

Original Research Article

Describing Congenital Anomalies among Newborns in Kenya: A Hospital Based Study

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ABSTRACT

Background: Congenital Anomalies (Birth defects) are functional, metabolic and even structural deficiencies that are present before or at birth. They are a major contributor to perinatal and infant morbidity and mortality. In Kenya, there is little empirical data on congenital anomalies.

Study objective: The objective of this study was to determine the prevalence and pattern of congenital anomalies; and to describe the associated risk factors.

Methodology: This was a hospital based descriptive, cross-sectional study design. 52 respondents were recruited for this study using the Fischer's formula. A researcher-administered questionnaire was used to collect data. Data from structured questionnaires was entered, checked, cleaned and analyzed. Descriptive analysis using means, frequency and proportions was computed.

Results: Analysis of the data showed that among the 315 neonates admitted in Newborn Unit, Kenyatta National Hospital, the prevalence of Congenital Anomalies was 19.4% (61). The Musculoskeletal system was the most affected (38.5%). 88.4% of the mothers were below 35years of age and 61.5% were not working. The prevalence of Congenital Anomalies was more among neonates born vaginally.

Conclusion: The prevalence of Congenital Anomalies was high compared to the global prevalence of 3-7%. Congenital anomalies were more likely to be associated with younger maternal age, being of low socio-economic class, vaginal delivery and the neonate being a first born.

Key words: Congenital anomalies, Pattern, Prevalence, Risk factors, Newborn Unit, Kenyatta National Hospital

INTRODUCTION

World Health Organization (WHO) defines Congenital Anomalies (CAs) as defects of function, metabolism and structure. They exist at, or before birth. [1] These deficiencies can be isolated or multiple in nature. [2] CAs can be categorized into two; Major and Minor anomalies. Major CA is a defect that has a remarkable effect on function or social acceptability, e.g. hydrocephalus. Minor CA is a defect that has minimal impact on

clinical function but may have a cosmetic impact, e.g. pre-auricular pit. [3]

Globally, there are variations in prevalence of CAs among geographical regions as well as time. As a rough calculation, it has been recorded that 3-7% of infants are diagnosed with birth defects. [4]

In the United States of America, the prevalence of birth defects is 2-5% of all babies born alive. [5] In Asia; it is 0.88% in India [6] and 844.2 per 10,000 births in

China. [7] In Glasgow city, United Kingdom, the prevalence was 324 per 10,000 births [8] 3.4% in Sweden [9] and 36.1/1000 newborns in Russia. [10]

Scientific studies have been done in Africa to investigate the prevalence of CAs. However, few reports exist. This may be due to various reasons like: underreporting, deficiencies in diagnostic capabilities and poor follow-up for examinations in the postnatal period. [11]

In Nigeria, the prevalence was 2.8%, [12] 2.5% in Zagazig University Hospital in Egypt, [13] while in South Africa it was 1.1%. [14] In Eastern Africa; Bugando Medical Center in Mwanza registered a prevalence of 29% [15] while in Entebbe, Uganda, it was 20.3 per 1000 births. [16] In Kenya; the overall incidence rate of CAs was 1.94% at Pumwani Maternity Hospital (PMH), [17] and a previous study in Kenyatta National Hospital (KNH) recorded a prevalence of 2.8%. [18]

The pattern of birth defects also varies with geographical location and time. In general, birth defects involving the Musculoskeletal System (MSS) and Central Nervous Systems (CNS) have been reported to be the most common. [19]

In India, at Bangabandhu Sheikh Mujib Medical University (BSMMU) Hospital in Dhaka, the commonest type of anomaly was Neural tube defect (46.67%), followed by renal system (23.33%). [20] An earlier study (2004) at the same center noted that MSS was most commonly involved system. [21] Regions where CNS had the highest prevalence are Urmia, northwest of Iran, [22] Zambia [23] and in Tanzania. [15] The Cardiovascular System (CVS) was most commonly affected in Glasgow city, [8] in Sweden [9] and in Barbados. [24] Geographical areas that recorded the highest anomalies in Musculoskeletal System (MSS) are Mexico in North America, [25] Zagazig University Hospital, Egypt, [13] Entebbe, Uganda, [16] PMH, Kenya [17] and KNH, Kenya. [18] In South East of Nigeria, common abnormalities seen included those

of cleft lip/cleft palate, and neural tube defects. [12]

Approximately 50% of all birth defects cannot be associated with a specific cause. [26] However, in about a quarter of all malformations, the causes seem to be involving several factors, indicating a compound relationship between genetic make-up and the surroundings. [27] Maternal illnesses like diabetes mellitus and rubella, folic acid deficiency, consumption of medicinal and recreational drugs like thalidomide and tobacco respectively, certain environmental chemicals and high doses of radiation are factors that can cause birth defects. [13]

Consanguinity (when parents are related by blood), greatly increases the prevalence of rare genetic CAs. [28] Consanguineous marriages are a common social trend mainly in North Africa and most parts of Asia, where one in every three marriages is between cousins. The product of a consanguineous marriage has a greater risk for recessive anomalies because of the expression of autosomal recessive gene mutation gotten from a familiar ancestor. [29] Some ethnic communities, such as Caucasians [30] Asians and Blacks, [31] have been found to have a comparatively high prevalence of rare genetic mutations such as Cystic Fibrosis and Haemophilia C.

Being a Low-income earner may be an indirect determinant of CAs, with a higher frequency among families and countries with constrained resources. It is estimated that approximately 95% of severe congenital anomalies occur in low- and middle-income countries. [15]

Younger maternal age is associated with nervous and abdominal wall anomalies. Advanced maternal age increases the risk of chromosomal abnormalities, including Downs and Turners syndrome. [32]

Use of certain substances like alcohol and cigarette smoking, have been associated with occurrence of birth defects. If a pregnant woman is subjected to certain products like pesticides, drugs and other pollutants; she is at risk of having an infant

with birth defects. Radiation has also been linked with CAs. Occupational exposure or living near, or in, waste sites, smelters or mines may also be a risk factor. [33]

Maternal infections such as Cytomegalovirus and Rubella are a significant risk factor of CAs. [34] In the recent past, the effect of being exposed to Zika virus during the intrauterine life on the growing baby has been recorded. Commonly noted birth malformations associated with the infection include microcephaly. [35]

Insufficient folate intake during the pre and peri-conception time increases the chances of having a baby with a neural tube and congenital heart anomalies. [36] Excessive vitamin A intake may affect the normal development of an embryo. [37]

Maternal education to degree level has been cited as protective factor. [38] Being male, Muslims and caesarian born babies have been found to be more affected with birth defects. [39] The prevalence of CAs has been found to be notably more in the babies of mothers with diabetes in pregnancy. [40]

It is estimated that 270,000 babies die during the neonatal period annually from birth defects. [41] Some of the CAs may be fatal, and may damage the physical and mental ability of an individual. [2] Neonatal mortality from sepsis, birth asphyxia and respiratory disease has steadily declined due to improvements in essential obstetric and neonatal care. This has led to birth defects being a significant cause of perinatal mortality and morbidity. [6]

According to Kenya Demographic Health Survey (KDHS) 2014, the Millennium Development Goals (MDGs) for maternal and child health were not achieved. The survey indicates that the neonatal mortality rate in Kenya is 22 deaths/1000 live births. It also noted that there has been a decline in early childhood mortalities. However, Neonatal mortality has exhibited the slowest rate of decline. [42]

A study done at the Moi Teaching and Referral Hospital (MTRH), Kenya's second largest referral hospital showed that

CAs ranked fourth in causes of neonatal mortality. [43]

KNH, located in Nairobi, Kenya, is the biggest referral hospital in East and Central Africa. KNH serves patients from all over the country and beyond; and therefore has a large catchment area. Neonates born with CAs are referred from far and wide to KNH for specialized care.

In KNH, there isn't a recent study on this topic.

Results from this study will act as a baseline for the development of policy frameworks in prevention and management of CAs; as well as resource allocation. The findings of the study will inform the necessary steps that need to be taken in terms of educating the public on CAs. Future researchers who would be interested in conducting a research on the same or related topics will use the findings of the study to add to their knowledge.

It is against this background that a study was done to describe Congenital Anomalies in KNH.

MATERIALS AND METHODS

This was a hospital based descriptive, cross-sectional study that employed quantitative study design. The study was carried out in NBU, KNH. The study population was mothers of neonates with CAs admitted at the New Born Unit of KNH. For those mothers who gave consent, they were recruited into the study.

The sample size was calculated using the Fisher's formula as described by Naing: [44]

$$N = \frac{Z^2 pq}{d^2}$$

Where;

N = desired sample size (population > 10,000)

Z = normal deviation at the desired confidence interval (95%) = 1.96

P = proportion of the population with the desired characteristics (50% will be used. This is because there is no recent study in KNH on this or related topic)

Q = proportion of the population without the desired characteristics (50%)

d² = degree of precision (5%)

Substitution for the formula:

$$N = \frac{1.96^2 [0.5][0.5]}{[0.05][0.05]} = 384.16$$

$$N=384.16$$

The formula will be adjusted using the Cochran formula, [45] since the population is less than 10,000 using the formula:

$$nf = n/[1 + n/N]$$

Where;

nf = the adjusted sample size

n = total population 60 (Every month, it estimated that 300 neonates are admitted in NBU, KNH. 20% of these are estimated to have congenital anomalies. Data will be collected over a period of 1 month. Therefore, the total population will be [20% of 300 multiplied by 1] which is 60)

N = the sample size calculated

$$nf = 60/[1 + 60/384.16]$$

$$= 60 / [1+ 0.156]$$

$$= 60 / 1.156$$

$$= 51.9$$

A sample size of 52 participants was used.

Consecutive sampling method was used to collect data. A semi-structured questionnaire (SSQ) was used as the main tool of data collection. The questionnaire was researcher-administered.

Pretesting was done at PMH, the NBU unit. Approximately 10% of the sample size (6 participants) was used. Validity of the research instrument was ensured through the use of a well-designed questionnaire. Reliability was tested through Test-Retest reliability method.

Data collection was done by the researcher, being assisted by two trained research assistants. Consenting process was voluntary with the recruited participants signing the consent forms. Each questionnaire had a unique identifier to

allow for validation. After filling the questionnaire, the researcher reviewed each of the participants' files for validation. Filled questionnaires were collected and checked for completeness and consistency by the Principal investigator. Inconsistent information was eliminated and unclear responses clarified from the respondents. Double entry of the same data was done to ensure accuracy.

Approval was sought from Kenyatta National Hospital Ethical Review Committee. Permission was sought from the Hospital administration, authority from the Ward in charge and consent from mothers.

Statistical analysis

Data was exported to Statistical Package for the Social Sciences (SPSS) computer software, version 20. Univariate analysis was performed in order to obtain descriptive statistics. Proportions like percentages and rates and measures of central tendency like means modes and medians were determined during the analysis. Results were presented in frequency tables, pie charts and bar graphs. Scientific conclusions were then drawn from the findings.

RESULTS

Pattern and Prevalence of CAs

A total of 315 neonates were admitted in NBU during the one-month study period. 61 neonates were diagnosed with CAs, thus giving a prevalence of 19.4%.

The commonest congenital anomaly was that of the MSS 38.5% (20/52), which was followed by the CNS 25% (13/52), Gastro-intestinal system 21.2% (11/52) and CVS 19.2% (10/52).

Table 1: Distribution of Congenital Anomalies according to ICD 10 (n=52)

International Disease Classification (ICD-10)		N	%
ICD1	Congenital malformations of the nervous system	13	25.0
ICD2	Congenital malformations of eye, ear, face and neck	1	1.9
ICD3	Congenital malformations of the circulatory system	10	19.2
ICD4	Congenital malformations of the respiratory system	2	3.8
ICD5	Cleft lip and cleft palate	6	11.5
ICD6	Other congenital malformations of the digestive system	11	21.2
ICD7	Congenital malformations of genital organs	4	7.7
ICD8	Congenital malformations of the urinary system	2	3.8
ICD9	Congenital malformations and deformities of the musculoskeletal system	20	38.5
ICD10	Other congenital malformations	7	13.5
ICD11	Chromosomal abnormalities, not elsewhere classified	1	1.9

Among the infants with Musculoskeletal malformations, Congenital Talipes Equino-Varus (CTEV) was the most common; with a prevalence of 6 (30%).

Risk factors of CAs

Maternal demographics showed that 46 (88.4%) of the mothers had an age of between 16 and 35 years of age. The other 6 (11.5%) were aged above 35 years. Mean maternal age was 26 years. All participants were of African race.

Table 2: The correlation of age and race to Congenital Malformations

		N	%
Age group	16 - 24 years	23	44.2
	25 - 35 years	23	44.2
	>35	6	11.5
Race	African	52	100.0
	Non-African	0	.0

In regards to parity; 24 (46.2%) were Primigravidas, 28 (53.8%) were multigravidas while none was a grand multigravida. Mothers' parity was not statistically significant in relation to occurrence of congenital anomalies.

49 (94.2%) of the respondents were Christians, while 3 (5.8%) were Muslims. Regarding education, those with primary education were 18 (34.6%), secondary education were 19 (36.5%) and 14 (26.9%) of the respondents had tertiary education. Only 1 (1.9%) participant didn't have any form of formal education.

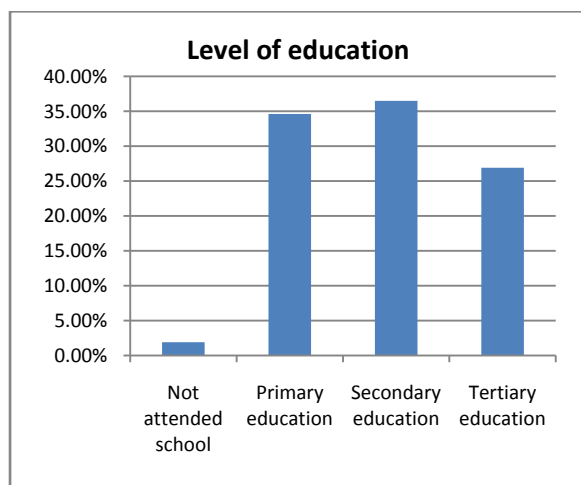


Figure 1: Distribution of respondents by Level of education

Majority of the mothers; 32 (61.5%), were not working; 11 (21.2%) were employed and 9 (17.3%) were self-employed.

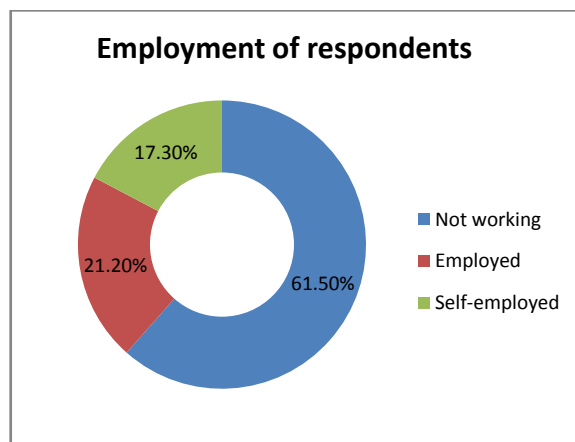


Figure 2: Distribution of respondents by Employment

Family history of congenital anomalies was forthcoming in 6 (11.5%) women while 46 (88.5%) had no family history of birth defects. In the present study, there was only one case of consanguinity, where the father of the child was a cousin to the mother. This malformed baby was born to Muslim parents.

Table 3: Summary of the Family history and Maternal factors associated with CAs at birth.

	n	%
Is there history of Congenital anomalies in your family?	Yes	6 11.5
	No	46 88.5
Is the father of your child a relative?	Yes	1 1.9
	No	51 98.1
List all drugs taken while pregnant	Folic acid	37 77.1
	Vitamin A	0 .0
	Other	11 22.9
Did you suffer any medical condition during pregnancy?	Yes	14 26.9
	No	38 73.1

Out of 52 respondents, 37 (77.1%) took folic acid and iron supplements during pregnancy. No participant reported having taken Vitamin A supplements. Exposure to drugs was noted in 11 (22.9%) mothers who delivered congenitally malformed babies. The offender drugs included antibiotics like Amoxicillin and Cefuroxime, Paracetamol, Mebendazole, Albendazole, Clotrimazole pessaries, Anti-retroviral drugs (ARVs), Anti-diabetics, Byofater and Multivitamins. Some mothers were not able to specify the drugs they took during pregnancy.

Fourteen (26.8%) respondents reported to have suffered a medical condition during pregnancy. Five (35.7%) had Hypertension and one (7.1%) had diabetes.

Majority of the mothers, 48 (92.3%), did not report any drinking habits during pregnancy. None of the mothers who delivered a congenitally malformed baby was an active smoker during pregnancy.

Forty nine (98%) of the participants received antenatal care whereas 2 (2%) were deprived of it. For those who had attended ANC, 2 (3.8%) had attended once, 4 (7.7%) twice, 16 (30.8%) had attended thrice, 13 (25%) four times and 17 (32.7) more than four times.

Table 4: Summary of maternal factors and occurrence of CAs at birth

		N	%
Were you screened for congenital anomalies during pregnancy?	Yes	29	55.8
	No	23	44.2
Are there any industries close to where you live?	Yes	4	7.7
	No	48	92.3
Mode of delivery	Caesarian section	16	30.8
	Vaginal delivery	36	69.2

Antenatal Ultrasonography was done for 29 (55.8%) mothers as compared to 23 (44.2%) who did not. For those who did the ultrasound, 27 (93.1%) of the congenital anomalies were not detected. Only 2 (6.9%) participants knew prenatally that her child had a congenital malformation.

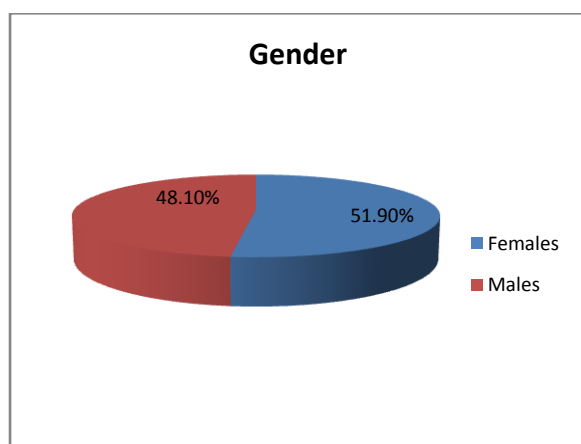


Figure 3: Distribution by Gender

Most of the mothers, 48 (92.3%), didn't live anywhere close to industries;

only 4 (7.7%) did. Frequency of congenital anomalies was observed more with vaginal route born babies as compared to cesarean section route (69.2% vs 30.8%). Out of the 52 neonates with congenital anomalies, 25 (48.1%) were males and 27 (51.9%) were females. Male to female ratio was 1:1.1.

Regarding weights of newborns; 26 (51%) had <2.5kg weight, 25 (49%) had between 2.5 to 4kg and none was more than 4kg weight.

Concerning birth order; 24 (46.2%) were 1st born, 13 (25%) were 2nd born, 13 (25%) were 3rd born, while 2 (3.8%) were 4th born.

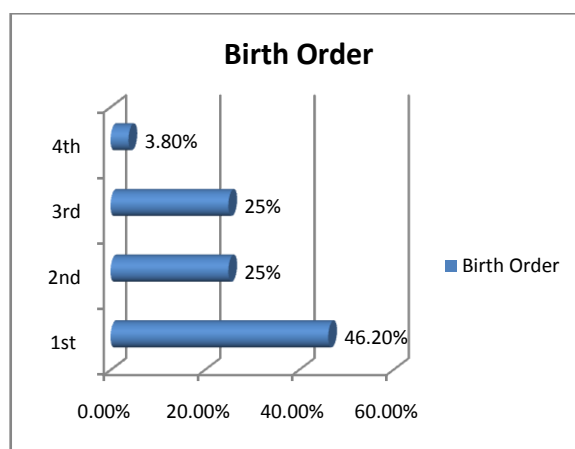


Figure 4: Distribution by Birth Order

Twenty four (46.2%) were preterm babies (before 37 completed weeks), 28 (53.8%) were term babies (37 completed weeks to 41 completed weeks) and none were post-dates babies (after 41 completed weeks). Mean weight of the babies was 2.563kg.

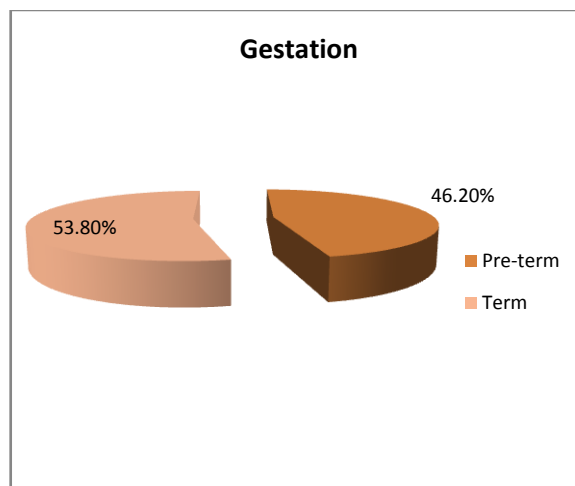


Figure 5: Distribution by Gestation

Statistical analysis

Table 5: Summary of risk factors and number of anomalies

		Anomalies				p-value
		One anomaly		More than one anomaly		
		n	%	n	%	
Religion	Christian	29	59.2	20	40.8	0.158
	Islam	3	100.0	0	.0	
Level of education	Not attended school	1	100.0	0	.0	0.855
	Primary education	11	61.1	7	38.9	
	Secondary education	11	57.9	8	42.1	
	Tertiary education	9	64.3	5	35.7	
Employment	Working	9	45	11	55	0.063
	Not working	23	74	9	26	
Is there history of Congenital anomalies in your family?	Yes	3	50.0	3	50.0	0.537
	No	29	63.0	17	37.0	
Is the father of your child a relative?	Yes	1	100.0	0	.0	0.425
	No	31	60.8	20	39.2	
Did you suffer any medical condition during pregnancy?	Yes	13	92.9	1	7.1	0.005
	No	19	50.0	19	50.0	

In comparing employment status and the number of anomalies; mothers who are working are at risk of multiple CAs though this is not statistically significant.

DISCUSSION

Pattern and Prevalence of CAs

The prevalence of CAs recorded in this study is high compared to reports in other countries. At BSMMU Hospital in India, the prevalence was 3.68% (20), in Iran it was 1.87%. [22] In Europe: 3.24% in Glasgow city [8] and 3.4% in Sweden. [9]

In Africa, the prevalence of birth defects was lower in most countries. In Nigeria, it was 2.8% [12] and 2.5% in Egypt. [13] Uganda recorded a prevalence of 2% [16] while in Tanzania, it was 29%. [15] Previously, Kenya also recorded a lower prevalence: PMH had a prevalence of 1.94% [17] and 2.8% in KNH. [18]

The high prevalence in this study may be explained by the study area; KNH is the largest teaching and referral hospital in East and Central Africa. Most neonates with CAs from Nairobi and beyond are referred to KNH, as this is the only public hospital with the capacity to conduct specific investigations and some surgical interventions. In addition, the classification used in the present study, (ICD10), may have resulted in a high prevalence, as it does not show the difference between minor and major defects.

Defects of the MSS were the commonest in the present study, followed by CNS. Similar studies done in Kenya showed a similar trend; [17] and [18]

Musculoskeletal system anomalies were also leading in studies conducted in Uganda, [16] Egypt [13] and in Mexico. [25] Some studies, however, recorded a higher incidence in CNS anomalies; Mwanza, Tanzania, [15] Zambia, [23] and cleft lip/cleft palate in Nigeria. [12]

Of the musculoskeletal system anomalies, Talipes was the commonest, followed by polydactyl and gastroschisis. This is comparable to a previous study in PMH, where Talipes (53.97%) and polydactyl (17.46%) were also leading. [17]

The difference in pattern and prevalence of CAs indicates that they vary over time and also with geographical location. This is in line with what Mashuda [15] had concluded in his study.

Risk factors of CAs

A majority of anomalous babies were born of mothers' below 35 years. This is in agreement with Tennant, [32] who reported that younger maternal age is associated with nervous and abdominal wall anomalies. In contrast, Khanum [21] noted that being above 35 years of age is a risk factor of CAs; something that was also reported in Tanzania [46] and a study previously done in KNH. [18]

All the mothers interviewed were of African race. Blacks are reported to have a higher prevalence of rare genetic malformations. [31] KNH being in Kenya;

which is mainly populated by blacks, and a public hospital, other races were not expected to be observed.

Parity; majority were multigravidas. Mothers' parity was not statistically significant in relation to occurrence of CAs. In South India, being a primigravida was identified as a risk factor [47] while in Eastern India, there was higher incidence of birth defects among the multiparous. [48] In another study, the birth defects were seen more frequently among mothers with a parity of four and above. [39]

Most of the respondents were Christians, followed by Muslims. This is fairly the normal trend in Kenya according to the East African Living Encyclopedia which stated that Christians contribute 70% of the population while Muslims are approximately 6%. [49] In India, religious pattern had no much effect on prevalence of congenital anomaly. [6] In Jammu, the anomalies were more common among the Muslims compared to Hindus. [39]

In Denmark, women whose attendance to school was <10 years had an almost three-fold higher chance of delivering an anomalous child, as compared with mothers who had received >4 years of tertiary education. [50] This is comparable with the present study since those with tertiary education were 26.9%. In UK, it was noted that a mother's education to degree level was protective. [38]

In the present study, a vast majority of the mothers were not working. Low social economic status has been found to be an indirect determinant of birth defects. Constrained resources may lead to inaccessibility of sufficient and nutritious as well as limited access to healthcare and screening. [15]

A positive history in the family of congenital anomalies has been linked with a greater risk of siring other children with birth defects. [13] In the present study, only few of the respondents had a family history of birth defects. It is possible that there was under-reporting of family history of birth defects due to shame and stigma. As

Dellicour [51] noted in his study, children with birth defects were neglected either because of deficient knowledge on where to seek help, or because these infants brought shame to the family, and so were hidden from the society.

Only one malformed baby was a product of consanguineous marriage. Consanguineous marriages are not a common practice in Kenya, its mainly in North Africa, Middle, East and West of Asia. Studies done in these regions have reported a correlation between consanguinity and occurrence of CAs. [28,52,29]

Neural tube defects are the recorded to be the most preventable congenital anomalies. Particularly, the adequate intake of Folic acid (daily dose of 0.4mg) reduces the prevalence and re-occurrence of neural tube defects. [53] It is also known to reduce other defects like cardiovascular and renal system anomalies, cleft lips and limb reduction defects. [54] Majority of the mothers took folic acid and iron supplements during pregnancy. However, most of them reported to have started the intake in the second trimester. For normal brain and spinal cord development, it is crucial that the mother takes folic acid during the preconception period. [55] This low uptake of folic acid during the first trimester could explain the higher prevalence of neural tube defects noted.

78.8% of mothers reported not taking any medications during pregnancy which is comparable to those in Dhaka (75.3%). [56] Several medications consumed in the present study overlap with those ones in Dhaka where in Dhaka: 2.6% reported of taking antibiotics and 2.2% took some kind of medication but could not specify which ones. In Lebanon, mothers' consumption of drugs was associated with higher risk of birth defects. [57]

Several mothers reported to have suffered medical conditions. Hypertension was the most common. Chronic hypertension in pregnancy exposes the neonates to a significant risk of being born

with renal, cleft lip/cleft palate and limb birth defects. [58] Diabetes in pregnancy has been found to have toxic effects on the developing embryo, and the risk of birth defects is significantly increased. [59,40]

The findings indicated that alcohol consumption and maternal smoking (active smoking) were not associated with birth defects. Maternal smoking in the first three months of pregnancy has been found to have a positive correlation with cleft lip and cleft palate. [60] In contrast to other studies, there was a null association between alcohol intake during pregnancy and the risk of congenital anomalies when a meta-analysis was done. [61] Alcohol consumption and active cigarette smoking are not common practices among Kenya women, especially during pregnancy due to cultural norms.

A significant majority of the participants had received antenatal care with only slightly less than a half attending clinic less than 4 times. The National Guidelines for Quality Obstetrics and Perinatal Care recommend at least 4 antenatal visits. In his study, Granado reported that no, 3 or less antenatal visits is associated with occurrence of birth defects. [62] In BSMMU research findings, [20] 92% had sought antenatal care irregularly while 8% had had regular visits. Receiving antenatal care is an integral part of prenatal care. It is during those visits that mothers are taught on importance of adequate nutrition, avoiding teratogens and even infectious diseases in pregnancy. Iron and folate supplements are also distributed during these visits. [63]

Less than a third of the participants did an ultrasound during pregnancy. Even so, only 2 of these knew prenatally that their child had a birth defect. The diagnosis of a congenital malformation prenatally helps the mother and health care workers make informed decisions during pregnancy and appropriate management perinatally, like place of delivery and mode of delivery. This is assumed to have an improved outcome. [64]

Majority of the participants reported to not live near industries. Stingone

concluded that there was some positive correlation between certain pollutants and birth defects. [33] Most of the participants in this study were referrals from outside Nairobi, and most industries are located in industrial area.

More than two thirds of the anomalous neonates were born via the vaginal route. This is in contrast in Jammu where most babies were born via caesarian section. [39] The choice of delivery route must be based on fetal maturity, the presenting part and even the nature of the anomaly in question. Since most of the anomalies in the present study were not diagnosed prenatally, presence of congenital anomaly did not dictate the route of birth; other factors did.

There were more malformed female than male neonates; however, the sex of the neonate was not significant. BSMMU had contrary outcome where males were more than the females. [20] A previous study in KNH also reported more anomalous male than female infants, although the difference was not statistically relevant. [18]

The relationship between low birth weight and an greater risk of birth defects is clearly documented. [57,2] The findings of this present study are in accordance with that.

The prevalence of birth defects was decreasing with increasing birth order. At Sir T Hospital, similar findings were filed. [6] On the contrary, the occurrence of birth defects was higher in babies who had a birth order of ≥ 4 . [21,46]

The prevalence of malformations was slightly higher in term babies as compared to preterm babies. Many studies have reported different findings: in Eastern India [48] and Egypt, the incidence of birth defects was significantly higher in preterm babies compared to term babies.

CONCLUSION

The prevalence of Congenital Anomalies (CAs) at NBU, KNH is 19.4%. This is a high prevalence compared to the

global prevalence of 3-7%. The commonest system involved was the MSS.

CAs were more likely to be associated with younger maternal age, being of low socio-economic class, vaginal delivery and the neonate being a first born.

RECOMMENDATIONS

The Ministry of Health should mobilize and allocate more resources in preventing, screening and prompt management of CAs.

Through the Department of Preventive and Promotive health, the Ministry of Health should educate the public about birth defects. Preventable causes of congenital anomalies need to be taught; preconception care, use of folic acid, cessation of smoking and consumption of alcohol and consanguinity. Health education can be done through mass media like television, social media like Facebook and Twitter; and fliers.

Ultrasounds for prenatal diagnosis of CA should be recommended for prevention, early intervention and even termination of the pregnancy where necessary.

The 'National guidelines for quality obstetric and perinatal care' recommends at least 4 antenatal visits. The MOH should, through the antenatal clinics should encourage pregnant women to have regular antenatal visits. Ultrasounds for prenatal diagnosis of CA should be recommended for early intervention and even termination of the pregnancy where necessary.

REFERENCES

1. Congenital anomalies [cited 2018 Oct 19]. Available from: <http://www.who.int/en/news-room/fact-sheets/detail/congenital-anomalies>
2. Khan AA, Khattak TA, Shah SHA, Roshan E, Haq A. Pattern of congenital anomalies in the newborn. *J Rawal Med Coll*. 2012;16(2):171–173.
3. Gillani S, Kazmi NHS, Najeeb S, Hussain S, Raza A. Frequencies of congenital anomalies among newborns admitted in nursery of ayub teaching hospital Abbottabad, Pakistan. *J Ayub Med Coll Abbottabad*. 2011;23(1).
4. Rosano A, Botto LD, Botting B, Mastroiacovo P. Infant mortality and congenital anomalies from 1950 to 1994: an international perspective. *J Epidemiol Community Health* [Internet]. 2000 Sep 1 [cited 2017 Dec 6];54(9):660–6. Available from: <http://jech.bmj.com/content/54/9/660>
5. Sekhobo JP. An Evaluation of Congenital Malformations Surveillance in New York State: An Application of Centers for Disease Control and Prevention (CDC) Guidelines for Evaluating Surveillance Systems. *Public Health Rep* [Internet]. 2001 Jul 1 [cited 2017 Dec 6];116(4):296–305. Available from: <http://phr.oupjournals.org/cgi/doi/10.1093/phr/116.4.296>
6. Parmar A, Rathod SP, Patel SV, Patel SM. A study of congenital anomalies in newborn. 2010;
7. Zheng X, Song X, Chen G, Chen J, Ji Y, Wu J, et al. [Epidemiology of birth defects in high-prevalence areas of China]. *Zhonghua Liu Xing Bing Xue Za Zhi Zhonghua Liuxingbingxue Zazhi*. 2007 Jan;28(1):5–9.
8. Dastgiri S, Stone DH, Le-Ha C, Gilmour WH. Prevalence and secular trend of congenital anomalies in Glasgow, UK. *Arch Dis Child* [Internet]. 2002 Apr 1 [cited 2018 Apr 26];86(4):257–63. Available from: <http://adc.bmj.com/content/86/4/257>
9. Persson M, Cnattingius S, Villamor E, Söderling J, Pasternak B, Stephansson O, et al. Risk of major congenital malformations in relation to maternal overweight and obesity severity: cohort study of 1.2 million singletons. *BMJ* [Internet]. 2017 Jun 14 [cited 2018 Apr 26];357:j2563. Available from: <https://www.bmj.com/content/357/bmj.j2563>
10. Postoev VA, Nieboer E, Grjibovski AM, Odland JØ. Prevalence of birth defects in an Arctic Russian setting from 1973 to 2011: a register-based study. *Reprod Health* [Internet]. 2015 Jan 10 [cited 2018 Apr 26];12. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4298118/>
11. Ndibazza J, Lule S, Nampijja M, Mpairwe H, Oduru G, Kiggundu M, et al. A description of congenital anomalies among infants in Entebbe, Uganda. *Birt Defects Res A Clin Mol Teratol* [Internet]. 2011 Sep 1 [cited 2017 Dec 13];91(9):857–61. Available from: <http://onlinelibrary.wiley.com/doi/10.1002/bdr.a.20838/abstract>
12. Daly MJ, Gaidamakova EK, Matrosova VY, et al. Small-molecule antioxidant proteome-shields in *Deinococcus radiodurans*. *PLoS One*. 2010 Sep 3;5(9):e12570.
13. El Koumi MA, Al Banna EA, Lebda I. Pattern of congenital anomalies in newborn: a hospital-based study. *Pediatr Rep* [Internet]. 2013 Feb 5 [cited 2017 Nov 16];5(1). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3649744/>
14. Delport SD, Christianson AL, Berg HJS van den, Wolmarans L, Gericke GS. Congenital

- anomalies in black South African liveborn neonates at an urban academic hospital. *S Afr Med J* 1995 Jan 1 [cited 2017 Dec 13];85(1):11–5. Available from: <https://www.ajol.info/index.php/samj/article/view/149601>
15. Mashuda F, Zuechner A, Chalya PL, Kidenya BR, Manyama M. Pattern and factors associated with congenital anomalies among young infants admitted at Bugando medical centre, Mwanza, Tanzania. *BMC Res Notes* [Internet]. 2014 Mar 29 [cited 2017 Nov 10];7:195. Available from: <https://doi.org/10.1186/1756-0500-7-195>
 16. Ndibazza J, Lule S, Nampijja M, Mpairwe H, Oduru G, Kiggundu M, et al. A description of congenital anomalies among infants in Entebbe, Uganda. *Birt Defects Res A Clin Mol Teratol* [Internet]. 2011 Sep 1 [cited 2017 Dec 13];91(9):857–61.
 17. Nabea GM, Kamau TM, Kaburu EW. The Incidence of Congenital Anomalies among Newborns at Pumwani Hospital, Nairobi, Kenya. 2015;
 18. Muga R, Mumah SCJ, Juma PA. Congenital malformations among newborns in Kenya. *Afr J Food Agric Nutr De.* 2009 Jan 1 [cited 2017 Nov 16];9(3). Available from: <https://www.ajol.info/index.php/ajfand/article/view/43008>
 19. El Koumi MA, Al Banna EA, Lebda I. Pattern of congenital anomalies in newborn: a hospital-based study. *Pediatr Rep* 2013 Feb 5 [cited 2017 Dec 13];5(1). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3649744/>
 20. Fatemaq K, Begum F, Akter N, Zaman SMM. Major Congenital Malformations Among The Newborns in BSMMU Hospital. *Bangladesh Med J* [Internet]. 2011 [cited 2018 Jan 23];40(1):7–12. Available from: <https://www.banglajol.info/index.php/BMJ/article/view/9955>
 21. Khanum S, Noor K, Kawser CA. Studies on congenital abnormalities and related risk factors. *Mymensingh Med J MMJ.* 2004 Jul;13(2):177–80.
 22. Abdi-Rad I, Khoshkalam M, Farrokh-Islamlou H-R. The prevalence at birth of overt congenital anomalies in Urmia, Northwestern Iran. *Arch Iran Med.* 2008;11(2):148–151.
 23. Kunda I, Siziya S, Mwanakasale V. A Review of Congenital Anomalies Presenting at Arthur Davison Children's Hospital. *Int J Sci.* 2016;29(1):7.
 24. Singh K, Krishnamurthy K, Greaves C, Kandamaran L, Nielsen AL, Kumar A. Major Congenital Malformations in Barbados: The Prevalence, the Pattern, and the Resulting Morbidity and Mortality [Internet]. *International Scholarly Research Notices.* 2014 [cited 2018 Apr 26]. Available from: <https://www.hindawi.com/journals/isrn/2014/651783/>
 25. Hernández EN, Serrano SC, Pablo AER. Prevalence of congenital malformations recorded on the birth certificate and fetal death certificate, Mexico, 2009 to 2010. *Bol Med Hosp Infant Mex.* 2013;70:7.
 26. WHO | Congenital anomalies [Internet]. WHO. [cited 2017 Nov 25]. Available from: <http://www.who.int/mediacentre/factsheets/fs370/en/>
 27. Moore KL, Persaud TVN. *Human Birth Defects in: The Developing Human: Clinically Orientated Embryology*, 1998. WB Saunders Co. 1998;167–200.
 28. Tayebi N, Yazdani K, Naghshin N. The Prevalence of Congenital Malformations and its Correlation with Consanguineous Marriages. *Oman Med J* [Internet]. 2010 Jan [cited 2018 Feb 5];25(1):37–40. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3215379/>
 29. Hamamy H. Consanguineous marriages. *J Community Genet* [Internet]. 2012 Jul [cited 2017 Dec 6];3(3):185–92. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3419292/>
 30. Egbe AC. Birth Defects in the Newborn Population: Race and Ethnicity. *Pediatr Neonatol* [Internet]. 2015 Jun 1 [cited 2018 Feb 5];56(3):183–8. Available from: <http://www.sciencedirect.com/science/article/pii/S1875957214001703>
 31. Knowles RL, Ridout D, Crowe S, Bull C, Wray J, Tregay J, et al. Ethnic and socioeconomic variation in incidence of congenital heart defects. *Arch Dis Child* [Internet]. 2017 Jun [cited 2018 Feb 5];102(6):496–502. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5466927/>
 32. Tennant PWG, Raza F, Bythell M, Rankin J. Maternal age and the risk of structural congenital anomalies. *Arch Dis Child - Fetal Neonatal Ed* [Internet]. 2010 Jun 1 [cited 2018 Feb 5];95(Suppl 1):Fa4–Fa4. Available from: http://fn.bmj.com/content/95/Suppl_1/Fa4.2
 33. Stingone JA, Luben TJ, Daniels JL, Fuentes M, Richardson DB, Aylsworth AS, et al. Maternal exposure to criteria air pollutants and congenital heart defects in offspring:

- results from the national birth defects prevention study. *Environ Health Perspect.* 2014 Aug;122(8):863–72.
34. Wright HT. Congenital Anomalies and Viral Infections in Infants- The Etiologic Role of Maternal Viral Infections. *Calif Med* [Internet]. 1966 Nov [cited 2018 Feb 5];105(5):345–51. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1516552/>
 35. Rather IA, Lone JB, Bajpai VK, Park Y-H. Zika Virus Infection during Pregnancy and Congenital Abnormalities. *Front Microbiol* [Internet]. 2017 Apr 4 [cited 2018 Feb 5];8. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5378815/>
 36. Feng Y, Wang S, Chen R, Tong X, Wu Z, Mo X. Maternal Folic Acid Supplementation and the Risk of Congenital Heart Defects in Offspring: A Meta-Analysis of Epidemiological Observational Studies. *Sci Rep* [Internet]. 2015 Feb 17 [cited 2018 Feb 16];5. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4330542/>
 37. Brody JE. Study Links Excess Vitamin A and Birth Defects. *The New York Times* [Internet]. 1995 Oct 7 [cited 2018 Feb 5]; Available from: <http://www.nytimes.com/1995/10/07/us/study-links-excess-vitamin-a-and-birth-defects.html>
 38. Sheridan E, Wright J, Small N, Corry PC, Oddie S, Whibley C, et al. Risk factors for congenital anomaly in a multiethnic birth cohort: an analysis of the Born in Bradford study. *The Lancet* [Internet]. 2013 Oct 19 [cited 2018 Jan 26];382(9901):1350–9. Available from: [http://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(13\)61132-0/abstract](http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(13)61132-0/abstract)
 39. Singh A, Gupta RK. Pattern of Congenital Anomalies in Newborn: A Hospital Based Prospective Study. 2009;
 40. Sharpe PB, Chan A, Haan EA, Hiller JE. Maternal diabetes and congenital anomalies in South Australia 1986-2000: a population-based cohort study. *Birt Defects Res A Clin Mol Teratol.* 2005 Sep;73(9):605–11.
 41. Organización Mundial de la Salud. World health statistics 2008 [Internet]. Geneva, Switzerland: World Health Organization; 2008 [cited 2017 Dec 6]. Available from: <http://site.ebrary.com/id/10233806>
 42. KDHS 2014.pdf.
 43. Yego F, Stewart Williams J, Byles J, Nyongesa P, Aruasa W, D'Este C. A retrospective analysis of maternal and neonatal mortality at a teaching and referral hospital in Kenya. *Reprod Health* [Internet]. 2013 Feb 19 [cited 2017 Dec 14];10:13. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3599365/>
 44. Mashuda F, Zuechner A, Chalya PL, Kidenya BR, Manyama M. Pattern and factors associated with congenital anomalies among young infants admitted at Bugando medical centre, Mwanza, Tanzania. *BMC Res Notes.* 2014 Mar 29 [cited 2018 Jan 22];7:195. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3974194/>
 45. Sunitha T, Rebekah Prasoona K, Muni Kumari T, Srinadh B, Laxmi Naga Deepika M, Aruna R, et al. Risk factors for congenital anomalies in high risk pregnant women: A large study from South India. *Egypt J Med Hum Genet.* 2017 Jan 1 [cited 2018 Jan 26];18(1):79–85. Available from: <http://www.sciencedirect.com/science/article/pii/S1110863016300064>
 46. Sarkar S, Patra C, Dasgupta MK, Nayek K, Karmakar PR. Prevalence of Congenital Anomalies in Neonates and Associated Risk Factors in a Tertiary Care Hospital in Eastern India. *J Clin Neonatol.* 2013 [cited 2018 Sep 4];2(3):131–4. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3830148/>
 47. East Africa Living Encyclopedia. 2014 [cited 2018 Sep 4]. Available from: <https://www.africa.upenn.edu/NEH/kreligion.htm>
 48. Olesen C, Thrane N, Rønholt A-M, Olsen J, Henriksen TB. Association between social position and congenital anomalies: A population-based study among 19,874 Danish women. *Scand J Public Health* [Internet]. 2009 May 1 [cited 2018 Sep 4];37(3):246–51. Available from: <https://doi.org/10.1177/1403494808100938>
 49. Dellicour S, Desai M, Mason L, Odidi B, Aol G, Phillips-Howard PA, et al. Exploring Risk Perception and Attitudes to Miscarriage and Congenital Anomaly in Rural Western Kenya. *PLoS ONE* [Internet]. 2013 Nov 13 [cited 2018 Feb 5];8(11). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3827434/>
 50. Mosayebi Z, Movahedian AH. Pattern of congenital malformations in consanguineous versus nonconsanguineous marriages in

- Kashan, Islamic Republic of Iran. *East Mediterr Health J*. 2007;13(4):868–875.
51. Taruscio D, Carbone P, Granata O, Baldi F, Mantovani A. Folic acid and primary prevention of birth defects. *BioFactors Oxf Engl*. 2011 Aug;37(4):280–4.
 52. Salerno P, Bianchi F, Pierini A, Baldi F, Carbone P, Mantovani A, et al. [Folic acid and congenital malformation: scientific evidence and public health strategies]. *Ann Ig Med Prev E Comunita*. 2008 Dec;20(6):519–30.
 53. Hall J, Solehdin F. Folic acid for the prevention of congenital anomalies. *Eur J Pediatr*. 1998 Jun;157(6):445–50.
 54. Bari CFM. Spectrum of congenital anomalies among children attending the pediatric departments of dhaka medical college hospital. *IOSR J Dent Med Sci*. 2014;13(2):20–46.
 55. Francine R, Salameh P, Hamadé A. Congenital Anomalies: Prevalence and Risk Factors. *J Public Health*. 2014 Jan 2;2:58–63.
 56. Bellizzi S, Ali MM, Abalos E, Betran AP, Kapila J, Pileggi-Castro C, et al. Are hypertensive disorders in pregnancy associated with congenital malformations in offspring? Evidence from the WHO Multicountry cross sectional survey on maternal and newborn health. *BMC Pregnancy Childbirth* [Internet]. 2016 Jul 29 [cited 2018 Sep 6];16. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4966715/>
 57. Chen C-P. Congenital Malformations Associated with Maternal Diabetes. *Taiwan J Obstet Gynecol* [Internet]. 2005 Mar 1 [cited 2018 Sep 6];44(1):1–7. Available from: <http://www.sciencedirect.com/science/article/pii/S1028455909600991>
 58. Little J, Cardy A, Arslan MT, Gilmour M, Mossey PA. Smoking and Orofacial Clefts: A United Kingdom–Based Case-Control Study. *Cleft Palate Craniofac J* [Internet]. 2004 Jul 1 [cited 2017 Dec 6];41(4):381–6. Available from: <http://www.cpcjournal.org/doi/full/10.1597/02-142.1>
 59. Wen Z, Yu D, Zhang W, Fan C, Hu L, Feng Y, et al. Association between alcohol consumption during pregnancy and risks of congenital heart defects in offspring: meta-analysis of epidemiological observational studies. *Ital J Pediatr*. 2016 Feb 3 [cited 2018 Sep 6];42. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4739085/>
 60. Costa CM da S, Gama SGN da, Leal M do C. Congenital malformations in Rio de Janeiro, Brazil: prevalence and associated factors. *Cad Saúde Pública*. 2006 Nov [cited 2018 Sep 6];22(11):2423–31. Available from: http://www.scielo.br/scielo.php?script=sci_abstract&pid=S0102-311X2006001100016&lng=en&nrm=iso&tlng=en
 61. Penchaszadeh VB. Preventing congenital anomalies in developing countries. *Community Genet*. 2002;5(1):61–9.
 62. Todros T, Capuzzo E, Gaglioti P. Prenatal diagnosis of congenital anomalies. *Images Paediatr Cardiol*. 2001 [cited 2018 Sep 6];3(2):3–18. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3232499/>
 63. McCurdy CM, Seeds JW. Route of delivery of infants with congenital anomalies. *Clin Perinatol*. 1993 Mar;20(1):81–106.
 64. El Koumi MA, Al Banna EA, Lebda I. Pattern of congenital anomalies in newborn: a hospital-based study. *Pediatr Rep*. 2013 Feb 5;5(1):e5.

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