Prevalence of Congenital Malformations in Grenada

B Nelson[1], V Naraine[1], C Patterson[2], S Rodrigo[3]

ABSTRACT

Objectives: *To determine the prevalence of congenital malformations in Grenada for the period January 2000–December 2004.*

Methods*: The study included neonates diagnosed with congenital malformations as well as those who were part of the Grenada Heart Foundation for the same time period. Patient delivery records from the three government hospitals were reviewed. Parents were contacted and a questionnaire administered to obtain demographic and maternal history related to the birth.*

Results: *The prevalence of birth defects was 0.78% (95%CI: 0.61, 0.98) for the five-year period among the 9004 live births. Cardiovascular malformations were the most prevalent (0.32%; 95% CI: 0.22, 0.45%), with abnormalities of the genitourinary system being the least prevalent (0.04%; 95% CI: 0.01, 0.11%).*

Conclusion: *The prevalence of congenital malformations in Grenada is low in comparison to other developed and developing countries.*

Keywords: Birth defects, Caribbean, congenital malformations, developing country, Grenada

Prevalencia de las Malformaciones Congénitas en Granada

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RESUMEN

Objetivos: *Determinar la prevalencia de las malformaciones congénitas en Granada en el período de enero 2000 – diciembre 2004.*

Métodos: *El estudio incluyó recién nacidos diagnosticados con malformaciones congénitas, así como aquellos que fueron parte de la Fundación Cardiológica de Granada en el mismo período de tiempo. Se revisaron las historias clínicas de partos provenientes de los tres hospitales gubernamentales. Padres y madres fueron contactados, y se aplicó un cuestionario para obtener datos demográficos y maternos relacionados con los nacimientos.*

Resultados: *La prevalencia de defectos congénitos fue de 0.78% (IC 95%: 0.61, 0.98) para el período de cinco años entre los 9004 nacidos vivos. Las malformaciones cardiovasculares fueron las más prevalentes (0.32%, IC 95%: 0.22, 0.45%), siendo las anormalidades del sistema genitourinario las menos prevalentes (0.04%, IC 95%: 0.01, 0.11%).*

Conclusión: *La prevalencia de malformaciones congénitas en Granada es baja en comparación con otros países desarrollados y en vías de desarrollo.*

Palabras claves: Defectos congénitos, malformaciones congénitas, país en vías de desarrollo, Granada, Caribeño

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INTRODUCTION

Congenital malformations are the structural, functional, biochemical or molecular defects present at birth that result in death, physical or mental disabilities (1, 2). Such defects are among the major causes of neonatal morbidity and mortality worldwide and are estimated to account for 2– 3% of live births worldwide, with individual variations observed geographically

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(3–5). Estimated costs in the United States of America (USA) are over $6 billion for babies born with one or more of the 17 major birth defects (2); the economic impact is expected to be greater in developing countries.

International data show that congenital malformations accounted for 7% and 8.7% of neonatal deaths in 2008 and 2010, respectively (6). The data, however, are underestimates since probable misclassifications of deaths in verbal autopsy studies may result due to non-standard definitions and variations in the method of detection (1, 7).

Data on neonatal outcomes, particularly congenital malformations, in developing countries such as the Caribbean region, have remained limited (8, 9). Research conducted in the 1970s and 1980s found congenital malformations in 8.8% of autopsied Jamaican infants (10, 11). More recent data from a Jamaican study showed a prevalence of 1.5% of congenital malformations in live births, the rate being lower than the 18.5% reported in a 2009 audit (12).

Congenital malformations are reported to be the fourth leading cause of death in children under five years in the Caribbean region (13), the third leading cause of death in children under five years in Guyana (14) and were also reported to be the leading cause of neonatal mortality in Grenada for 2000 (15); however, more detailed data were not available.

Healthcare interventions have significantly reduced the number of deaths of children with congenital malformations in developed countries such as the USA (16). However, the overall prevalence in developing countries has been unchanged because of the lack of adequate healthcare services to prevent or to care for those at risk (17). The impact of congenital malformations may also be due in part to the lack of knowledge regarding the extent of the problem. The lack of recent data in the Caribbean cripples the decision and policy-making process that can lead to prevention and better care for patients affected by congenital malformations. This study determined the five-year prevalence of congenital malformations in Grenada and identified risk factors to determine association with congenital malformations.

SUBJECTS AND METHODS

This retrospective cohort study, approved by the Ethics Committee of the Grenada Ministry of Health, reviewed the medical records of all live births at the government hospitals during the period January 2000 to December 2004. These hospitals include the Grenada General, Princess Alice and Princess Royal Hospitals. In addition, records of children with heart problems obtained from the Grenada Heart Foundation were included in the review. Stillbirths were not included.

The study was guided by a review of the congenital malformations recorded in the literature. The chart review process utilized a list of 37 defects generated by the Metropolitan Atlanta Congenital Defects Monitoring Programme (MACDP) and the United States Centers for Disease Prevention and Control (CDC) Birth Defects Monitoring Programme (BDMP) in 1991 (18).

After verbal consent was obtained, a telephone questionnaire was administered to the mothers of babies identified. In addition, the mothers were asked about congenital malformations that may have been diagnosed after discharge from the hospital.

The overall annual and five-year prevalence was calculated as the number of infants with a birth defect delivered during the period under study divided by the number of live births for the same period and was reported as prevalence per 1000 live births. Abnormalities were grouped into categories by organ system, with multiple abnormalities being placed in a multisystem category. Data were analysed using Chi-squared statistics to determine differences between the infant groups based on mortality status. Analyses were performed using SPSS, version 20 (IBM SPSS).

RESULTS

During the study period, there were 9004 live births, with 70 having congenital malformations; however, questionnaire data were obtained from 69 primarily due to incorrect or outdated contact information. No malformations were recorded for the islands of Carriacou and Petit Martinique.

The Table shows the demographic characteristics of the parents and neonates by the mortality status of the neonate. The majority of the neonates weighed between 2.1 and 4.0 kg (84.3%), with 28.6% of these having weights between 3.1 and 3.5 kg. Children who were dead at the time of data collection had lower birthweights (2.46 ± 1.11) compared with those who were alive (3.07 ± 0.57), however, the difference in means was not statistically significant.

The majority of the malformations occurred among mothers aged 20–25 years (27.1%) and fathers aged 36–40 years (22.9%). The majority (65.7%) of the mothers did not use folic acid before or during pregnancy. At least 14% engaged in either smoking, alcohol consumption or drug use during pregnancy. Of these, at least 40% had a baby with a chromosomal malformation and 20% had a baby with a cardiovascular malformation.

The five-year prevalence of congenital malformations was 0.78% (95%CI: 0.61, 0.98%), with the highest annual prevalence observed in 2002 (Fig. 1). There was no significant difference in the prevalence across the five years ($p > 0.05$). Of those with malformations, 13 (18.6%) died and the status of two (2.9%) was unknown. Most of the malformations occurred in males (59.6%) compared with females (39.3%), gender being unknown for one child. Multiple malformations were observed in 12 (17.1%) neonates, with five infants dying shortly after birth because of numerous anomalies. These five cases had inadequate documentation of their malformations in the medical record.

A total of 81 abnormalities were recorded among the cases identified, with the distribution by organ system shown in Fig. 2. Cardiovascular malformations were the most prevalent (0.32%; 95%CI: 0.22, 0.45%), with abnormalities of the genitourinary system being the least prevalent (0.04%; 95%CI:

Table: Distribution of neonatal and maternal characteristics by mortality status of the infant

Characteristic	All (n = 69)	Dead (n = 13)	Alive (n = 56)	*p*-value
Infant				
Male	40 (57.1)	9 (69.2)	31 (55.4)	0.30
Birthweight (kg)	2.94 (± 0.74)	2.46 (± 1.11)	3.07 (± 0.57)	0.075
Gestational age (weeks)	38.5 (± 1.33)	39.6 (± 1.51)	39.6 (± 1.15)	0.99
Maternal				
Age (years)	30.2 (±7.75)	27.3 (± 9.66)	31.1 (± 7.09)	0.21
Duration of labour (hours)	3.77 (± 5.67)	2.46 (± 3.87)	4.11 (± 6.04)	0.23
Mode of delivery				0.38
Vaginal	59 (75.7)	8 (72.7)	44 (81.5)	
Caesarean section	13 (18.6)	3 (27.3)	10 (18.5)	
Labour type				0.54
Spontaneous	47 (67.1)	6 (85.7)	40 (90.9)	
Induced	5 (7.1)	1 (14.3)	4 (9.1)	
Gravidity				0.21
0	3 (4.3)	1 (7.7)	2 (3.6)	
1	21 (30.0)	6 (46.2)	14 (25.0)	
2	12 (17.1)	3 (23.1)	9 (16.1)	
≥ 3	34 (48.6)	23 (23.1)	31 (55.4)	
Parity				0.01
0	12 (17.1)	6 (46.2)	5 (8.9)	
1	19 (27.1)	3 (23.1)	16 (28.6)	
2	7 (10.0)	1 (7.7)	6 (10.7)	
≥ 3	32 (45.7)	3 (23.1)	29 (51.8)	
Previous pregnancy				0.74
Normal	2 (2.9)	0 (0.0)	2 (15.4)	
Abnormal	13 (18.6)	2 (100)	11 (84.6)	
History of abortion	7 (10.0)	1 (7.7)	6 (10.7)	0.61
Family history of consanguinity	2 (2.9)	1 (7.7)	1(1.8)	0.34
Diabetes mellitus	2 (2.9)	0 (0.0)	2 (3.6)	0.84
Hypertension	4 (5.7)	1 (7.7)	3 (5.4)	0.30
Folic acid	24 (34.3)	5 (38.5)	19 (33.9)	0.47
Vitamin	15 (21.4)	2 (25.0)	13 (44.8)	0.32
Smoking	2 (2.9)	1 (7.7)	1 (1.8)	0.34
Alcohol consumption	5 (7.1)	2 (15.4)	3 (5.4)	0.24
Drug use	7 (10.0)	2 (7.1)	5 (19.2)	0.036

Values are n (%), mean (± SD) or median (range)

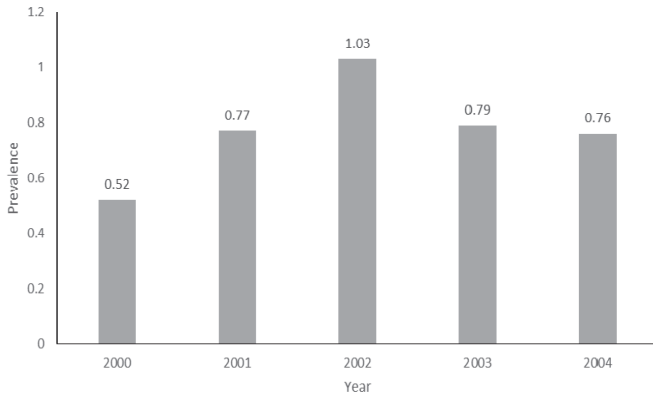

Fig.1: Trend in annual prevalence of congenital malformations.

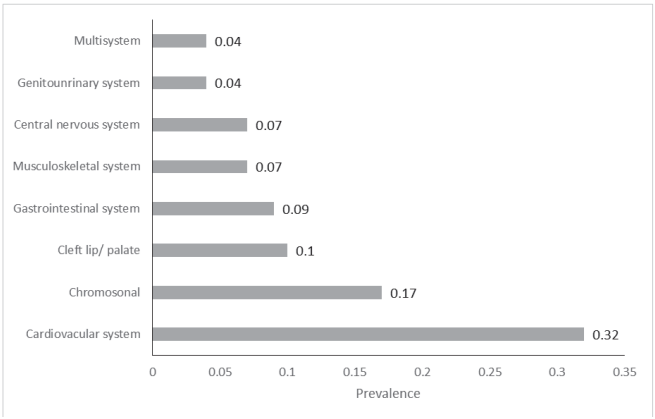

Fig. 2: Distribution of congenital abnormalities by organ system.

0.01, 0.11%). Of those who developed cardiovascular malformation, 54.2% of the mothers had a history of folic acid use prior or during pregnancy.

The prevalence of chromosomal abnormalities such as Down syndrome was 1.7 cases/1000 live births, with five of the eleven infants (45%) having at least one other major malformation. Three infants had significant cardiac malformation,

one had Hirschsprung's disease and one had duodenal atresia. Down syndrome was associated with advanced maternal and paternal ages (> 35 years).

DISCUSSION

In developing countries such as Grenada, small increases in the number of births with congenital malformations can negatively impact the limited healthcare resources and result in a marked increase in neonatal mortality. The overall prevalence of congenital malformations in this study was 0.78% which is lower than the 1.5% obtained in the 2012 Jamaican study (12) and findings from other developing and developed countries.

The overall prevalence of cardiovascular system malformations was 0.32% (3.2 cases/1000 live births) which is greater than previous reports of 2.5 cases/1000 live births in developed countries (19, 20). The result found in Grenada may be under-represented when compared with these studies, since the studies reviewed from the developed countries included data from more invasive diagnostic techniques such as cardiac catheterization, cardiac surgery and postmortem examinations that are not performed in Grenada. Additionally, a number of minor defects such as silent patent ductus arteriosus, small atrial septal defects and biscuspid aortic valve might go undetected since they often require diagnostic echocardiography.

The prevalence of chromosomal abnormalities such as Down syndrome in Grenada was 1.7 cases/1000 live births. This finding is similar to that obtained in the USA (1.4/1000 live births) and Malaysia [1.3/1000 live births] (21, 22). Currently, one infant with Trisomy 18 and urological malformations is alive. This infant represents an economic burden to the healthcare system of the country and to the family.

Folic acid use was low among the women in this study. Previous studies have shown the benefits of folic acid in the prevention of neurological and cardiovascular malformations (23, 24). However, this study lacked data to compare folic acid use among those who had babies with congenital malformation with those having normal babies.

Known risk factors for congenital malformations include parental age, maternal smoking and alcohol consumption, and low birthweight. Zhu *et al* noted that while maternal age has been the only non-genetic risk factor for chromosomal malformations, paternal age is significantly associated with musculoskeletal malformations and Down syndrome (25). Maternal smoking and alcohol consumption have been strongly linked to cardiovascular malformations such as septal and right-sided obstructive defects (26, 27). In addition to cardiovascular malformations, maternal smoking is also associated with the development of cleft lip/palate (28). In the current study, only a small per cent of the mothers engaged in smoking and alcohol consumption during pregnancy; however, there were not enough data to show associations with the various malformations.

Low birthweight has been found to be associated with congenital malformations (1). In the current study, the majority of the babies with malformations weighed 3.1–3.5 kg. It is interesting to note that the babies who died had a lower mean birthweight in comparison to those alive at data collection.

Congenital malformations were highest in women from St George's which is the most developed parish on the island. Virjheld *et al* (16) showed that non-chromosomal malformations were more likely to occur in less affluent areas, whereas chromosomal malformations such as Down syndrome are more common in affluent areas. In the current study, there was no socio-economic stratification with regard to non-chromosomal *versus* chromosomal malformations; however, cases of Down syndrome were noted in the more affluent parishes of St George's and St Andrew.

One major limitation of this study is the unavailability of data for those infants delivered at home. However, trained midwives attended all home deliveries and all major obvious defects would be referred to the hospital and therefore represented in the chart review. However, subtle malformations such as cardiac defects may go undetected.

No cases of congenital malformations were recorded on the islands of Carriacou and Petit Martinique during the study period. This may be due to the lack of ultrasound services, absence of paediatric services and experienced cardiac examiners on these islands. Hence, the data obtained may be an underestimate of the true situation.

This retrospective study is the first of its kind presenting a better understanding of congenital malformations in Grenada. While this was a five-year retrospective report, a ten-year report will address the current situation. This study showed that the prevalence of congenital malformations is lower in Grenada compared to other developing countries and developed countries, but was not able to relate occurrence with specific risk factors. Further research is needed to determine the cause of malformations in Grenada.

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