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GEO-LOCATION AND PERIOD OF CONCEPTION OF BABIES WITH SPINA BIFIDA IN NORTHWEST NIGERIA: IMPLICATIONS FOR ONE HEALTH-ORIENTED PREVENTIVE STRATEGIES

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Abstract

Spina bifida is a congenital anomaly that result from failure of fusion of neural tube. Factors such as folic acid deficiency, exposure to high temperature during pregnancy and genetic abnormality were implicated in its development. Peri-conceptual folic acid use has been shown to be protective against giving birth to babies with spina bifida. Targeted folic acid supplementation to individuals with high occurrence especially at a period more prone to development of spina bifida may ensure more effective prevention of this unwanted congenital anomaly. The general objectives of this study were to identify geographical location with higher occurrence of babies with spina bifida, to determine period of conception of babies delivered with spina bifida and provide opportunity for targeted preventive strategy

Retrospective review of bio-demographics, state of residence and period of conception of babies with spina bifida between January 2020 to December 2022.

We recorded 100 patients with complete records over 3-year period, males constituted the majority (52%) with a male-to-female ratio of 1.1:1. Gusau, Dange-shuni and Bungudu local governments top the lists of location with most cases of spina bifida (5.2%) each. Majority of cases were residence of Sokoto state, 36.0%, followed by Zamfara, 28.0% and Kebbi 26.0%. Most pregnancies for babies with spina bifida were conceived in February (17.0%).

Spina bifida occurs in male children predominantly with high occurrence in Sokoto, Zamfara and developing in the months of February, April and September.

Keywords: spina bifida, myelomeningocele, Sokoto, paediatric neurosurgery, folic acid supplementation

Introduction

Spina bifida is a congenital central nervous system anomaly involving the spine that results from failure of fusion of neural tube during intra-uterine life. (Isma'il et'al, 2017) Spina bifida remains the commonest congenital central nervous system anomaly compatible with life. It occurs worldwide but relatively occur more often in developing nations because of certain factors like poor nutrition and paucity of intrauterine diagnosis of the condition and termination of pregnancies found with a foetus with spina bifida. Global data reports 300,000 cases are recorded yearly with a worldwide incidence rate of 1 in 1000 live births, relatively greater in northern China (3.7/1000 live births). (Rampersaud et'al. 2005; MacHenry et'al 1979, Oumer et'al, 2020) While in Africa about 1-3 per 1000 birth per annum are affected also, in Sokoto Nigeria prevalence of 2.2 per 1000 deliveries was reported. (Nnadi et'al, 2016)

Several factors are implicated in the development of spina bifida the factors include folate deficiency, exposure to heat during pregnancy, maternal diabetics, maternal use of anticonvulsants such as sodium valproate, carbamazepine and phenytoin. (Usman et'al. 2023; Mashuda et'al. 2014, Catala, 2021).

Failure of neural tube fusion with consequent spina bifida results from interaction between genetic and environmental factors. (Engelhardt et al. 2022).

The development of neural tube defects like spina bifida is multi-factorial and polygenic, genes as high as 80 were implicated. (Kakebeen & Niswander, 2021; Lee & Gleeson, 2020;) Defective canonical WNT/ β -catenin signalling, mutation in Pax3, Nap1/2 genes, Notch pathway (Hes1, Hes3, Rbpj), trisomy 13, trisomy 18, genes for folate homocysteine pathway tetrahydrofolate especially reductase (MTHFR) were implicated in the occurrence of spina bifida. (Williams et'al, 2002; Rogner et al., 2000; Ramakrishnan et al., 2021) The presentation of individuals with spina bifida depends on the presence or affectation of neural tissue in the defect. In case of meningocele where there is minimal involvement of neural tissue the manifestation is limited to midline back swelling but where neural tissue is involved as in myelomeningocele, in addition, neurologic dysfunction such as weakness of limbs, impaired sensation, sphincteric dysfunction and tethered cord may be present.

Spina bifida being a common neural tube defect seen worldwide including sub-Saharan African nations like Nigeria, it continues to be seen in clinical setting causing serious neurological dysfunction such as paralysis, urinary and faecal incontinence, disability, pressure ulcers and even mortality. A quite high mortality of 17-27% was recorded in Nigeria, a lower rate reported in western world. (Nkwerem et'al, 2025; Alatisse et al. 2006). Periconceptional folic acid administration has been shown to significantly reduce the delivery of babies with spina bifida, thus the commonly practice folic acid fortification of staple foods in the developed nations. A reduction as high as 30–46% in the occurrence of neural tube defects has resulted from folic acid fortification of staple food. (DeWals et al.2007;Sayed et al. 2008) Identification of geographical location of the children with spina bifida as well as period of conception may provide opportunity for institution of preventive measures like folic acid administration as well health education on ways to the health and well being of the affected individuals and also preventive measures amongst pregnant women, this strategy of targeted prevention will help in prioritising resource allocation to the individuals with the problem as against a mass prevention to all communities irrespective of the presence or absence of the disease, thereby reducing waste of resources especially in resource-constraints setting like sub-Saharan African countries.

Targeted folic acid supplementation to individuals with high occurrence especially at a period more prone to development of spina bifida may ensure more effective prevention of this unwanted congenital anomaly.

Methods

This was a retrospective study, data was collected from patients case files and operation register where relevant information such as bio-demographics including age, gender as well as state of residence and period of conception of all children with spina bifida between January 2020 to December 2022 was retrieved. Relevant data was collected in a proforma and entered into excel, exported into SPSS version 20.0 for statistical analysis. Reverse conception calculation was done by subtracting 38 weeks from day of birth of full-term babies diagnosed with spina bifida.

Results

We recorded 100 patients over 3-year period; males constituted the majority (52%) with a male-to-female ratio of 1.1:1. Gusau, Dange-shuni and Bungudu local governments top the lists of location with most cases of spina bifida (5.2%) each. Majority of cases were residence of Sokoto state, 36.0%, followed by Zamfara, 28.0% and Kebbi 26.0%. (figure 1) Most pregnancies for babies with spina bifida were conceived in February (17.0%), September (14.0%) and April (11.0%).(figure 3 and 4) Only 40.0% had antenatal care despite history of fever in 36.0% of the pregnant mothers.

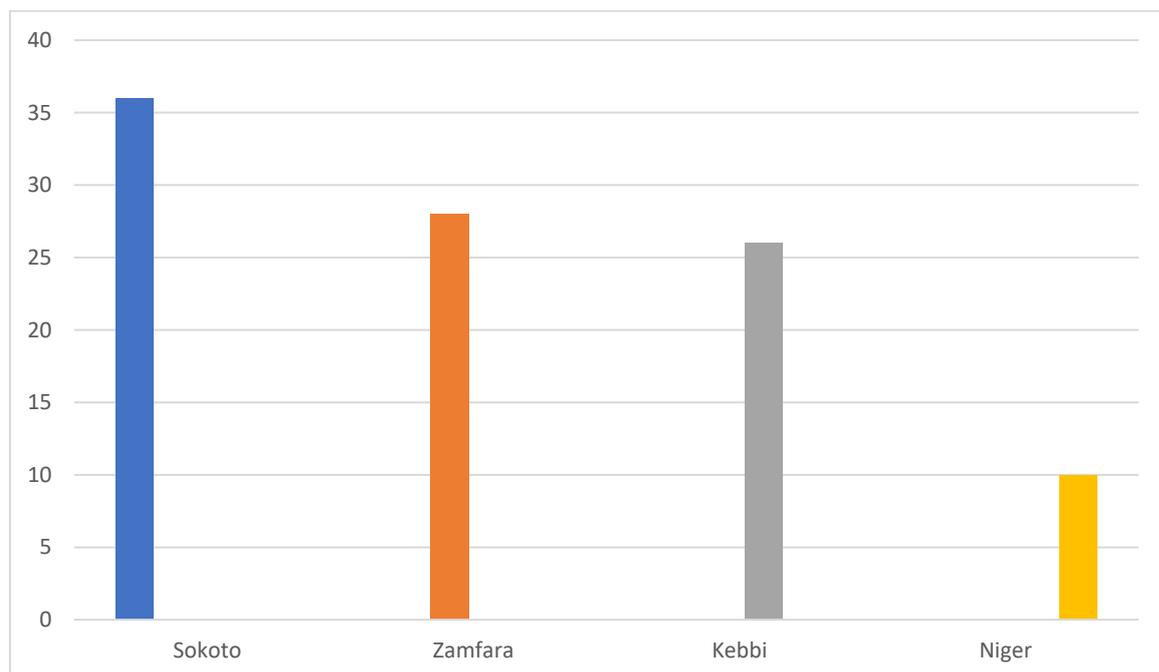


Figure 1: Distribution based on state of residence

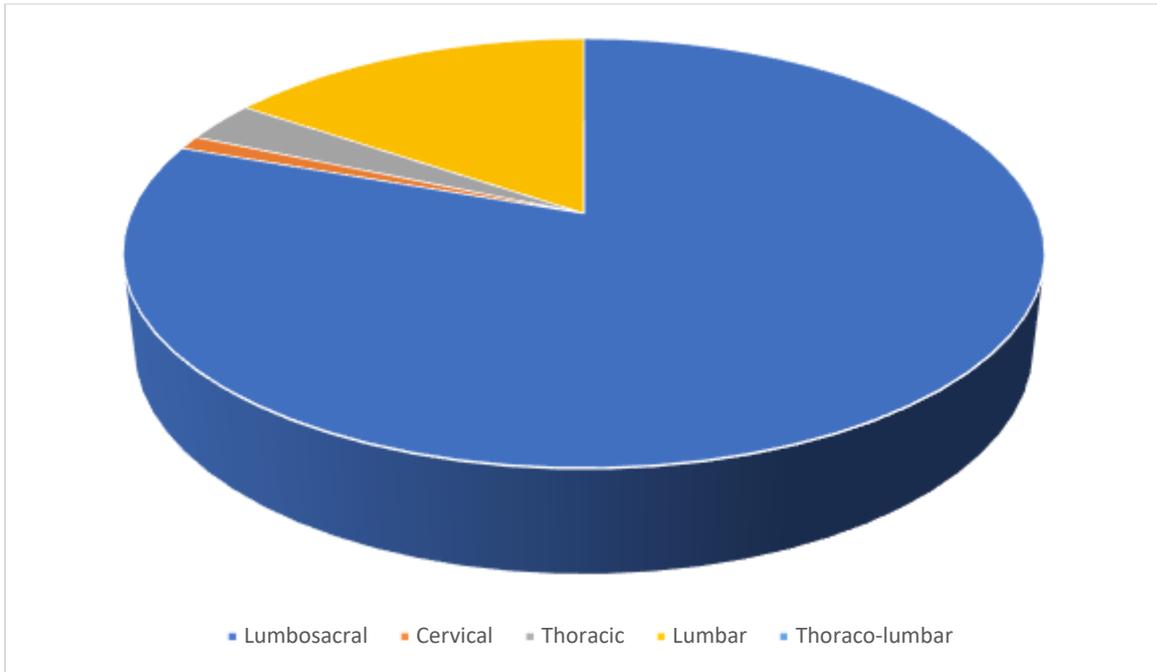


Figure: Distribution based on anatomical location

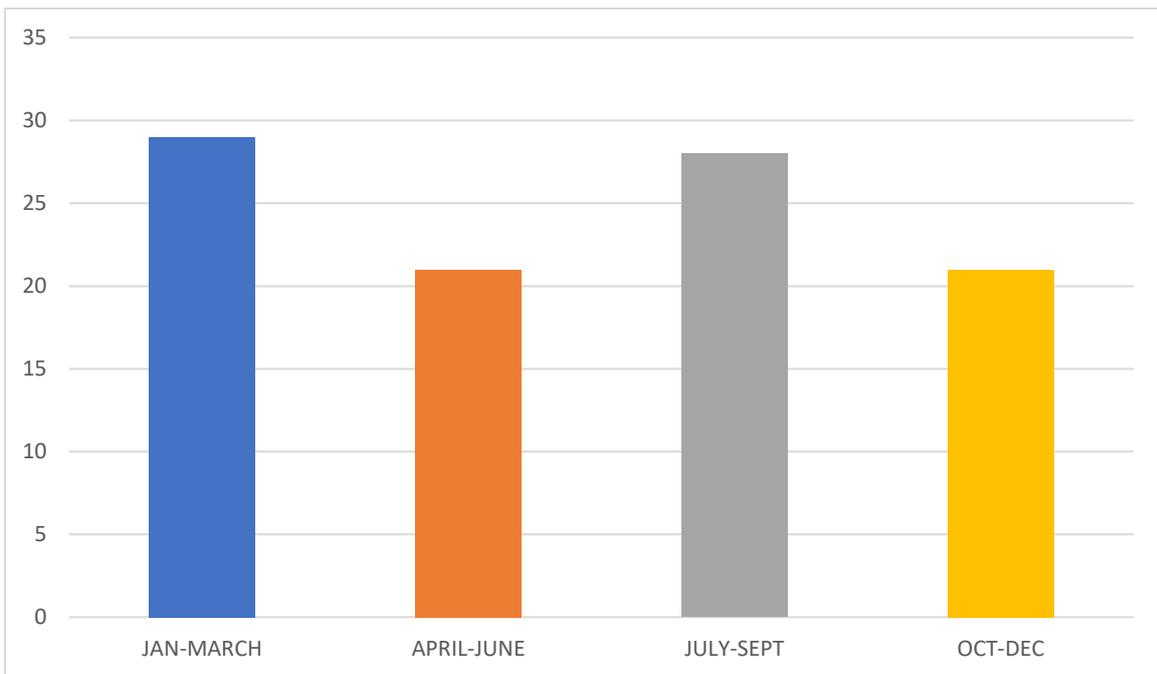


Figure 3: Distribution based on group-months of conception

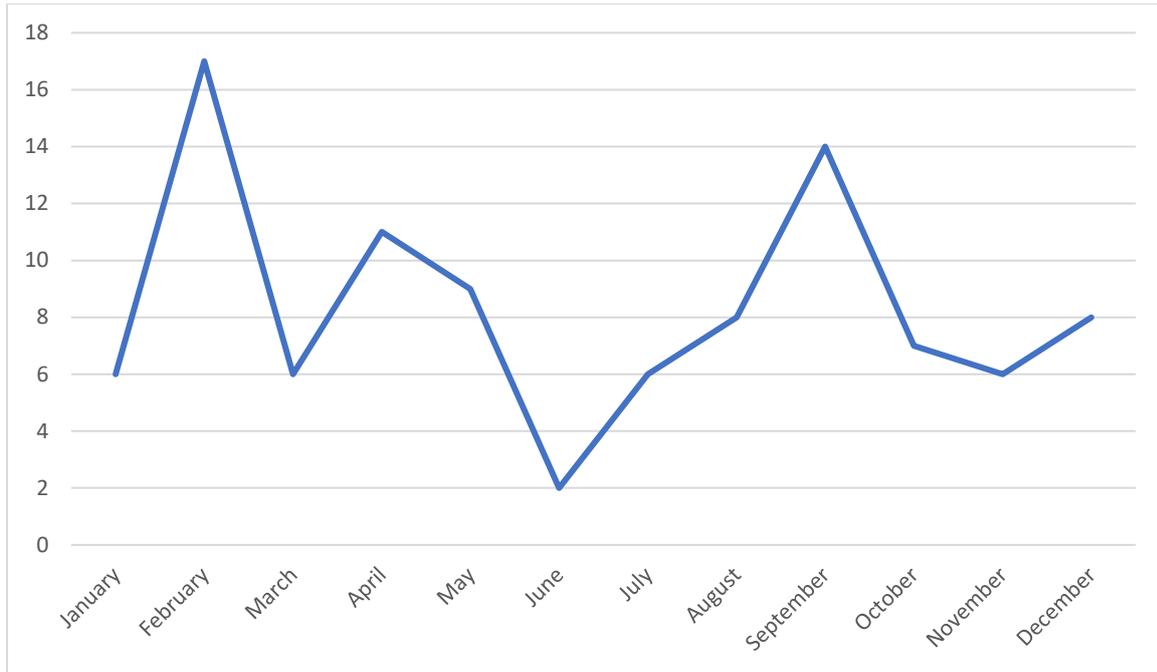


Figure 4: Individual month of conception of pregnancies delivering spina bifida

Table 1: Associated congenital anomalies

Associated anomaly	Frequency (no.)	Percentage (%)
Hydrocephalus	22	22
Club foot	14	14
Craniosynostosis	2	2
Encephalocele	1	1
Diprosopos	1	1
Prune belly	1	1
Craniopagus	1	1
Bladder exstrophy	1	1
Total	43	43



Figure 5: An infant with huge lumbosacral myelomeningocele

Discussion

Determination of geographical location as well as period of conception of babies with spina bifida may pave way for allocation of preventive measures like folic acid administration, supplementation and health education to specific communities bedevilled by the occurrence of spina bifida. Also, unveiling communities with higher incidence of spina bifida provides an avenue for surgical and medical outreaches to the affected areas while minimising waste of resources and manpower by channelling the resources to people and community in dire need of such care.

In the present study, males constituted the majority against female counterpart. Previous study in the index centre published 9 years ago reported males' preponderance, similarly other published data concurred with this finding. (Isma'il et'al, 2017; Ozor et 'al, 2021; Eke et' al, 2016; Alatise et 'al, 2006). In contrast, females preference were reported in other studies. (Polfuss et'al, 2022; Babagana et'al, 2021). A study in South-west Nigeria demonstrated almost equal occurrence across gender. (Komolafe et' al, 2018). The similarities and differences recorded in various studies may not be unconnected to variations in disease bio-demographics across regions and location and also, differences in study design and the study population among research outputs.

Present study demonstrated that the state of residence of most cases of spina bifida was Sokoto, a state where this study was conducted. Studies on climate change reported increasing temperature and heatwave in Sokoto and Maiduguri much more than other states in Nigeria. (Osanyinro et'al, 2024; Elusoji et'al, 2024) Exposure to heat within the first four weeks of pregnancy has been shown to be risk factor for development of spina bifida by interfering with neural tube formation, (Suarez et al., 2004; Obeidat and Amarin, 2010; Auger et al., 2017) as such, it was not unexpected to record a higher cases of spina bifida in Sokoto compared to other states. Other possible reasons for finding more children with spina bifida compared to other neighbouring states may be attributed to larger population as well as presence of a regional neurosurgical centre in the city as against other states like Kebbi that

presently have a neurosurgeon in the state capital and Zamfara with no resident neurosurgeon but closer to two teaching hospitals in Zaria and Kano that the residents of that state can take their children for neurosurgical care. The current study is arguably the first data to unravel the geographical distribution of children diagnosed with spina bifida based on state of residence. Thus, mapping the location of areas with higher cases for spina bifida providing an opportunity for preventive strategies as well as surgical care to the people in dire need.

Period of conception of babies with spina bifida was an important tool that may unfold the reasons spina bifida occurs more common in certain period of the year than others. In this current data, hotter months of February and September top the list of the months with higher occurrence of spina bifida, this further elucidates the relationship between maternal exposure to ambient heat and the delivery of babies with spina bifida. Recent study from southeast Nigeria has reported almost similar findings of recording higher cases of spina bifida during hotter months of January to march. (Okpara et al., 2023; LaPointe et al, 2024)

Conclusion

Spina bifida occurs in male children predominantly with high occurrence in Sokoto, Zamfara and Kebbi, developing during hotter months of February, September and April. This study provides opportunity for targeted preventive strategy for geographical locations and time period upon which spina bifida occurs most.

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