Birth Prevalence of Overt Congenital Anomalies in Kano Metropolis: Overt Congenital Anomalies in the Kano

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Abstract Congenital anomalies are abnormalities of prenatal origin, and their prevalence varies worldwide. The objective of this study was to determine the prevalence and spectrum of overt congenital anomalies in live born neonates in selected hospitals in the Kano metropolis of North western Nigeria, as well as the associated maternal, paternal and neonatal risk factors. A descriptive study design was employed. All live born neonates in three major hospitals in Kano metropolis were prospectively studied from April 2013 to December 2013. Detailed family history and clinical data were recorded in a structured questionnaire for each child. A total of 1456 live born neonates were recruited into the study, of which 41 (28.15 per 1000 live births) had overt congenital malformations with 5 (12.20%) having multiple system involvement and 36 (87.80%) having a single system affection. The most common system involved in neonates with isolated single system malformations were the central nervous system (10 cases) and the genitourinary system (10 cases). The consanguinity rate in the study was 17.83%. Birth weight of the neonates had a significant but negative association with the likelihood of being born with a congenital malformation [OR = 0.374; (95% CI 0.196 – 0.711) P = 0.003]. Given the high frequency of potentially preventable central nervous system malformations in this study, emphasis on the primary prevention of congenital malformations by encouraging periconceptional use of folic acid containing multivitamin supplements is recommended.

Keywords Congenital malformation; Overt; Consanguinity; Periconceptional; Neonate

development [1-4]. The birth prevalence of congenital anomalies varies from country to country. It is believed that between 2-4% of live born infants and 15-20% of stillbirths have a significant birth defect [5,6,7]. Birth defects are an important cause of childhood morbidity and mortality as it is estimated that one out of every 3 babies that die in the world has a congenital anomaly [7,8].

The World Health Organization (WHO) estimates that about 260,000 deaths worldwide (i.e. 7% of all neonatal deaths) were caused by congenital anomalies in the year 2004 [9]. Apart from the direct impact on affected children and their families, congenital anomalies exert an enormous financial burden on a nation's health, educational and social support services [2,10].

Congenital anomalies could be broadly classified into 2 major groups i.e. single system abnormalities affecting a single organ system or body part, and multiple abnormalities which affect more than one organ system or body part [1,2,11]. Major congenital anomalies are defined as those abnormalities that if uncorrected or uncorrectable will significantly impair normal body functions or reduce life expectancy, while minor anomalies are those that cause no handicap i.e. they cause no significant physical or functional effect and can be regarded as normal variants if they affect more than 4% of the population [1,5].

Recorded prevalence rates for congenital anomalies in developing countries are underestimated by deficiencies in diagnostic capabilities, lack of reliability of medical records and health statistics, and underreporting [10]. In response to this concern, this study was undertaken to establish the prevalence and spectrum of overt congenital malformations at birth in the Kano metropolis in Northwestern Nigeria.

1. Introduction

Congenital malformations also known as birth defects are structural or functional anomalies of prenatal origin which result from a defect or abnormality in the process of

2. Materials and Methods

A study of 1456 consecutive live births at three major hospitals (Aminu Kano Teaching Hospital, Murtala Mohammed Specialist Hospital, and Sheikh Jidda Specialist Hospital) in the Kano metropolis of northwestern Nigeria.

The study was carried out between April 2013 and December 2013.

Approval was obtained from the Teaching Hospital's and Kano State's ethical committees for this study. All babies were routinely examined within 48 hours of delivery [1]. The diagnosis of congenital abnormality was based only on clinical examination and assessment by trained research assistants who were either medically qualified or medical students. Chromosomal analysis and autopsies were not performed in this study. Both major and minor malformations were included in the study. Structural anomalies are considered "overt" or "external" when they are visible on inspection, otherwise they are considered "occult" or internal" [4,12]. In neonates with congenital anomalies involving two or more systems, a diagnosis was made if the group of malformations constitute a known syndrome or chromosomal disorder, and the child is recorded only once under that diagnosis. If no diagnosis can be made, the infant is classified and coded only once as having a multiple congenital abnormality, and the system with the most obvious or major malformation was noted [7,13]. For each case, a detailed pregnancy and family history, including the presence or absence of consanguinity, was obtained by interviewing the mother [1]. Data were recorded on a pretested structure questionnaire for each neonate. Data were analyzed using SPSS 15.0 (SPSS Inc, Chicago, IL).

Descriptive statistics were computed for continuous variables, while proportions were used for categorical characteristics of the study subjects. The chi-square test was used to test for association. Fisher's exact test (two-tailed) was used where appropriate. Multivariate logistic regression was done to identify significant predictors of being born with congenital anomaly. Level of significance was set at $P < 0.05$ for all tests.

3. Results

A total of 1456 live born neonates were recruited into the study over the study period.

The basic characteristics of the study neonates and their mothers (Table 1 and Table 2) are as depicted. Most of the neonates were males (52%; 757/1456), majority of them were products of singleton gestation (91.62%; 1334/1456). Vaginal delivery was the main type of delivery (85.60%) in the study. A consanguinity rate of 17.83% was observed in the study.

During the study period, 41 babies were found to have an overt congenital malformation, giving a prevalence of 28.15 per 1000 live births (Table 3). Among those with a congenital malformation, 5 (12.2%) had multiple abnormalities, while 36 (87.8%) had involvement of a single system. The prevalence for multiple malformations in the study was thus 3.43 per 1000 live births, and that for single-system malformations was 24.72 per 1000 live births. Among the neonates with single-system malformations

(Table 3 and Table 4), the most common systems involved were the central nervous system and genitourinary system with 10 cases each, the dermatological system (6 cases), and gastrointestinal system (5 cases).

Table 1. Characteristics of Neonates in the Study

Variables	Frequency	Percentage (%)
Gender		
Male	757	52
Female	699	48
Type of Delivery		
Vaginal	1242	85.60
Caesarean Section	209	14.40
Gestational Age (Weeks)		
36 and above	363	25.55
37 – 40	838	58.97
41 and above	220	15.48
Nature of Gestation		
Singleton	1334	91.62
Twins	116	7.97
Triplets	6	0.41
Birth Weight (kg)		
< 2.5	98	7.42
2.5 – 4.0	1196	90.54
>4.0	27	2.04

Table 2. Socio-demographic characteristics of neonates' mothers

Variables	Frequency	Percentage (%)
Age (Years)		
19 and below	153	10.58
20 – 34	061	73.37
35 – 39	170	11.76
40 and above	62	4.29
Highest Level of Education		
None	25	1.72
Primary/Quaranic	552	38.07
Secondary	661	45.59
Post – Secondary	212	14.62
Religion		
Christianity	68	4.68
Islam	1382	95.11
Others	3	0.21
Ethnic Group of Husband		
Hausa/Fulani	1312	90.30
Igbo	21	1.45
Yoruba	24	1.65
Others	96	6.61
Nature of Marriage		
Consanguineous	256	17.83
Non- Consanguineous	1180	82.17
Parity		
1	392	27.36
2 – 4	571	39.85
5+	470	32.80
Booking Status of Pregnancy		
Booked	1386	95.52
Unbooked	65	4.48
Age of Husband (Years)		
19 and below	0	0
20 – 34	498	35.98
35 – 39	309	22.11
40 and above	580	41.91

Table 3. Summary of congenital malformations in the study

Malformations	No. of Cases	Prevalence Per 1000 Births
Multiple Malformations		
Syndromes	2	1.37
Undetermined	3	2.06
Sub-Total	5	3.43
Single-System Malformations		
Central nervous system	10	6.87
Mouth	2	1.37
Gastrointestinal	5	3.43
Genitourinary	10	6.87
Musculoskeletal	3	2.06
Dermatological	6	4.12
Sub-Total	36	24.72
Total	41	28.15

Table 4. Single –System involvement among neonates with congenital malformations

	System	No. of Cases
A.	Central Nervous System	
	Hydrocephalus	2
	Anencephaly and encephalocoele	1
	Encephalocoele	1
	Microcephaly	6
	Sub Total	10
B.	Mouth	
	Cleft lip and palate	1
	Cleft palate	1
	Sub Total	2
	Gastrointestinal System	
C.	Intestinal Obstruction	2
	Omphalocele	1
	Gastroschisis	2
	Sub Total	5
D.	Genitourinary System	
	Bladder exstrophy/epispadias complex	3
	Undescended testes	7
	Sub Total	10
E.	Musculoskeletal System	
	Polydactyly	3
	Sub Total	3
	Dermatological	
	Hyperpigmented patches	6
	Sub Total	6
	Total	36

Table 5. Multiple congenital abnormalities in the study

	Malformations	No. of Cases
A.	Syndromes	
	Down's	1
	Beckwith - Wiedemann	1
	Sub Total	2
	Undetermined	
B.	Microcephalous and sacrococcygeal teratoma	1
	Hydrocephalus, meningocoele and bilateral talipes equinovarus	1
	Cleft lip, cleft palate and polydactyly of both upper and lower limbs	1
	Sub Total	3
	Total	5

Of the 5 neonates with multiple malformations, 2 had recognized syndromes one of which was a case of Down's syndrome and the other a case of Beckwith – Wiedemann syndrome (Table 5). In 3 of these neonates with multiple malformations, a complete evaluation was not possible in order to determine whether they were syndromes, associations, sequences, complexes or chromosomal abnormalities. They were thus classified as “undetermined” (Table 5). The birth prevalence of Down's syndrome and Beckwith – Wiedemann syndrome in the study was 0.69 per 1000 live births each.

Table 6. Socio-demographic characteristics of neonates' mothers in relation to birth of a child with a congenital malformation

		Congenital malformation		Statistical significance	
Background characteristics	n	Present	Absent	x ²	p-Value
Age (Years)					
19 and below	153	3	150	1.383	0.710
20 – 34	1061	29	1032		
35 – 39	170	5	165		
40 and above	62	3	59		
Highest level of education					
None	25	0	25	1.633	0.652
Primary/Quaranic	552	17	535		
Secondary	661	20	641		
Post –Secondary	212	4	208		
Religion					
Christianity	68	2	66	0.091	0.956
Islam	1382	39	1343		
Others	3	0	3		
Ethnic group of husband					
Hausa/Fulani	1312	38	1274	1.203	0.752
Igbo	21	1	20		
Yoruba	24	0	24		
Others	96	2	94		
Nature of marriage					
Consanguineous	256	8	248	0.01	0.937
Non-	1180	33	1147		
Parity					
1	392	11	381	0.118	0.943
2 – 4	571	15	556		
5+	470	14	456		
Booking status of pregnancy					
Booked	1386	40	1346	0.07	1.00
Unbooked	65	1	64		
Age of husband (Years)					
20 – 34	498	12	486	0.493	0.782
35 – 39	306	9	297		
40 and above	580	18	562		

Table 6, Table 7 and Table 8 respectively present the results of the bivariate analysis of socio-demographic characteristics of neonates' mothers, peri-pregnancy characteristics of neonate's mothers, and characteristics of the neonates in the study in relation to the birth of a child with a congenital malformation. Only birth weight showed a significant association ($p=0.003$) with being born with a

congenital malformation, as children who weighed less than 2.5kg at birth, had a higher prevalence of congenital malformation (8/98; 8.16%) than those who weighed 2.5kg – 4.0kg at birth (29/1196; 2.42%) and those who weighed more than 4.0kg at birth (0/27; 0%).

Multivariate analysis of the data is depicted in Table 9 which presents the adjusted odds ratios and 95 percent confidence intervals for being born with a congenital abnormality, based on the result of a binary logistic

regression analysis done using age of mother, nature of parents' marriage, mother's parity, gestational age and birth weight as independent variables.

The findings of this model also showed that birth weight of the neonates was an important and significant predictor of being born with a congenital abnormality [OR =0.374; (95% CI 0.196 -0.711) p= 0.003]. Thus birth weight has a significant but negative association with the likelihood of being born with a congenital abnormality

Table 7. Peri-Pregnancy characteristics of neonates' mothers in relation to birth of a child with a congenital malformation

Background characteristics	n	Congenital malformation		Statistical significance	
		Present	Absent	χ^2	p-Value
Folic acid containing multivitamin supplement use in pregnancy.					
≤ 1 month before pregnancy	73	2	71	0.632	0.889
2 nd or 3 rd month of pregnancy	158	4	154		
After 3 rd month of Pregnancy	1063	29	1034		
No use at all	158	6	152		
Pregestational Diabetes mellitus					
Yes	23	0	23	0.678	0.410
No	1431	41	1390		
Febrile illness in first trimester of pregnancy					
Yes	358	12	346	0.491	0.484
No	1096	29	1067		
Native medication use in first trimester of pregnancy					
Yes	98	4	94	0.611	0.435
No	1356	37	1319		

Table 8. Characteristics of neonates in the study in relation to being born with a congenital malformation

Background characteristics	n	Congenital malformation		Statistical significance	
		Present	Absent	χ^2	p-Value
Gender					
Male	757	21	736	0.010	0.920
Female	699	20	679		
Types of Delivery					
Vaginal	1242	35	1207	0.002	0.966
Caesarean Section	209	6	203		
Gestational age (Weeks)					
36 and below	363	11	352	0.295	0.863
37 – 40	838	23	815		
41 and above	220	5	215		
Nature of gestation					
Singleton	1334	38	1296	0.201	0.904
Twins	116	3	113		
Triplets	6	0	6		
Birth weight (kg)					
< 2.5	98	8	90	11.751	0.003
2.5 – 4.0	1196	29	1167		
>4.0	27	0	27		
Birth defect in a relative					
Yes	47	2	45	1.396	0.497
No	1367	37	1330		
Don't Know	36	2	34		

Table 9. Multivariate analysis of congenital malformations and other birth characteristics

Explanatory variable	Odds Ratio	p-Value	95% CI (for odds ratio)	
Age of Mother	1.044	0.284	0.965	1.128
Nature of Marriage				
Consanguineous#	-	-	-	-
Non-Consanguineous	0.808	0.625	0.343	1.902
Mother's parity	0.941	0.500	0.789	1.122
Gestational age (weeks)	1.004	0.950	0.878	1.149
Birth weight (kg)	0.374	0.003	0.196	0.711

#Comparison Group

4. Discussion

Birth defects are an important cause of morbidity and mortality among children worldwide, thus making them a relevant public health concern. Congenital abnormalities are believed to arise from genetic causes in about 10-20% of cases, environmental causes in 10-20% of cases, and 60-80% are attributed to unknown factors [3,8]. It thus follows that birth defects can be categorized as those of a simple genetic origin (monogenic); or those due to interactions between multiple genetic and non-genetic, usually undefined factors (multifactorial), those associated with chromosomal abnormalities, those attributed to discrete environmental factors as the major causes, and all others with no recognized cause [2,14].

The overall prevalence of birth defects in a given population, tells how many children in that population were born with at least one congenital abnormality. Worldwide surveys have shown that birth prevalence of congenital abnormalities varies greatly from country to country and even within the same country among regions, and this may be attributed to one or more factors such as the design of the study (hospital based or population based, prospective or retrospective), definitions, classifications and inclusion criteria used, end-point of the detection period, type of surveillance system and completeness of patient ascertainment, etiological heterogeneity of malformations, accuracy of diagnosis, prenatal screening policies, the extent of selective termination of affected pregnancies, the gestational age at which these are included in monitoring reports, the extent to which the terminations and notified, social, racial, ecological and economical influences [2,15,16]. As a consequence of all these factors, estimates of birth prevalence vary from place to place and thus make comparison of rates among studies difficult and probably not very informative [2,17]. However, apart from a small number of specific anomalies, any differences in prevalence are thought largely to be due to methodological difference rather than true difference in underlying population incidence [17].

The prevalence of congenital malformations in this study was 28.15 per 1000 live births. This figure is lower than the 6.9% reported in neonates by Bakare *et al.*, in South western Nigeria [18]. It is however higher than the figure (0.75 %) reported from a hospital based study in neonates by Eluwa *et*

al., in Cross River state of Southern Nigeria [19]. Birth prevalence of congenital anomalies varies appreciably from country to country, being as low as 1.07 % in Japan and as high as 4.3 % in Taiwan [16]. The prevalence of congenital anomalies found in this study is comparable to studies from other countries [2,6,7,16]. One of the reasons to explain this variation of prevalence figure could be that some degree of selection bias was probably in effect because the study was conducted in 3 major hospitals in the Kano metropolis of North Western Nigeria, which also receive referrals of high risk pregnancies from peripheral hospitals in the region. The exact number of such referrals as well as the number of pregnancies with fetal malformations diagnose elsewhere and referred to these hospitals for management was not assessed by this study. It is also worthy of note to mention that the rates reported in this study might have underestimated the prevalence of birth defects in the region as not all congenital anomalies could be detected at birth or shortly thereafter because of the lack of cytogenetic and teratology investigations or autopsies for still birth and neonatal deaths [15].

Longitudinal cohort studies with special follow up examination provide high incidence figures for congenital anomalies as contrasted to studies based on information from hospital data, because it collects valid information on late manifestation of congenital malformations [20].

The highest frequency of congenital malformations reported in this study involved the Central Nervous System (CNS) and genitourinary system (GU), followed by dermatological system, gastrointestinal system (GIT), musculoskeletal system, and the mouth. CNS anomalies which occurred both as single system and multiple system malformations are considered the most common anomalies in this study. This finding is similar to what has been reported from Cross Rivers State in the South of Nigeria [19], and from Jos in the North central region of Nigeria [21], as well as workers from other parts of the world [15,20,22]. The finding is however at variance with the report of Bakare *et al.*, from South Western Nigeria and that of some other workers from outside the region [2, 14, 16, 18]. The data however show that the frequency of anomalies in other systems differs in different studies done from various regions of the world [1, 3, 8].

Observational studies have shown that maternal use of at

least 400 micrograms of folic acid alone or in multivitamin supplements daily starting at least one month before conception and through the first trimester of pregnancy is effective in preventing both the occurrence and recurrence of neural tube defects [2,23,24]. Periconceptional use of folic acid alone, or in multivitamins supplements have also been shown to reduce the occurrence of some other congenital abnormalities [25,26,27].

Consanguineous marriages are believed to be important in contributing to the risk of being born with a congenital abnormality [28 -31]. It has been documented that the risk of a child having a recessively inherited condition is higher if the parents are related, and the more closely related the parents are, the higher the risk [1, 30]. High rates of consanguinity ranging between 25-60 % of all marriages have been reported for Muslim Arab countries [2,20,29]. Majority of the mothers in this study (95.11 %) were from Muslim homes, and the consanguinity rate in the study was 17.83 % the rate of malformation was 3.13 % and 2.80 % in consanguineous and non-consanguineous marriages respectively. Although, the prevalence of anomalies was higher in consanguineous marriages than non-consanguineous marriages, this was however not statistically significant. This finding is in agreement with the finding of Tayebi *et al.* [32], but is at variance with the results from the study by Francine *et al.* [16], who found a statistically significant relationship between parental consanguinity and being born with a congenital abnormality.

In this study, females were more affected with congenital anomalies (2.86%) than males (2.77%). This difference was however not statistically significant. Other workers have reported a male excess for congenital anomalies [20,33]. This finding has raised some speculations i.e. either females are afflicted with a relatively more minor abnormality which they survive with, or they suffer more fatal anomalies [30]. It is thus recommended that sex distribution should be studied in every congenital malformation separately and not in the whole group, as it is evident from literature that there are large reported variations in patterns of congenital malformations involving different body system [20,30].

Multi-parity was associated with increased prevalence of congenital malformations in this study. Women who had 5 or more children had the highest prevalence of births with a congenital malformation (2.98 %). The relationship between parity and the birth of a child with a birth defect was however, not statistically significant. Shawky and Sadik had earlier noted an association between multi-parity and an increase in the prevalence of congenital malformations [20]. Muga *et al.*, had also noted in their study that among the babies with a CNS malformation, that birth order "4" contributed 55.2 % of the cases [7]. At variance with these observations however is the report by Tomatir *et al.*, who showed that in their series, 78.1 % of the mothers who had given birth to a child with a congenital anomaly, were experiencing their first or second live birth [8].

Findings from this study reveal that the prevalence of birth

defects was higher in the offspring of women who gave a history of having a febrile illness in the first trimester of pregnancy (3.35 %) than those who did not have (2.65 %). The association between the birth of a child with a congenital anomaly and having a febrile illness in the first trimester of pregnancy was however not statistically significant. It has been known for about 100 years now that malformations could be induced in various animal species by exposing the mother to high body temperatures during critical periods of gestation [34, 35, 36]. Although human data are inconclusive and often conflicting, it is believed that the threshold of effect in many species begins at about 1.5⁰C over normal core body temperature [34, 35]. Defects of the CNS, craniofacial development including clefts, the axial and appendicle skeleton, the body wall, teeth, and heart are commonly found in various animal species, and nearly all these defects have been found in human epidemiological studies following maternal fever or hyperthermia during pregnancy [36].

Data from this study reveal that 9.76 % of the mothers of the neonates with congenital anomalies had a positive history of use of native medication (non-alcohol, non-orthodox) in the first trimester of pregnancy. The prevalence of congenital anomalies was higher (4.08 %) in the offspring of mothers who had used native medication in the first trimester of pregnancy than in those who had not (2.73 %). This was however, not statistically significant. Drugs taken by pregnant women can cross the placenta, alter its oxygen transport function by constricting blood vessels, and affect the fetus by acting directly on it, causing damage, abnormal development, teratogenesis or death [20]. Francine *et al.*, documented in their series that maternal drug intake during pregnancy was positively associated with congenital malformation in the offspring [16].

In this study, a high prevalence of birth defects (8.16 %) was observed in children whose birth weight was less than 2.5 kg, than in those with a birth weight of 4.0 kg and above (0 %). This finding was statistically significant ($p=0.003$). Multivariate analysis also revealed that birth weight was a significant and important predictor of being born with a congenital abnormality among the neonates in the study. A high prevalence of birth defects was also noted in this study for preterm (less than 37 weeks gestational age) neonates than for term (37 weeks gestational age or more) neonates. This finding was however not statistically significant. A high prevalence of birth defects have also been previously reported in other studies among infants with low or very low birth weight as well as in prematures [16,37,38,39]. More than 20 million low birth weight (LBW) infants are born globally each year, consisting 17 % of all births in developing countries, which is more than the 7 % rate in industrialized nations [40].

Low birth weight babies basically constitute two groups of babies- those born before 37 completed weeks (preterms) and those born after 37 completed weeks [small for gestational age (SGA)], with the causes and mechanism

involved in LBW being different for premature infants and SGA infants and thus requiring different interventions for prevention [41]. The relationship between growth restriction and malformations may be explained by either the growth restriction as primary and predisposing the fetus to malformations, or as secondary to the presence of malformations, or by coexisting with a malformation due to common etiologic factors [37]. Low birth weight can be caused by various perinatal problems, most frequently by low gestational age [40]. The prevalence of low gestational age (less than 37 weeks gestational age) in this study was 25.55 %.

This study had some limitations in that it sought to detect only external (overt) congenital anomalies in neonates within the first 48 hours of birth, relying only on clinical examinations to make a diagnosis. Also neither cytogenetic analysis nor autopsies for stillbirths were done. It has been documented that a specific diagnosis may not be reached for 30-60% of infants with malformations and that diagnosis is not always apparent in the new born period [2]. Notwithstanding the noted limitations, this study provides some information on the magnitude and spectrum of congenital malformations diagnosed soon after birth in neonates in the Kano metropolis of North Western Nigeria.

5. Conclusions

Data from this study show that CNS anomalies which occurred both as single system and multiple system anomalies, were the most common congenital malformations noted in the study population. Also the prevalence of low gestational age (prematurity) in the study was 25.55 %. Given that congenital anomalies are a major cause of morbidity and mortality in developing countries, and that a positive association exist between low birth weight, prematurity and congenital malformations, emphasis ought to be placed on primary prevention of congenital anomalies, targeting those obstetric factors that increase the incidence of prematurity and neural tube defects in the offspring by encouraging routine and comprehensive prenatal care for all expectant mothers, periconceptional use of folic acid containing multivitamin preparations, the avoidance of known teratogens and probable teratogenic agents, as well as preventing and treating disease such as malaria and HIV/AIDs.

Conflict of Interest

None Declared.

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