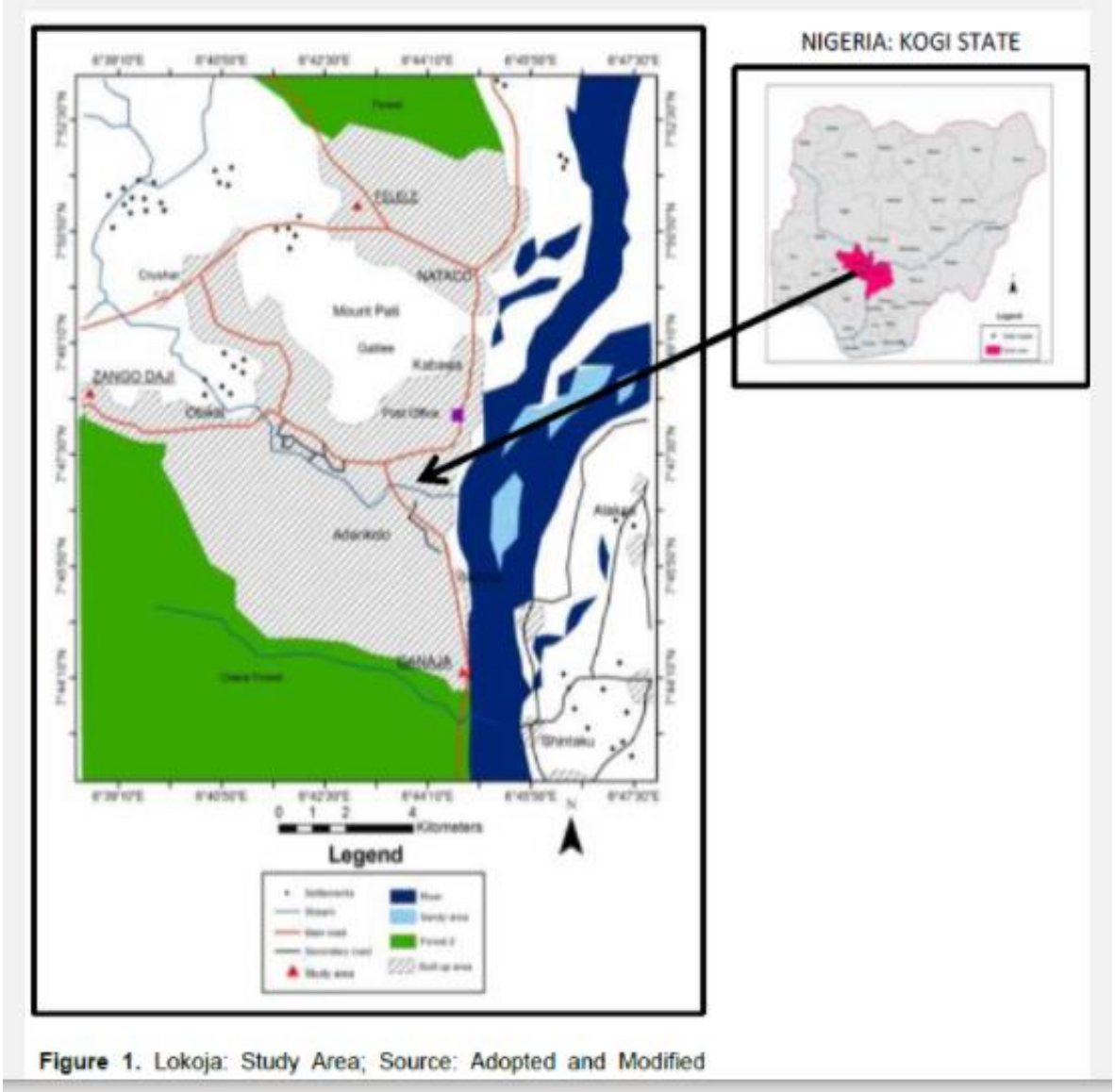

Figure 1. Lokoja: Study Area; Source: Adopted and Modified

Figure 1: Kogi State Ministry of Lands and Survey, Lokoja (2021)

There are two Secondary Health Care (SHC) and Primary Health Care (PHC) centers where women visit for delivery care in the study area. The Secondary Health Care includes Federal Medical Centre (FMC) and State Specialist Hospital. Aside these two hospitals, there are other government owned health centres. These include; Medical Reception Station, Army Barracks,

Primary Health Centre, Zango, Healthcare and Maternity Clinic, Gadumo, Plant Parenthood Federation of Nigeria (PPFN) Clinic, Gadumo, Medical clinic, Federal University Lokoja and Lokoja Government Primary Health Care Centre (Figure 1).

Lokoja also houses several private health care centers patronised by maternal women such as Prime Care Clinic, Adankolo, Destiny Specialist Clinic, Adankolo, Favour of God Clinic, Adankolo, Redeem Clinic, Feyintolu, Meezan Orthopaedic Hospital, Adankolo, Niger Specialist Clinic, Adankolo, A-4 Consultants Clinic and Dialysis Centre, Ganaja, Concord Clinic, Gadumo, Helping Hands Women Specialist Hospital, zone 8, Zenith Specialist Hospital, Gadumo to mention but a few.

Both secondary and primary data were used in this study. The secondary data collected from the National Population Commission (NPC), Lokoja Office, Nigeria, contained information on live births, including months of delivery and the male and female composition of births, while the primary data consists of Key Informant Interviews (KII) conducted with maternal women on seasons of conception and income barriers. The informant interview was conducted to elicit information from childbearing women and caregivers on variables that were not covered in the NPC report but are critical to the study. The data from the NPC was preferred because vital registration systems provide the best source of data for studies of seasonality of births. These systems are usually organised monthly or annually at sub-national or national levels. Before the actual data collection process, reconnaissance survey was carried out. During this period, the researcher was able to familiarise himself with key persons in the institution and the unit to assist in providing the data for the study. In addition, it was at this time that consent letter was written

to NPC seeking for data on live birth and soliciting their cooperation during the actual data collection process.

The study utilized data on all registered 38,696 live births in Lokoja Region, north central Nigeria in the period 2014-2018 compiled by NPC (2019). The register contains individual records of all live births from 13 hospitals including indicators of the socio-demographic status of the mothers and basic information on the newborn infants. The sampled hospitals are District Head Office, District Office, Agbeja, FAREC, Federal Medical Centre (FMC), Local Government Area (LGA) Unit Lokoja, Military Hospital Lokoja, Maternal and Primary Health Centre (MPHC) Felele, National Population Commission (NPC) Office, Lokoja, NPC State Office Lokoja, Primary Health Center (PHC) Obajana, PHC Lokongoma, PHC Seriki Noma, and Kogi State Specialist Hospital Lokoja. The registered data obtained in protected excel file was copied into a new environment (spreadsheet) to enable proper calibration of the variables. Age and education of the mothers constitute the socio-demographic characteristics of mothers used in the study. Age of maternal women was categorized into the following age group: <15, 15-19years; 20-24years; 25-29years; 30-34years; 35-39years; 40-44years; 45-49years; >50years. Mothers were grouped into five categories of education: No formal education, primary, secondary, tertiary and quoranic education. Place of birth was operationalized based on home, hospital and others (which included religious places and local maternal homes). Birth order was classified into six categories: 1^{st}, 2^{nd}, 3^{rd}, 4^{th}, 5^{th} and 6^{th} or higher.

Seasonality in live births was first examined by visual inspection of the seasonal trends in monthly frequencies of observed numbers of births. The months of delivery were further grouped into rainy and dry seasons to calculate for seasonality. Afterward, the monthly live birth data

including the socio-economic indicators were exported into Statistical Product for Service Solution (SPSS) version 21.0 for onward analysis. The annual reported cases were obtained by adding values for the respective months and the variability was determined using trend analysis. The One-Way Analysis of Variance was used to find out whether there is any significant seasonal variation in birth rate, while the Student t-test was used to determine significant difference in male and female births in the period under review. The results have been discussed.

Results and Discussions

Socio-demographic Characteristics of Maternal Women

Registered data on the ages of delivery women in Table 1 indicates that women between the ages of 25 and 29 years (36.5%) dominated the records, followed closely by women within the ages of 30-34 years (24.9%); next was 20-24 years (9.8%), then women within 35-39 years (9.6%), women within ages 15-19 years (4.0%), women within ages of 40-44 years and 45-49 years had a representation of 3.8 percent and 1.2 percent respectively, and women less than 15years (0.1%) and those above 50years (0.1%) had the lowest representations respectively. The educational status of the women (table 4.1) revealed that a good number of the women had secondary (40.2%) and tertiary (30.4%) education. Table 4.1 showed that non educated women were 15.64 percent, followed by women with primary education (13.5%), while women with quoranic education were 0.3 percent. There was a consensus among childbearing women that economic disposition of the woman or household plays an important role in meeting the healthcare needs of childbearing women including children. A female participant expressed the economic hardship women go through to access maternal care:

> *Kogi is a Civil Service State. There are no jobs for women. For those who are working, the State government is paying half salary. This half salary is not paid on time. We are Civil Servants with poor income. We are not always able to afford the healthcare charges. Insufficient income prevents many pregnant women to go for antenatal care not to talk of delivering at the hospital. Those who have money use the health facility, while those who don't have money depend on God. Sometimes, family members have to contribute money to take a woman under labour to the health center or resort to home delivery where financial assistance is difficult to find.*
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> KII 1, Halimat Musa, Kabawa

Table 1: Age and Educational Characteristics of Delivery Mothers

Variables		No Of Birth (2014-2018)	Percentage
Age	Below 15	13	0.10
	15-19	507	4.03
	20-24	2493	19.82
	25-29	4596	36.51
	30-34	3128	24.85
	35-39	1205	9.57
	40-44	481	3.82
	45-49	151	1.20
	50 and above	15	0.12
	Total	12589	100.00
Level of Education	Quranic	31	0.25
	Primary	1704	13.54
	Secondary	5061	40.20
	Tertiary	3824	30.38
	Non Educated	1969	15.64
	Total	12589	100.00

Source : National Population Commission, Lokoja (2019)

Information on the place of birth (Table 2) showed that women who give birth in the hospital made up 84.2 percent, women who gave birth at home make up 15.3 percent and those women who delivered in other places including being assisted by traditional birth attendant (TBAs) and prayer houses made up 0.5 percent. In some instances, grandmothers and mother-in-laws acted as

caregivers during deliveries and do not see the need to take the woman in labour to the health facility. A childbearing woman disclosed that:

> *I gave birth to my first child at home with the assistance of my grandmother. I lost my mother some years back. So each time my Expected Delivery Date (EDD) is near, I invite my grandmother and a few church members. We were together in the bedroom when I delivered and they assisted me. It was my church members who bathed the baby.*
>
> KII 2, Cathrine Adama, Adankolo.

With respect to birth order, children born as first order made up 35.2 percent of the live births. Children born as the second child made up 27.3 percent, those born as the third child made up 19.6 percent, whereas children born as the fourth and fifth child made up 10.1 percent and 4.5 percent respectively. Children born as the sixth and above children together made up 3.3 percent.

Table 2: Place and Order of Birth

Variables		No of birth	Percentage
Place of Birth	Home	1928	15.31
	Hospital	10595	84.16
	Others	66	0.52
	Total	12589	100.00
Order of Birth	1	4434	35.22
	2	3435	27.29
	3	2464	19.57
	4	1275	10.13
	5	564	4.48
	>5	417	3.31
	Total	12589	100.00

Source : National Population Commission, Lokoja (2019)

Health facility deliveries from 2014 to 2018

The number of births per hospital is depicted in Table 3. The result apparently showed that a total of 38,696 births were recorded in the period under review with 2017 having the highest number of births with 28.4 percent of the total births; this is closely followed by 2018 with 23.1

percent, while 2016 recorded the lowest births with 14.5 percent of the total births. The result in Table 3 further showed that District Head Office had the highest number of births with 22.2 percent of the births occurring or delivered in the hospital; this is followed by MPHC Felele and State Sp. Hospital Lokoja with 12.3 percent and 10.2 percent of the total births respectively. Other hospitals with noticeable number of births were FMC, LGA Unit Lokoja and PHC Obajana with 10.0 percent, 8.8 percent and 8.7 percent respectively. The lowest number of births occurred in District Office, Agbeja and PHC Seriki Noma with 1.0 percent and 1.2 percent respectively.

Table 3: Yearly number of Births across Hospitals

Hospitals	Years					
	2014	2015	2016	2017	2018	Total
District Head Office	2544	1010	896	2560	1592	8602
District Office Agbeja	0	0	0	103	271	374
FAREC	0	0	0	0	0	0
FMC	773	867	655	845	718	3858
LGA Unit Lokoja	437	683	613	793	898	3424
Military Hospital Lokoja	566	457	417	718	658	2816
MPHC Felele	567	608	779	1503	1286	4743
NPC Office, Lokoja	254	516	210	1068	823	2871
NPC State Office Lokoja	237	279	316	889	652	2373
PHC Lokongoma	349	583	547	369	34	1882
PHC Obajana	366	605	582	963	840	3356
PHC Seriki Noma	0	0	0	158	309	467
State Sp. HospitalLokoja	804	641	600	1026	859	3930
Total	6,897	6,249	5,615	10,995	8,940	38,696

Source : National Population Commission, **Lokoja (2019)**

Trends in Seasonal Birth in Lokoja from 2014 to 2018

The trend in seasonal births in Lokoja from 2014 to 2018 is depicted in Table 4 and Figure 1. The result showed an upward trend in the number of births in the area. The result revealed that in

2014, the reported births was 6,897. This numbers lightly decreased by 9.4 percent in 2015 to 6,249 births. The number of births in the area however further decreased and in 2016, it decreased by 10.1 per cent 5,615. However, in 2017, the number of births in the area greatly increased to 10,995 representing 95.8 percent increase in births; it nevertheless decreased again to 8,940 births in 2018. The result obtained showed that from 2014 to 2018, the number of births in study area increased by 29.6 percent indicating a considerable increase in the number of births. Further analysis of the trend for the time period under review revealed that the lowest number of births was recorded in 2016, while the highest was recorded in 2017.

Table 4: Reported Births from 2014 to 2018

Year	Reported births
2014	6,897
2015	6,249
2016	5,615
2017	10,995
2018	8,940

Source: National Population Commission, **Lokoja (2019)**

Nevertheless, the trend in the number of births revealed that the period (2014 to 2018) was responsible for 40.0 per cent of the variation in the number of births recorded in the area. The figure however revealed a significant and upward or increasing trend in the number of births. The result in Table 4 and Figure 1 simply depict that there is an upward pattern in the number of births from 2014 to 2018; with 29.6 percent increase in the number of births.

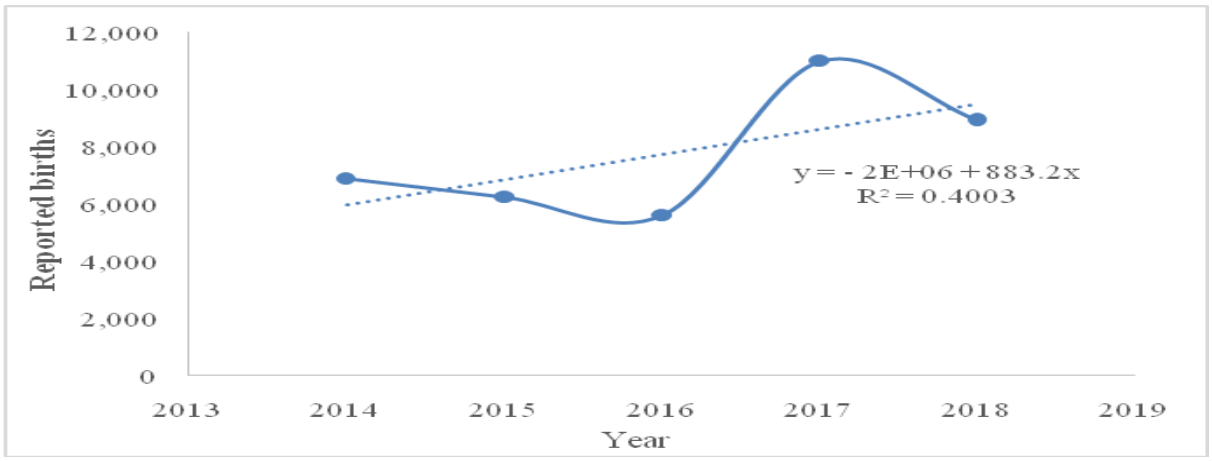

Figure 1: Trend in Seasonal Birth
Source : National Population Commission, Lokoja (2019)

Yearly difference in Male and Female Births

The result obtained is shown in Table 5. The result in Table 5 showed that in the period under review, there were more male births than females with male births constituting 50.9 per cent of the births recorded in the area. This further means that more males are born in the area than females. A look at the study further revealed that the highest number of births was recorded in 2017 with a larger percentage of the births being males. It also shows that male births predominate in all the years the study covered. The result in Table 3 also shows no statistically significant difference in male and female births in the period under review ($t = 0.271$, $p>0.05$). This decision is because the probability value of 0.793 is greater than 5 percent significance level. This result further confirms that sex ratios at birth are not the same.

Table 5: Yearly difference in Births between Male and Female

	Births	
Year	Boys	Girls
2014	3389	3073
2015	3173	3077
2016	2903	2727
2017	5608	5392
2018	4622	4450
Total	19,695	19,001

t = 0.271; df = 8; Probability value = 0.793

Source: National Population Commission, Lokoja (2019)

On the One-way Analysis of Variance (Table 6), the result shows no significant seasonal variation in births ($F = 1.440$, $p>0.05$). This is consequent upon the probability value of 0.232 being greater than 5 percent significance level. The result further shows that, although the numbers of births recorded yearly vary, the numbers do not result in a substantial variation in births over time.

Table 6: ANOVA Result of the Seasonal Variation in Births

Source of variation	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	1498798.215	4	374699.554	1.440*	0.232
Within Groups	15610504.000	60	260175.067		
Total	17109302.215	64			

*Insignificant at 5% alpha level

Source : National Population Commission, Lokoja (2019)

Monthly Variation in Conception and Births

The conception was computed from the months of birth deliveries in Table 7 by using a corresponding nine months interval from the month of birth. The table showed that most conception occurred in the month of April with 22.6 percent of births after a period of nine months. This was followed by conception in the months of November and December with 14.4

percent and 10.5 percent of the births respectively. Nearly similar values of about 6.0 percent births were recorded for conceptions in the months of February, March, May, August, September, and October. The lowest conception was recorded in the months of January, June and July with births of 5.50 percent, 5.01 percent and 4.7 percent respectively. Further analysis revealed that average conception during the rainy season (April-October) was 56.5 percent, while average conception in the dry season (November-March) was 43.5 percent. The monthly variation in birth from 2014-2018 revealed that there was high birth rate in December (22.6%). Next to December is July and August which correspond with months with high rainfall. Births recorded in July and August were 14.4 percent and 10.5 percent respectively. Other months were within the range of 5.5 percent - 6.8 percent respectively. The lowest numbers of births were observed in February (5.0%), while March (4.76%) is the annual "trough" with the fewest number of births in the year.

Table 7: Monthly Variation in Conception and Births.

Months of conception at the preceding year	Corresponding months of delivery	No. of Births	Percent (%)
May	January	2350	6.07
June	February	1940	5.01
July	March	1804	4.66
August	April	2323	6.00
September	May	2326	6.01
October	June	2633	6.80
November	July	5578	14.41
December	August	4067	10.51
January	September	2128	5.50
February	October	2526	6.53
March	November	2293	5.93
April	December	8728	22.56
Total		38696	100.00

Source: National Population Commission, Lokoja (2019)

Interview with a caregiver on season most favourable for conception revealed that most conception occurs during the rainy season. She revealed that:

> *Conception is not planned towards any season. During rainy days, we don't go to farm or work. We stay at home with our husbands. Though we do not plan to get pregnant during rainy or dry season but we observe that many of our women become pregnant in the rainy season. When a woman is pregnant, we just believe that it is God that brought the pregnancy that is all.*
>
> KII 3, Female, Aisha Hassan, Ganaja Village.

Discussion

From the socio-economic analyses of the study, it can be deduced that majority of the women (90.8%) are within the ages 20-39 years, implying that young adults have the highest population of reproductive women in the area. With young adults engaged in reproduction, it suggests that

many of them would be able to plan for their childbearing and better able to avoid the risk associated with pregnancy in particular seasons. The result indicates that majority of the child bearing women have formal education and this is likely to influence their literacy level. It is expected that the level of education of these women will have some effects on their knowledge of child birth and also influence their choices of periods for conception and general reproductive preferences. The study showed that 84.2 percent of women delivered at the health facility. This result indicates that a large number of the women made use of the hospital, suggesting that they are likely to have access to modern fertility practices. Delivery in hospitals may not be unconnected with women's level of education. The study has earlier pointed out that most of the mothers had one form of formal education or the other. This result agrees with the findings of earlier studies like those of Ononokpono and Odimegwu (2014) that reported a strong association between community level education and delivery in a health facility.

This result shows that as the order of birth increases, the number of children born decreases, implying an inverse relationship between birth order and number of births to a woman. This pattern of birth order may not be unconnected with parent's social and psychological changes. Parent's social and psychological changes within the family may relate to birth order effects in fertility, more so on the sex of the first born especially to young couples. With clearer evidence in this study that many of the children born were first order to over 30.0 percent young mothers, there is the likelihood of cumulative advantage of earlier born children over later born children and is suggestive for their favoured position in families (Hertwig, Davis and Sulloway, 2002). Notwithstanding, this could have an ambiguous effect on fertility. For instance, a higher educational attainment of first order children compared to later children might point to a reduced

fertility, while higher income of earlier children might bring about increased fertility (Morosow and Kolk, 2016).

The large numbers of births registered in the hospitals suggest that mothers and in particular young mothers initiating motherhood are aware of the health benefits of delivering in a health facility. This result confirms earlier finding by Houghton, Bedwell, Forsey, Baker and Lavender (2008) that women and professionals felt more at ease when birth occurred in the hospital setting and perceived it to be a safer environment. But the result shows that District Office, Agbeja and PHC Seriki Noma are rarely utilized by childbearing women for deliveries. The reason is likely that these are cottage health centres in peripheral areas occupied by fairly literate poor women some of whom are Muslims who patronize health centres less frequently. It is likely that mothers from poor families or those with limited financial resources may have difficulty paying for user fees, transport fare, medications and other supplies, and likely to deter them from using maternal health services in standard facilities. Also, the criticality of delivery service to pregnant women suggests that expectant mothers would want to utilise health facilities with the best services to guarantee their safety and that of their babies.

The low birth rate recorded in 2016 may be attributed to the economic recession that struck many families during this period. It is notable that families had to delay fertility to cushion the effects of economic hardship. The decline in fertility as a result of economic hardship has been noted by earlier scholars (Kihlbom & Johanson, 2004). Economic recession often leads to a temporary decline in fertility levels, one or two years, partly reflecting a postponement of childbearing that is often later compensated during the period of improved economic conditions. While fertility rates have declined slightly in some parts of Nigeria especially the southern region in recent

years, this analysis indicates that birth rates are rising in the northern part of Nigeria. The likely reason is religion, culture, age at first marriage, contraceptive use and education among others. High birth rate in this region has been reported by Izugbara and Eze (2010) who contend that the social meanings that women ascribe to their husbands' behaviours and the ways they respond to them are significant contributors to current high fertility in northern Nigeria.

The study found that there are more males than female births. This means that if the trend has been the same in the preceding years, we expect males to account for slightly higher numbers of the total population in the region even if the difference is not statistically significant. The reasons for this higher male sex-pattern of result are not far-fetched. Beside biological reasons, the tradition of male (son) preference has led to sex-selection in recent times among couples which later reflect in the natural sex ratios in large parts of Africa. This problem further manifests in sex-selective abortion and in discrimination in care practices for girls, both of which lead to higher female mortality (Hesketh and Xing, 2006). Other socioeconomic, psychological and environmental factors responsible for this sex variation at birth include race, season, wartime, birth order, paternal age, psychological status of parents, substance use and mother’s alcohol intake, parent’s handedness, the location of anomalously implanted pregnancy and maternal age.

There was a systematic pattern in the seasonality of conception with slight variability; however, most women showed preference in cold season for both pregnancy and childbirth. Conception was higher at the onset of the second quarter of the year, whereas birth peaks showed variable pattern with December having the highest live births. The lowest conception occurred at the first quarter of the year, while the least births were recorded in the mid-year. The results showed that most conceptions occurred in the month of April with 22.6 percent of the births after a period of

nine months, implying that most women become pregnant during the onset of the rainy season which is characterized with light wetness and diluted heat waves. This month succeeds the warmer dry season of the year. This finding is consistent with previous studies that sunlight exposure can boost the likelihood of a woman having a baby. This suggests that couples hoping to conceive may find that timing for sunnier seasons to improve their chances. This is followed by conception in the months of November and December with 14.4 percent and 10.5 percent of the births respectively. This period is characterized by dry, cold weather and social events that promote sexual activities.

The large number of births in June, July and August is an indication that women tend to conceive in the last quarter of the year (October, November) that marks cessation of the rainy season and the beginning of the cold harmattan season. The reason may not be unconnected with increased sexual activities associated with end of year holiday festivities as well as parental preferences associated with pregnancies conceived during major events/seasons like Christmas and the accompanying excitement that comes with the expectation of a newborn in the New Year. Nearly similar values of about 6.0 percent births were recorded for conceptions in the months of February, March, May, August, September, and October. The lowest conception was recorded in the months of January, June and July with births of 5.50 percent, 5.01 percent and 4.66 percent respectively. This shows that the lowest conception occurred during the peak of the rainy season. This result confirms findings in previous studies showing that most babies are born in the last quarter of the year, while fewest are born in the second quarter. Conception was slightly higher in the rainy season (56.5%) than the dry season (43.5%). This slight difference may be attributed to seasonal variation in sperm quality caused by changes in the daylight length, seasonal

variation in ovarian functions as well as other seasonal effects on bio-physiological processes. This result corroborates with the findings of Welling, Macdowall, Catchpole and Goodrich (1999). Good weather can promote sexual behaviour with some positive reproductive health effects on sperm motility and menstruation.

The findings of this study have shown that there is a clear pattern of births across the period under review. The pattern showed a progressive rise in the number of births from 2014 to 2018. Although the numbers of births vary in seasons, the variation does not result in a substantial increase over time. The study also found that most babies were born in December due to more conception in April. Next was July and August which correspond with months with the highest rainfall, allowing for cold weather. Births recorded in July and August were 14.4 percent and 10.5 percent respectively. This result suggests that a decrease in temperature during the rainy season may have a positive effect on birth rates. The study observed that the lowest births occurred during the periods of extreme heat in the study area. From this result, there is the possibility that temperature affects the birth rate and further suggests that exposure to high temperature may result in miscarriages or premature delivery for pregnancies that are near deliveries. This is substantiated by more births in the rainy season (April-October) than the dry season (November-March).

A series of interviews conducted on women who have experienced motherhood on the issue of conception revealed that most conceptions occur during the rainy season. The interview revealed that conception is not planned towards any season. However, most women interviewed revealed that they would have preferred to always get pregnant during the harmattan (dry) season when the weather is quite cold. The reason for this preference was that, considering the thermal

discomfort in the region, pregnancy would be preferred during the wet, cold dry harmattan season when the heat waves will be lesser. This response suggests that reproductive aged women do not have adequate knowledge of seasonal conception and this is likely to affect their reproductive preferences. Their knowledge of season of conception does not correspond with scientific evidence as shown by registered live births.

Conclusion and Recommendation

This study has established the fact that monthly reported deliveries in health facilities can provide a better understanding of seasonal patterns of conception and births in a population. This knowledge can help achieve better results with greater impact on birth control. The study has shown that birth rate increased by 30.0 percent within the period under review. This high birth rate is sustained by poor socio-economic conditions such as mother's age, education and birth order. This finding contributes to the existing body of literature on the close relationship between socio-economic factors and fertility rate. The 84.2 percent increase in health facility delivery is likely to have positive impact in reducing maternal and infant mortality. This will contribute to the achievement of the Sustainable Development Goal (SDG) 3. This goes to show that ongoing interventions are yielding results in reducing home birth practices in the area. The study has also expanded our understanding on the capacities of the health facilities based on the number of births recorded per hospital. This information is useful in health systems strengthening especially in resource-poor regions. The finding that conception was high in dry-warmer months and deliveries in wet seasons suggests that fertility and reproductive health outcomes are seasonally related.

These findings highlight the fact that data on monthly deliveries can be used to infer seasonally related births and conception and so suggest the potential benefit of focused and heightened efforts to prevent unintended pregnancies and unplanned births. Findings on season of high conception may influence sexual behaviour. Married or sexually active individuals may choose to avoid pregnancy or sexual activity during risky times of the year because of the likelihood of conception. This may also inform contraceptive use and negotiated sexual relations among sexual partners. Sexual health promotion campaigns and safer pregnancy related interventions; most notably contraceptive use advocacy should be targeted at young mothers at the onset of the rainy season. There should be more investment in family planning to address the unmet needs of women in the study area and encourage female secondary education to be better able to control fertility and develop a workforce to maximize demographic dividends and contribute to climate change adaptation. Aspects of seasonal influences on fertility should be incorporated into family planning as well as sexual and reproductive health information to enable women understand the health risks and benefits associated with reproduction in particular seasons to guarantee adequate timing of pregnancies towards seasons most preferred in order to achieve fertility. It is noteworthy that awareness of seasonal effects on conception and births has serious implications on maternal care provision and uptake. Efforts should be geared towards creating easier access to health care and counseling services as delay in seeking preventive services may reflect influence of seasonal barriers. Health education should focus more on risky seasons and safer periods to avoid the risk of unintended pregnancy and unplanned birth. Finally, the findings of this study point to the importance of considering seasonal effects on birth control programmes and further

serve to highlight the nexus between climatology and population studies within the wider discipline of geography.

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