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Frequency, Pattern, and Mortality Due to Congenital Anomalies among Neonates at Ramadi Teaching Hospital for Maternity and Children, Iraq

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ABSTRACT

Background and Objective: Recognizing the prevalence of congenital malformations is essential for tracking progress in neonatal healthcare and guiding improvement efforts. The present study aimed to estimate the prevalence, pattern, and clinical outcomes of neonates born with congenital anomalies.

Methods: This cross-sectional study was conducted at Ramadi Teaching Hospital for Maternity and Children from January 1, 2024, to May 1, 2024. Data were collected using a researcher-developed checklist that included the following: gender of the baby, maternal history of a previously affected child, gravida, parity, and abortions, and prenatal history of folic acid use or radiation exposure. The type of anomaly and the outcome of the baby after follow-up in the neonatal care unit (whether the baby died or was discharged in good health) were recorded. All live neonates admitted to the neonatal care unit and born at Ramadi Hospital were included. Diagnosis of anomalies was made by precise clinical examination and appropriate investigations based on clinical findings, including abdominal or brain ultrasound, echocardiography, chromosomal studies, brain imaging, and chest or whole-body X-ray.

Findings: A total of 1094 neonates were admitted to the neonatal care unit. Congenital anomalies were identified in 85 neonates (7.8%). The most common anomalies involved the cardiovascular system (63; 74.1%), followed by the musculoskeletal system (23; 27.1%) and chromosomal anomalies (12; 14.1%). Among affected neonates, 22 (25.9%) died during the neonatal period, while 63 (74.1%) survived. Mortality was significantly associated with low birth weight (p=0.009), cardiovascular defects (p=0.015), and central nervous system defects (p=0.018).

Conclusion: The results of the present study demonstrated that congenital heart defects were the most prevalent anomalies, and the cardiovascular system was the most frequently affected organ system overall.

Keywords: *Birth Defects, Congenital Anomalies, Cardiovascular Anomalies, Neurological Anomalies Prevalence, Ramadi City, Iraq.*

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Introduction

Congenital anomalies have a significant impact on infant mortality, particularly among neonates. The WHO Birth Defects Surveillance Manual states that congenital anomalies are a broad category of defects that are apparent at birth and have their origins in prenatal development (1). These abnormalities are divided into major and minor categories. Major anomalies require therapeutic attention due to their severe medical, social, or cosmetic consequences, while minor anomalies only have minor aesthetic concerns and health effects (1). Approximately 240,000 newborn deaths occur worldwide each year as a result of congenital anomalies, with low- and middle-income nations accounting for a substantial share of these deaths (2). Congenital heart defects and neural tube defects rank among the most common severe congenital anomalies (2).

According to the WHO classification system, congenital anomalies are divided into multiple categories, including clinical syndromes, chromosomal abnormalities, cleft lip and palate, and anomalies of the gastrointestinal, urinary, genital, musculoskeletal, nervous, cardiovascular, and respiratory systems, in addition to the eyes, ears, face, and neck. Each of these categories contains further subcategories (3).

Although certain genetic disorders, environmental factors, and infectious agents are established risk factors that can disrupt fetal development before, during, or after conception, approximately 50% of congenital anomalies remain without a known cause (4). Congenital anomalies can also be influenced by various maternal factors-including age, pregnancy type, delivery method, and maternal health-as well as physical and chemical environmental exposures (5).

Between one month and five years of age, congenital anomalies account for an additional 170,000 child deaths. Furthermore, congenital anomalies can exacerbate long-term disabilities, which have a substantial negative impact on individuals, families, healthcare systems, and society as a whole. Notably, 9 out of 10 infants born with congenital anomalies are delivered in low- and middle-income countries (2).

Iraq's experience with congenital anomalies provides a clear illustration of how armed conflict can cause lasting environmental damage with transgenerational health consequences. The Falluja Hospital's Facebook page, which is dedicated to documenting birth defects, features numerous cases posted by the medical team - highlighting both the remarkable range and volume of congenital malformations. Babies born in Falluja present with a wide array of anomalies, including deformed ears, noses, and spines; hydrocephaly; cleft palate; tumors; elongated skulls; and limb-length discrepancies (6).

Unlike Falluja, the city of Ramadi has been similarly exposed to war-related pollutants and environmental contamination; however, no prior studies have investigated the impact on congenital anomalies in this population. This knowledge gap underscores the need to compile and analyze available data to determine the prevalence, pattern, and clinical outcomes of affected neonates. The urgency of this research is further supported by anecdotal reports of increasing congenital anomaly prevalence in Ramadi, without any centralized database or systematic case analysis. Given the absence of such research in this region, we undertook this review with the objective of estimating the prevalence, pattern, and clinical outcomes of neonates born with congenital anomalies.

Methods

This cross-sectional study was conducted at Ramadi Teaching Hospital for Maternity and Children, a tertiary care center for children located in western Iraq. The study included both inborn and outborn neonatal care units.

Data were collected using a researcher-developed checklist that recorded the infant's sex, maternal history of a previously affected child, gravidity, parity, number of abortions, and prenatal history of folic acid use or radiation exposure. Anomaly type and infant outcome (death or discharge in good condition) following neonatal care unit admission were also recorded. The study was conducted over four months, from January 1, 2024, to May 1, 2024.

Data were collected prospectively via direct interviews with family members of affected neonates. In cases of minor anomalies that did not necessitate admission to the neonatal care unit, data collection occurred in the delivery room.

All live neonates admitted to the neonatal care unit (inborn or outborn) and those delivered at Ramadi Teaching Hospital for Maternity and Children were included in the study. Neonates whose families refused to participate, as well as stillbirths, were excluded.

Congenital anomalies were diagnosed using clinical examination, imaging, and echocardiography. Genetic studies were performed on patients presenting with syndromic features.

Congenital abnormalities were categorized using the International Classification of Diseases, 10th Revision (ICD-10) (7). Anomalies occurring within the same organ system were counted as a single abnormality, as were isolated malformations. Multiple congenital anomalies were defined as two or more independent structural abnormalities affecting different organ systems (8). Statistical significance was set at $p<0.05$. Categorical variables were compared using Pearson's chi-square test.

Ethical approval for this study was granted by the College of Medicine, University of Anbar (ethical code: 195, issued on 23 December 2024). All data were kept exclusively for research purposes, with no access granted to unauthorized individuals. Participant anonymity was maintained by using numeric codes instead of names. Individuals who refused to participate were excluded from the study. Oral informed consent was obtained from all participants prior to data collection through direct interviews with their caregivers.

All statistical analyses were performed using SPSS version 26. Categorical variables were summarized as frequencies and percentages. The association between categorical variables and the outcome was assessed using Pearson's chi-square test of independence and comparison with zero was considered invalid. The numerical variables were expressed as means±standard deviations. An alpha level of $p<0.05$ was considered statistically significant.

Results

A total of 1094 neonates were admitted during the study period. Congenital anomalies were identified in 85 neonates (7.8%), while the remaining 1009 neonates (92.2%) had no congenital anomalies. Table 1 presents the prevalence of congenital anomalies by organ system among the 85 affected neonates. The most common anomalies involved the cardiovascular system, occurring in 63 neonates (74.1%), followed by the musculoskeletal system in 23 neonates (27.1%), and chromosomal anomalies in 12 neonates (14.1%). Percentages sum to more than 100% because some neonates had anomalies affecting multiple systems.

Neonatal Characteristics: Among the 85 neonates with congenital anomalies, the majority (64; 75.3%) presented during the first week of life. Males were more commonly affected than females (53 [62.4%] vs. 32 [37.6%]). Preterm neonates (48; 56.5%) outnumbered term neonates (37; 43.5%).

Maternal Characteristics: The most common maternal age group was 20-29 years (40; 47.1%). Multigravidity and multiparity were each present in 40 mothers (47.1%). A majority of mothers (55; 64.7%) had no history of previous abortions. Folic acid supplementation was used by 60 mothers (70.6%). Positive

consanguinity (parents related by blood) was reported in 51 cases (60.0%). Table 2 summarizes the demographic and clinical characteristics of the study population.

Table 1. Different types of congenital anomalies and their prevalence

Anomaly [No. of cases (percentage of total anomalies, percentage of total neonates)]	Number(%)
Cardiovascular [N= 63 (74.1%, 5.8%)][a]	
Atrial septal defect (ASD)	38(62.3)
Patent ductus arteriosus (PDA)	37(60.7)
Pulmonary hypertension (PHT)	22(36.1)
Ventricular septal defect (VSD)	19(31.1)
Dilated right ventricle	5(8.2)
Pulmonary stenosis	4(6.6)
Dextrocardia	3(4.9)
Dilated right atrium	2(3.3)
Situs inversus	2(3.3)
Endocardial cushin defect	2(3.3)
Pulmonary atresia	1(1.6)
Mitral valve atresia	1(1.6)
Hypoplastic left ventricle	1(1.6)
Right ventricular hypertrophy	1(1.6)
Mitral regurgitation	1(1.6)
Left ventricular hypertrophy	1(1.6)
Myxoma	1(1.6)
Musculoskeletal & Skin & Abd. [N= 23 (27.1%, 2.1%)]	
Polydactyly	6(28.6)
Club foot	5(23.8)
Achondroplasia	3(14.3)
Omphalocele + club foot	1(4.8)
Epidermolysis bullosa	1(4.8)
Abd. Wall defect + omphalocele	1(4.8)
Aplasia of the left hand	1(4.8)
Omphalocele + polydactyly	1(4.8)
Osteogenesis imperfecta	1(4.8)
polydactyly + micro-penis	1(4.8)
Chromosomal [N= 12 (14.1%, 1.1%)]	
Down Syndrome	5(41.7)
Edward syndrome	3(25.0)
Poland syndrome	1(8.3)
Treacher Collin syndrome	1(8.3)
Kartagner syndrome	1(8.3)
Pearl syndrome	1(8.3)
CNS [N= 6 (7.1%, 0.5%)]	
Hydrocephaly	2(33.3)
Myelomeningocele	1(16.7)

Hydrocephaly + Myelomeningocele	1(16.7)
Microcephaly + absence of cerebral hemisphere	1(16.7)
Anencephaly	1(16.7)
Orofacial &Eye [N= 5 (5.9%, 0.5%)]	
Anosmia	2(40.0)
Absent eye	1(20.0)
Cleft lip & palate	1(20.0)
Cleft lip + nasal anomaly	1(20.0)
GIT [N= 5 (3.5%, 0.3%)]	
Congenital ascites	3(60.0)
Diaphragmatic hernia	1(20.0)
Imperforated anus	1(20.0)
Urogenital [N= 2 (2.4%, 0.2%)]	
Ambiguous genitalia	1(50.0)
Polycystic kidney	1(50.0)

[a]More than one anomaly in a single case

Table 2. General criteria of the neonates and their mothers

Parameters	Number(%)
Age at presentation	
1st week	64(75.3)
2nd week or more	21(24.7)
Sex	
Male	53(62.4)
Female	32(37.6)
Gestational age at delivery (37.2±1.7 weeks)	
32-37 weeks	48(56.5)
>37 weeks	37(43.5)
Mode of Delivery	
Normal vaginal delivery	18(21.2)
Cesarean section	67(78.8)
Place of Delivery	
Home	6(7.1)
Hospital	79(92.9)
Birth Weight (2.8±0.6 kg)	
<1.5 kg	1(1.2)
1.5-2.5 kg	17(20.0)
>2.5 kg	67(78.8)
Mother age (29.8±5.9 years)	
<20 years	3(3.5)
20-29 years	40(47.1)
30-39 years	39(45.9)
40+ years	3(3.5)

Gravida	
Primigravida	14(16.5)
Multigravida	40(47.1)
Grand multigravida	31(36.5)
Parity	
Primipara	18(21.2)
Multipara	40(47.1)
Grand multipara	27(31.8)
Abortion	
0	55(64.7)
1	14(16.5)
>1	16(18.8)
Fever during Pregnancy	11(12.9)
Folic Acid Use	60(70.6)
History of Previously affected Child	18(21.2)
Consanguinity	51(60.0)
Fate	
Life	63(74.1)
Died	22(25.9)

Table 3 presents the factors associated with mortality among the 85 neonates with congenital anomalies. Low birth weight, cardiovascular anomalies, and central nervous system anomalies each showed a statistically significant association with increased mortality risk.

Table 3. Factors that may affect the outcome of neonates presented with congenital anomalies

Variables	Living (n=63) Number(%)	Deceased (n=22) Number(%)	p-value
Age at presentation			
1st week	46(71.9)	18(28.1)	0.41
2nd week or more	17(81)	4(19)	
Sex			
Male	40(75.5)	13(24.5)	0.714
Female	23(71.9)	9(28.1)	
Gestational age at delivery			
32-37 weeks	33(68.8)	15(31.3)	0.198
>37 weeks	30(81.1)	7(18.9)	
Type of Gestation			
Single	63(75.9)	20(24.1)	Not
Twin	0(0)	2(100)	Valid
Place of Delivery			
Home	5(83.3)	1(16.7)	0.593
Hospital	58(73.4)	21(26.6)	
Mode of Delivery			
Vaginal delivery	11(61.1)	7(38.9)	0.156
Cesarean section	52(77.6)	15(22.4)	
Fever during pregnancy			
Yes	10(90.9)	1(9.1)	0.173
No	53(71.6)	21(28.4)	

Folic Acid Use			
Yes	47(78.3)	13(21.7)	0.169
No	16(64)	9(36)	
History of Previous affected Child			
Yes	13(72.2)	5(27.8)	0.836
No	50(74.6)	17(25.4)	
Consanguinity			
Yes	38(74.5)	13(25.5)	0.919
No	25(73.5)	9(26.5)	
Birthweight			
<2.5 kg	9(50)	9(50)	0.009*
≥2.5 kg	54(80.6)	13(19.4)	
Mother age			
<30 Years	33(76.7)	10(23.3)	0.576
≥30 Years	30(71.4)	12(28.6)	
Systems affected with anomalies			
One	46(76.7)	14(23.3)	0.406
Combined	17(68)	8(32)	
Cardiovascular system			
Yes	51(81)	12(19)	0.015*
No	12(54.5)	10(45.5)	
Central nervous system			
Yes	2(33.3)	4(66.7)	0.018*
No	61(77.2)	18(22.8)	
Urogenital			
Yes	2(100)	0(0)	Not
No	61(73.5)	22(26.5)	Valid
Gastro-intestinal			
Yes	3(60)	2(40)	0.458
No	60(75)	20(25)	
Orofacial &Eye			
Yes	2(40)	3(60)	0.073
No	61(76.3)	19(23.8)	
Chromosomal			
Yes	8(66.7)	4(33.3)	0.525
No	55(75.3)	18(24.7)	
Musculoskeletal, Skin & Abdomen			
Yes	15(65.2)	8(34.8)	0.254
No	48(77.4)	14(22.6)	
Gravida			
Primigravida	11(78.6)	3(21.4)	
Multigravida	30(75)	10(25)	0.852
Grand multigravida	22(71)	9(29)	
Parity			
Primipara	14(77.8)	4(22.2)	
Multipara	28(70)	12(30)	0.716
Grand multipara	21(77.8)	6(22.2)	
Abortion			
0	41(74.5)	14(25.5)	
1	10(71.4)	4(28.6)	0.968
>1	12(75)	4(25)	

Statistical significance set at p<0.05 using Pearson's chi-square test.

Discussion

The overall prevalence of congenital anomalies in this study was 7.8%. This finding is comparable to that reported by Chimah et al., who found a prevalence of 6.1% (9). However, our prevalence is higher than those reported in several other studies. Sravani et al. reported a prevalence of 3.7% (10), while Asemi-Rad et al. in Iran found a much lower prevalence of 1.49% (11). Similarly, Al-Dewik et al. reported a prevalence of 1.3% (12). Ghosh et al. (13) and Tiwari et al (14) reported incidences of 2.14% and 2.56%, respectively.

Several factors may explain the higher prevalence of congenital anomalies in our study compared to other regions. Our study area has experienced prolonged armed conflict, including the rise of ISIS and the use of various weapons over many years.

The most common anomalies in our study involved the cardiovascular system (63; 74.1%), followed by the musculoskeletal system (23; 27.1%) and chromosomal anomalies (12; 14.1%). This pattern is consistent with the findings of Giang et al. (15), Kumar et al. (16), and Doddabasappa et al. (17), as well as the WHO fact sheet on congenital anomalies (2). However, our findings differ from several other studies. Seba et al. (18), Cherian et al. (19), and Bhalerao et al (20) reported that musculoskeletal anomalies were the most common type of congenital anomalies. Additionally, other studies have identified nervous system defects as the most frequent anomalies (21). These discrepancies may be explained by geographical variation or by underdiagnosis of cardiac defects, as some heart anomalies may remain undetected until later in infancy.

Atrial septal defect (ASD) was the most frequent congenital heart defect in our study, accounting for 38 cases (62.3%). This finding is consistent with Giang et al. (15). In contrast, Hassan A. et al. (22), Al-Fahham et al (23), and Namuyonga et al. in Uganda (24) all reported that ventricular septal defect (VSD) was the most common congenital heart defect. These discrepancies may be explained by differences in sample characteristics or by the presence of cardiac anomalies associated with underlying genetic syndromes.

51 neonates (60.0%) had positive consanguinity. This finding agrees with Ameen et al. in Iraq (25), who reported a significant association between positive consanguinity and the occurrence of congenital anomalies. This is explained by the fact that children of consanguineous parents have a higher risk of autosomal recessive disorders.

In this study, 18 mothers (21.2%) had a previously affected child with a congenital anomaly. This finding is consistent with Ameen et al. (25), who reported that 27 cases (20.8%) had a history of congenital anomalies.

22 neonates (25.9%) with congenital anomalies died during the neonatal period, while 63 (74.1%) survived. Comparing our findings to other studies, Safaa et al. in Cairo reported a higher mortality rate of 30.53% (142 cases) (26). In contrast, Silesh et al. in Ethiopia (27) found lower mortality rates of 10.4% and 13.1% among neonates with congenital anomalies. These discrepancies may be attributed to differences in the types and severity of anomalies, as well as the organ systems involved across study populations.

In the present study, low birth weight was significantly associated with mortality among neonates with congenital anomalies (Table 3). This finding differs from that of Ajao et al in Nigeria (28), who found no significant association between low birth weight and mortality. This discrepancy may be attributed to differences in the quality of neonatal care, including the availability of essential equipment such as incubators, ventilators, and monitoring systems, which may influence survival outcomes among low-birth-weight neonates.

As shown in Table 3, cardiovascular and central nervous system anomalies were significantly associated with mortality in our study. This finding contrasts with that of Anane-Fenin et al. in Ghana (29), who reported no significant association between the type of organ system involved and mortality. This discrepancy may be explained by differences in the quality and accessibility of health care services between the two settings.

Furthermore, our study demonstrated that congenital heart defects were the most prevalent anomalies, and the cardiovascular system was the most frequently affected organ system overall. This high prevalence of cardiovascular anomalies may partially explain the strong association with mortality observed in our cohort.

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