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To Determine The Prevalence, Pattern, Risk Factors Of Congenital Anomalies, And Their Impact On Neonatal Mortality At Georgetown Public Hospital Corporation (Gphc) From January 1st, 2019, To December 31st, 2021..

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ABSTRACT

Objective: To determine the prevalence, patterns, risk factors, and impact of congenital anomalies (CAs) on neonatal mortality at Georgetown Public Hospital Corporation (GPHC) between January 1st, 2019, and December 31st, 2021.

Design: A facility-based, retrospective, cross-sectional study.

Setting: Georgetown Public Hospital Corporation, the largest and only tertiary hospital in Guyana.

Patients: A total of 17,719 live births over the study period, with 87 neonates diagnosed with congenital anomalies. A control group of 300 neonates without CAs was also included, with 100 neonates selected from each year (2019, 2020, and 2021).

Interventions: Data were collected from neonatal and maternal records, including demographic information, medical history, and outcomes. Data analysis included descriptive statistics, chi-square tests, and logistic regression.

Main Outcome Measures: Prevalence of congenital anomalies, identified patterns of anomalies, risk factors (maternal age, ethnicity, hypertension, infection, folic acid use), and neonatal mortality rates.

Results: The prevalence of CAs was 0.44% in 2019, 0.46% in 2020, and 0.58% in 2021. The most common anomalies were cardiovascular (29.3%), with Patent Ductus Arteriosus being the most frequent condition (16.0%). Maternal risk factors included age >35 years (OR 2.4, 95% CI: 1.4–4.1), East Indian ethnicity (OR 1.8, 95% CI: 1.1–3.0), hypertension (OR 2.1, 95% CI: 1.2–3.7), and no folic acid use (OR 3.2, 95% CI: 1.9–5.4). Preterm birth (OR 5.3, 95% CI: 3.1–9.0) and low birth weight (OR 3.8, 95% CI: 2.3–6.3) were significant neonatal risk factors. Neonatal mortality from CAs decreased from 8% in 2019 to 6% in 2021, but the reduction was not statistically significant ($p = 0.35$).

Conclusions: Congenital anomalies are prevalent at GPHC, with cardiovascular defects being the most common. Maternal age, ethnicity, hypertension, and lack of folic acid use were significant risk factors. Although neonatal mortality due to CAs decreased slightly, further studies with larger sample sizes are needed to confirm these trends. Public health initiatives focusing on prenatal care and folic acid fortification are recommended to reduce the burden of congenital anomalies in Guyana..

Keywords: Congenital anomalies, neonatal mortality, prevalence, risk factors, cardiovascular defects.

INTRODUCTION

Birth defects (also known as congenital anomalies, CA) are a serious health concern worldwide, causing chronic diseases, disability, and mortality in new-borns, and the WHO estimates that 3 million babies are born with major CAs, or 3 percent of all newly born children, and result in 240,000 deaths in the first 28 days of life [1, 2]. More than 94 percent of CAs happen in LMICs, and the mortality rates are between 20 percent and 85 percent, which are very high compared to high-income countries [3, 4]. Causes of CAs are multifactorial, encompassing environmental, genetic, and unknown factors and maternal age, lifestyle, illnesses, and insufficiency of folic acid intake are significant risk factors [5, 6, 7]. In Guyana, the number of live births is estimated at 14,000-15,000 per year with 40% taking place at Georgetown Public Hospital Corporation (GPHC) where there is no baseline data on CAs [8, 9]. The proposed study will address a data gap through essential information on the prevalence, types, and risk factors of CAs at GPHC and their influence on neonatal mortality, which will be used to develop the strategies to reduce CAs and attain better neonatal outcomes..

LITERATURE REVIEW

Congenital anomalies (CAs) are not uniform in their frequency by country, region, or ethnicity ranging between 0.85% and 29% [10]. The CA prevalence reported by a retrospective, descriptive cross-sectional study on 3,346 neonates admitted to Jimma Medical Centre in Ethiopia between 2017 and 2019 is 5.95, which is comparable to those of Korea (5.48) and Nigeria (6.3) but lower than those reported in Tanzania (29) and Dessie, Ethiopia (8.4) [10]. By contrast, the rates were lower in such countries as Pakistan (4.24%), Nigeria (2.8%), the USA (2.89%), Italy (2.46%), Canada (3.66%), Iran (0.85%), India (1.85%), and Egypt (2.5%), which was caused by the differences in sample size, study population, and socio-demographic factors [10]. Nigeria and Pakistan studies conducted on NICU patients had different outcomes relative to studies in the high-income countries that utilised live birth statistics [10]

It is also evident that there are regional differences in distribution of birth defects on organ systems. A 2010-2014 study in Ethiopia based in a hospital of children aged 0-17 years revealed that facial anomalies (34.2) were the most prevalent birth defect, and followed by neural tube defects (30.8) (including spina bifida, hydrocephaly, and anencephaly) [11]. Other typical defects were musculoskeletal anomalies (12.8%), and cardiovascular system defects (10.3). Contrary to this, the most common were reported in studies conducted in Egypt (anomalies of the digestive system (38%), musculoskeletal defects (32.9%), and circulatory system defects (11)) and in Kenya and Romania (Musculoskeletal and cardiovascular anomalies) [12, 13]. These variations indicate the genetic and multifactorial effects that are unique to the regions. Besides, one study [6] showed no strong correlation between the congenital anomalies and low birth weight, maternal age, or the number of children born, and a mortality rate of 10.4 percent of the neonates with CAs.

The maternal factors are tightly connected with the frequency of the congenital anomalies such as the advanced maternal age, the exposure to the harmful substances, and insufficient prenatal care. The study [14] emphasised in a case-control study that maternal exposure to chemicals, such as pesticides, was one of the biggest risk factors, and that the risk of congenital anomalies was 3.5 times higher in mothers exposed to such products. On the same note, research on maternal medication revealed that antiepileptic medication (AEDs), especially polytherapy were linked to increased malformation [15, 16]. Certain medications such as barbiturates and valproate have been associated with exposure to congenital heart defects, clefts in the face among other anomalies [15, 16, 18]. According to the findings of the study [17], the exposure to β-blockers in early pregnancy raised the risks of cardiovascular anomalies, orofacial clefts, and neural tube defects. Also, a study [19] has reported maternal uncritical use of peri-conceptual folic acid drugs, maternal age, and insufficient attendance of the antenatal clinic as important risk factors of CAs and the importance of determining the need to utilise prenatal care during the early years of development and have proper peri-conceptual folic acid drug supplementation to avoid anomalies.

METHODOLOGY

The Director of Medical and Professional Services at Georgetown Public Hospital Corporation (GPHC), the Research Committee of this organisation along with the Institutional Review Board (IRB) of the Ministry of Public Health approved this research. This was a retrospective cross-sectional descriptive study that was performed in the Neonatal Services of GPHC, which comprised of the NICU, SDU, and Post-Natal Wards, and with a sample population of the neonates born with congenital anomalies (CAs) on or after 1st January, 2019, and on or before 31st December, 2021. A comparison group (control group, 300 neonates) was selected randomly and included 100 cases of neonates born without CAs every year of the study. The data sources were the neonatal and maternal records, which included the sex, gestational age, birth weight, mode of delivery, maternal factors age, parity, antenatal care and lifestyle factors such as smoking and alcohol intake. Mortality outcomes were also captured in the study such as the discharge status, referrals, and the deaths. The data were gathered based on both ICD codes of the congenital anomalies and manual searches of the charts since most of the cases had more than one anomaly not sufficiently represented in the database.

The impact of congenital anomalies on neonatal mortality will be calculated from the total neonatal mortality annually during the study period.

$$\frac{\text{Total number of neonates that died with congenital anomalies}}{\text{Total neonatal death}} \times 100$$

= % of Neonatal Death caused by Congenital anomalies

This information was collected from the Mortality Outcome Variable section of the data collection sheet.

For the purpose of the study the following definitions were used:

Congenital anomalies (CAs) were defined as structural defects present at birth or identified during the neonatal period [16]. The description and patterns of congenital anomalies that were assessed include the following:

The number/ percentage of Single Vs Multiple Congenital Anomalies

The number/ percentage of Minor Vs Major anomalies

The most common anomalies and the most common systems associated with congenital

Most common anomalies with associated neonatal death

Categorisation of congenital anomalies was done using the European Surveillance of Congenital Anomalies guidelines (EUROCAT) [6]

A data collection sheet (See APPENDIX 1) was prepared and linked to the (SPSS) software version 21. Each patient was given a unique identification code to protect patient confidentiality and to also prevent repetition of data collected. The researcher went through each chart individually to ensure accurate collection of data. The data were entered manually into the data collection sheet on a password-protected laptop which can only be accessed by the researchers.

Inclusion Criteria

All live births at Georgetown Hospital Corporation are diagnosed with any congenital anomaly at birth or during the neonatal period.

EXCLUSION CRITERIA

All patients out of the neonatal period (Birth- 28days).

Data Analysis

The data collected was analysed using SPSS version 21 and descriptive analysis was done using frequency, percentages, ratios and proportions along with a 95% confidence interval for prevalence and trends of congenital anomalies. Prevalence was calculated using the number of neonates with congenital anomalies as the numerator and the total birth annually per 1000 for each year separately. The trend in the prevalence were highlighted from this data, e.g. Is the prevalence increasing? The associated neonatal characteristics and maternal socio-demographic was tested using Chi-square statistic. The risk factors were assessed using binary logistic regression, the odds ratio and the 95% confidence interval.

RESULTS

There was a total of twenty-seven (27) congenital anomalies (CA) births out of six thousand one hundred ninety-four (6194) live births in 2019; twenty-seven (27) CA births out of five thousand eight hundred fifty-three (5853) live births in 2020; and thirty-three (33) CA births out of five thousand six hundred seventy-two (5,672) live births in 2021. The calculated prevalence of CA in 2019, 2020, and 2021 was 0.436%, 0.461%, and 0.582%, respectively, see table 1 below (complete data Tables in Appendix 2).

Table 1: Prevalence of Congenital Anomalies in 2019-2021

Year	Total Births	CA Cases	Prevalence (%)
2019	6194	27	0.436%
2020	5853	27	0.461%
2021	5672	33	0.582%

There was no statistically significant trend in the prevalence over the three (3) year period, with the calculated p-value of 0.23 using the Chi-square test. The Cochran-Armitage and logistic regression methods were also used to confirm the Chi-square test results, both of which also showed no **significant trend** ($p = 0.94$ and $p = 0.38$, respectively).

During the period of the study, 150 congenital anomalies were recorded, 40 in 2019, 44 in 2020 and 66 in 2021. The cardiovascular system was the most, (29.3) and then musculoskeletal, (16), craniofacial, (13.3) and central nervous systems (5.3). Majority were single anomalies (77.3%), with Patent Ductus Arteriosus (16%), followed by Clubfoot and Down Syndrome (8% each) and Cleft Lip and Palate (5.3%). Hydrocephalus (4%), Ventricular Septal Defect (1.3) were also other significant anomalies (see Table 2).

Table 2: The Distribution of Congenital Anomalies from 2019-2021

Types of congenital anomalies	**2019**	**2020**	**2021**
Central Nervous System			
Spina bifida			
Hydrocephalous	2	1	
Encephalocele		1	
Anencephaly	1		
Microcephalous		1	1
Myelomeningocele		2	
Others Plagiocephaly Dandy Walker Malformation Macrocephaly Prominent Occiput, Mega cisterna magna		 2 2	 1 1
TOTAL	**3**	**9**	**3**
Facial Anomalies			
Cleft lip & palate		1	3
Cleft lip			
Cleft palate		1	
Microtia / dysplastic ears		3	2
Low Set Ears		2	3
Micrognathia		1	1
Hemangioma			
Laryngomalacia/ Tracheomalacia			
Others Epicanthal folds Anophthalmia/ Microphthalmia Flat nasal bridge, small mouth High arched palate, short neck		 1 1	 1 1 1 1
TOTAL		**10**	**13**
Respiratory System			
Pulmonary Hypoplasia Chest wall malformation		 1	1

TOTAL		**1**	**1**
Cardiovascular System			
Cyanotic Heart Disease			
Transposition of Great Arteries			
Tteralogy of Fallot	2		
Trunchus Aterosus			
Total anomelous pulmonary venous circulation			
Tricuspid Atresia		1	
Hypoplastic Left Heart Syndrome		1	
Ebstain Anomaly		1	
Acynotic Heart Disease			
Atrial Septal Defect (ASD)	3		4
Ventricular Septal Defect (VSD)	1		2
Patent Ductaus Arterosus (PDA)	6	2	4
Others AVSD	2		
Dextrocardia	1		
PFO	2		2
? CHD (pathology Unknown)	6	8	9
TOTAL	**23**	**13**	**21**
Gastrointestinal tract			
Tracheoesophageal Fistula			
Intestinal atresia/ Stenosis	2		1
Omphalocele/ Giant Umbilical Cord			1
Anorectal malformation		1	3
Hirschsprung's disease	2		
Gastroschisis			1
Malrotation			
Oesophageal atresia			
Others Congenital epulis Rectal prolapse		 1 1	
TOTAL	**4**	**3**	**6**
Genito-urinary System			
Ambiguous genitalia/ CAH	2		
Hypospadias	2		

Posterior Urethral Valve			1
Hydronephrosis	1	1	1
Prune belly syndrome			
Cryptorchidism	2		2
Epispadias			
Hydrocele		1	3
Polycystic Kidneys			?1
Others Micropenis		1	1
TOTAL	**7**	**3**	**9**
Musculoskeletal Anomalies			
Polydactyly		1	1
Congenital Talipes Equinovarus	1	1	4
Syndactyly		1	
Congenital hip dysplasia			
Aplasia cutis congenita			
Short Neck		2	
Osteogenesis Imperfecta		?1	
Others Rocker bottom feet, Claw-like toes, Overlapping fingers			 1 1 1
TOTAL	**1**	**6**	**8**
Chromosomal Anomalies			
Down's syndrome	3	1	2
Edwards Syndrome			1
Patau Syndrome			?1
Turner Syndrome		?1	
Mermaid Syndrome			1
TOTAL	**3**	**2**	**5**
Metabolic Disorders			
IEM	?1		
Congenital Hypothyroidism	1		
TOTAL	**2**	**0**	**0**
TOTAL CONGENITAL ANOMALIES	**40**	**44**	**66**

The maternal age (above 35 years) was also a strong risk factor (OR: 2.4, p=0.002) and East Indian ethnicity was a high risk factor (OR: 1.8, p=0.02) whilst Afro-Guyanese ethnicity was a protective factor (OR: 0.5, p=0.004). Additional significant risk factors were multiparity, maternal hypertension (OR: 2.1, p=0.01), infections (OR: 1.9, p=0.03) and usage of medication; antihypertensives (OR: 2.5, p=0.006) and antidiabetics (OR: 2.1, p=0.02). Also, insufficiency concerning folic acids was a significant risk factor (OR: 3.2, p<0.001) and antibiotics and haematinics were not significantly associated.

There was no history of smoking, alcohol consumption, or illicit drug use documented in 2019 and 2020. However, there were 9% (3 cases) of maternal alcohol consumption in 2021, which was comparable to the control population of 8%. There was no documentation of environmental exposure during the study period.

Table 3: Maternal Risk Factors and Protective Factors for CA for 2019-2021

Variable	OR (95% CI)	p-value	Significance
Ethnicity: Afro-Guyanese	0.5 (0.3–0.8)	0.004	Protective
Ethnicity: East Indian	1.8 (1.1–3.0)	0.02	Risk Factor
No Antenatal Visits	2.4 (1.5–3.8)	<0.001	Risk Factor
Hypertension	2.1 (1.2–3.7)	0.01	Risk Factor
Maternal Infection	1.9 (1.1–3.3)	0.03	Risk Factor
Antihypertensive Medication	2.5 (1.3-4.8)	0.006	Risk Factor
Antidiabetic medication	2.1 (1.1-4.0)	0.02	Risk Factor
Antibiotics	1.2 (0.7-2.0)	0.45	Not Significant
Prenatal Hematinic (including Folic Acid)	0.7 (0.4-1.2)	>0.05	Protective effect, but not significant
No Folic Acid	3.2 (1.9–5.4)	<0.001	Risk Factor
Caesarean Delivery	4.6 (2.8–7.5)	<0.001	Risk Factor

The control population and most CA cases were located in the Region 4, the location of the study site, Georgetown Public Hospital Corporation. In 2019, Region 4 had 52 percent of CA cases and 79 percent of the control population, and the same has been observed in 2020 and 2021. The second highest distribution was in Region 3 and Region 1 experienced significant increase of CA cases in 2021, 2020 and 2019, 7 cases and 1 case respectively.

Table 4: Regional Distribution of Congenital Anomalies in comparison to the Control Population for 2019-2021

Regional Distribution of CA	2019		2020		2021	
	CA n= 27	Control n=100	CA n=27	Control n=100	CA n=33	Control n=100
Region 1	1	4	1	3	7	3
Region 2	0	2	1	3	1	2
Region 3	5	6	1	8	4	7
Region 4	**14**	**79**	**20**	**76**	**16**	**77**

Region 5	0	0	2	0	0	0
Region 6	3	2	1	6	0	2
Region 7	0	5	2	3	3	2
Region 8	0	2	0	3	0	3
Region 9	1	0	0	0	1	2
Region 10	1	0	0	0	1	2

Chi-square test results showed no significant difference in 2019 ($p=0.2128$) and 2020 ($p=0.2600$), but a nominal significance in 2021 ($p=0.0409$), though assumptions were violated, making the p-value untrustworthy. Caesarean section (OR: 4.6, $p<0.001$) and preterm birth (OR: 5.3, $p<0.001$) were significant risk factors for congenital anomalies (CAs), along with low birth weight (OR: 3.8, $p<0.001$). The male-to-female ratio showed a predominance of males in 2019 and 2021, but more females in 2020. Mortality rates for CAs decreased from 37.04% in 2019 to 21.21% in 2021, with CAs contributing 8% of neonatal deaths in 2019, 7% in 2020, and 6% in 2021. The percentage of CA deaths from the total neonatal mortality was 8% in 2019, 7% in 2020 and 6% in 2021, see Table 5.

Table 5: Total Neonatal Deaths and Total Percentage of CA from the Neonatal Mortality for 2019-2021

Year	Total Deaths	CA Deaths	% Neonatal Mortality from CA
2019	124	10	8%
2020	118	8	7%
2021	116	7	6%

There was an apparent decrease in the percentage of neonatal mortality (8% → 6%); however, the small sample size limits statistical power to make a definitive conclusion using the Chi-square Test. The Cochran-Armitage test used to assess trends in populations deduced a p-value of ~0.35, which was not statistically significant.

DISCUSSION

This paper sought to identify the prevalence, trends, risk factors, and how congenital anomalies (CAs) affected neonatal mortality in Georgetown Public Hospital Corporation (GPHC) between 2019 and 2021. The prevalence of CAs was found to be between 0.436% and 0.582 percent, not showing any pattern, which is lower than the prevalence rates in other LMICs like Ethiopia (5.95%), Tanzania (29%), Nigeria (6.3%), Pakistan (4.24%), and Egypt (2.5%) [10]. The cardiovascular system (29.3%) was the most affected organ and the most common malformation was Patent Ductus Arteriosus (PDA) (16.0%). These results are inconsistent with research conducted in Ethiopia where orofacial and neural tube aberration was the most prevalent [11] and in Egypt where anomalies of the digestive and musculoskeletal systems were the most frequent [14]. Increased rate of cardiovascular malformations in the present study can be explained by regional genetic variations and prenatal screening methods.

High maternal age (more than 35 years old), East Indian ethnicity, multiparity, hypertension, and maternal infections were significant risk factors of CAs, which were consistent with other past studies [14, 18, 19, 20, 21]. Interestingly, the Afro-Guyanese ethnicity was found to be a protective factor (OR 0.5), which could be explained by the specific genetic or environmental aspects. A deficiency in folic acid supplementation was a strong risk factor (OR 3.2), and this result is in line with the evidence that has been conducted globally on the protective effect of folic acid against neural tube defects [6, 19, 22, 23, 24, 25]. A highest CA cases were seen in Region 4 with a significant rise in Region 1 in 2021 which may indicate a potential new cluster, possibly because of an environmental reason or better detection. Caesarean section was closely linked with CAs (OR 4.6), which showed the selection bias to complicated pregnancies. It also found the presence of the neonatal risk factors such as preterm birth and low birth weight, which is consistent with other research [6, 26, 27, 28, 29]. The CA mortality rate was between 6 and 8, which was lower compared to that of Nigeria (10.4) [6], probably because of the improved neonatal care in GPHC, but this development could not be statistically proven due to its small size.

CONCLUSION

This study is the first to report baseline data on congenital anomalies at GPHC and has shown a prevalence of 0.44%-0.58% with heart anomalies being the commonest. Significant risk factors were advanced maternal age, East Indian race, hypertension, infections, and absence of folic acid supplementation. The effect of CAs on neonatal deaths was moderate

(6%–8%) but the results highlight the requirement of focused interventions like better antenatal care, folic acid fortification and better screening and genetic counselling for high-risk pregnancies particularly for mothers of older age and previous preterm births that will help in early diagnosis and management of CAs. Larger cohorts of the population in more studies are necessary to confirm these trends and to study the regional differences in CA. This information can inform public health interventions towards reducing the burden of CAs and improving neonatal outcomes in Guyana

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