Republic of Yemen

Ministry of Higher Education & Research

Emirates International University

Faculty of Medicine & Health Sciences

Community Medicine Department

Patterns and Associated Factors of Congenital Anomalies Among Neonates in 14 Yemeni Governorates 2021-2023

Research submitted in the fulfillment of the degree of MBBS in General Medicine and Surgery.

Researchers

Hiam Abdulrahman Ahmed Al-Atnah* Anas Najeb Khalil Al-Qubati*

Amir Addin Mosleh Khalid Al-Hashdi Muath Ali Mohammed Alsaidy

Saleh Mohammed Ali Issa Al Shawish Mohammed Raji Jaber Damaj

Saleh Ali Saleh Ali Albasarah Jamal Jameel Hazza Abdo

Abdullah Ali Abdullah Goruon Abdulrahman Yahya Abdulrahman Al-Thawr

Wissam Fathi Abdo Albaseer

*Co-Authors

Supervisor:

Asst.Prof/ Moamar Badi

Assistant Professor of Community Medicine

Faculty of Medicine and Health Sciences

Emirates International University

2023 AD-1445H

TABLE OF CONTENTS

DEDICATION

To our families, friends, and mentors, your unwavering faith in our potential has been the guiding light in the voyage of this research, illuminating our path toward knowledge and discovery.

ABSTRACT

Introduction: Congenital Anomalies (CAs) present as structural, functional, or metabolic defects, resulting in long-term impairment and a decrease in quality of life. This research provides a comprehensive overview of CAs in neonates across 14 Yemeni governorates, a significant yet overlooked public health concern.

Objectives: To determine the patterns and associated factors of Congenital Anomalies (CAs) in 14 Yemeni governorates in 2021- 2023.

Methods: The study employed a Case-Control 1:2 framework, utilizing secondary data from various health facilities from 2021 to 2023 across 14 governorates in Yemen. The study compared 612 neonates with CAs to 1224 controls of healthy neonates from similar socioeconomic backgrounds. Data was then digitized and analyzed using Epi info version 7.2, where bivariate and multivariate logistical regression was used to identify factors associated with CAs ($p < 0.001$), in addition to T-test, and chi-square.

Results: The majority of the CAs identified were located in Al-Hudaydah (34%), Ibb (17.2%), and Sana'a (13.1%). Most of the CAs were isolated 518 (84.64%), whereas 94 (15.36%) were multiple. The highest percentage of CAs that we found were those of the nervous system (33.9%), followed by the skeletal system (14.8%) and orofacial anomalies (10.6%). Furthermore, significant statistical associations were found with CAs and positive consanguinity (OR=27.637), low socioeconomic class (OR=11.427), maternal age ≥35 years old (OR=8.264), low neonatal birth weight <2500g (OR=4.675), stress (OR=4.456), acute diseases (OR=2.759), positive family history (OR=1.955), gestational age <37 weeks, (OR= 1.630), grand-multiparity (OR=0.599) and male sex (OR= 0.1034).

Conclusion: This study identified that the predominant CAs in 14 Yemeni governorates were isolated. The majority were those of the nervous system, skeletal system and orofacial anomalies. Statistically significant associations were identified with positive consanguinity low socioeconomic class, maternal age ≥35 years old, low neonatal birth weight <2500g, stress, acute diseases, positive family history, gestational age <37 weeks, grand-multiparity and male sex.

Keywords: *Congenital Anomalies, Associated Factors, Yemen.*

ACKNOWLEDGMENTS

*First and foremost, we thank **God almighty** for bestowing upon us the fortitude and opportunity to conduct this research.*

*We extend our sincere appreciation to our research supervisor, **Dr. Moamar Badi**, for his tremendous guidance, and unwavering support. His expertise has been instrumental in shaping our research.*

*Our deepest thanks go to the university president, **Dr. Nasser Al-Mofari**, and the vice president of the university, **Dr.Ahmed Al-Badaany** for their visionary leadership, encouragement and dedication to promoting a conducive research environment.*

*We also extend our appreciation to the dean of the faculty of medicine, **Dr. Saleh Al-Dhaheri**, and the vice dean, **Dr. Sadeq Abdulmoghni** for their commitment and constant mentorship to steer us to excellence.*

*Our heartfelt gratitude extends to the medical department coordinator, **Dr. Maha Al-Montasser** for her rigorous research review and meticulous attention to detail. We also like to thank the head of the laboratory medicine faculty, **Dr.Abdulbasit Al-Ghoury** for his thorough review and invaluable feedback. Their dedication has enriched our research. We also extend our thanks to the rest of the department heads at the faculty of medicine for their assistance and cooperation.*

*We are grateful to **Dr. Najeb Al-Qubati**, the Deputy Minister of the Ministry of Health and Population. His invaluable assistance in allocating available resources and granting us full access to all hospitals across Yemeni governorates was imperative for the successful completion of our research.*

*We also like to thank **Dr. Yasser Ghaleb**, whose analytical prowess and attention to detail have been critical in guaranteeing the accuracy and credibility of our research results.*

Finally, this study is devoted to the indomitable spirits of those affected by CAs *as well as to the perpetual pursuit of medical breakthroughs that promise a future full of hope and healing. May our study be a stepping stone and a glimpse of light for all children with* CAs *in our beloved country, Yemen.*

ABBREVIATIONS

CA/CAs	*Congenital Anomalies*
CDC	*Centre for Disease Control and Prevention*
CI	*Confidence Interval*
CT	*Computerized Tomography*
DALY	*Disability-Adjusted Life Years*
ICD	*International Classification of Diseases*
LBW	*Low Birth Weight*
MRI	*Magnetic Resonance Imaging*
OR	*Odds Ratio*
P-Value	*Probability Value*
Ref	*Reference*
WHO	*World Health Organization*

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

1.1 Background

In the vast tableau of human health, congenital anomalies (CAs) are an imperative and frequently neglected thread. They can be detected prenatally, at birth, or later in infancy and may present as structural, functional, or metabolic anomalies, resulting in long-term impairment and a diminished quality of life. The prevalence and types of CAs vary by country, and even within a country, from area to region (Figure 1.1.). This depends on the definition of CAs adopted, the method of their identification, the length of time, the population under surveillance, the ethnic and socioeconomic characteristics of the community investigated (1,2). CAs are the major cause of neonate mortality and morbidity worldwide and one of the primary contributors to the global burden of disease.

According to severity, CAs are categorized into major and minor anomalies. (3) They can also be divided into three categories: minor, severe, and lethal anomalies. Major anomalies are regarded as both severe and lethal. (4) However, worldwide, CAs are categorized according to the impacted body system. (5)

About 25% of CAs are significantly influenced by genetic factors. Single-gene problems, which arise from gene mutations and chromosomal abnormalities, constitute around 10% of affected children, and are the two most frequent genetic causes of CAs. (6,7) Thousands of more children, which constitute 8-12%, are born with severe birth defects as a result of maternal exposure to environmental toxins (teratogens) that can harm an unborn child, including alcohol, rubella, syphilis, and iodine deficiency. Additionally, 20-25% are thought to be multifactorial and 40-60% cannot be linked to a specific cause. (8)

Globally, the prevalence rates of CAs ranges from 2% to 6%, and about 8 million neonates are born with CAs annually, with significant variations. (9–11). Due to pronounced differences in maternal health and other significant risk factors, such as poverty, elder mothers, positive consanguineous marriages, and the protective factor against malaria for carriers of sickle cell, thalassemia and glucose-6- phosphate dehydrogenase, both the proportion of births with CAs and the absolute number of births are much higher in middle-income and low-income countries than in high-income countries (12–15). For instance, the prevalence of CAs in Yemen, Egypt, Ethiopia, Kenya, Uganda and Nigeria (16–20) is higher than the

prevalence in India, Iran, and Britain (9–11). Moreover, antenatal care visits and adequate nutritional practices such folic intake can significantly reduce the incidence of CAs(17,21).

Additionally, CAs significantly contribute to the global burden of diseases. An estimated 295,000 neonates die annually before they reach the age of four weeks due to their congenital disorders and complications. They also result in lifelong disability and health disorders and account for 25.3-38.8 million disability-adjusted life years (DALYs), which could be prevented with timely surgery or other interventions. (22,23) Furthermore, about 3.2 million neonates born with CAs each year are predicted to become disabled in the absence of suitable treatment. According to a conservative estimate, CAs are responsible for approximately 3.3 million deaths annually. This estimate takes into account both the 50% of infants who pass away in low-income nations and the 30% of high-income and middle-income countries who are born with major CAs that are mostly or completely genetic.

Although CAs are a worldwide concern, they especially have a negative impact in middle-income and low-income nations, where they are responsible for almost 94%t of major CAs and 95%t of children's deaths. Nationally in Yemen, CAs are responsible for roughly >69.9 births per 1000 births and one-fifth of all disabilities while non-contagious illnesses and injuries account for the remaining 15–16 % of disabilities according to the National Health and Demographic Survey in Yemen conducted in 2013 (24) Additionally, one out of 10 neonates is born with CAs in a recent study conducted in a tertiary hospital in Sana'a, Yemen by Thabet SA et al (2017).

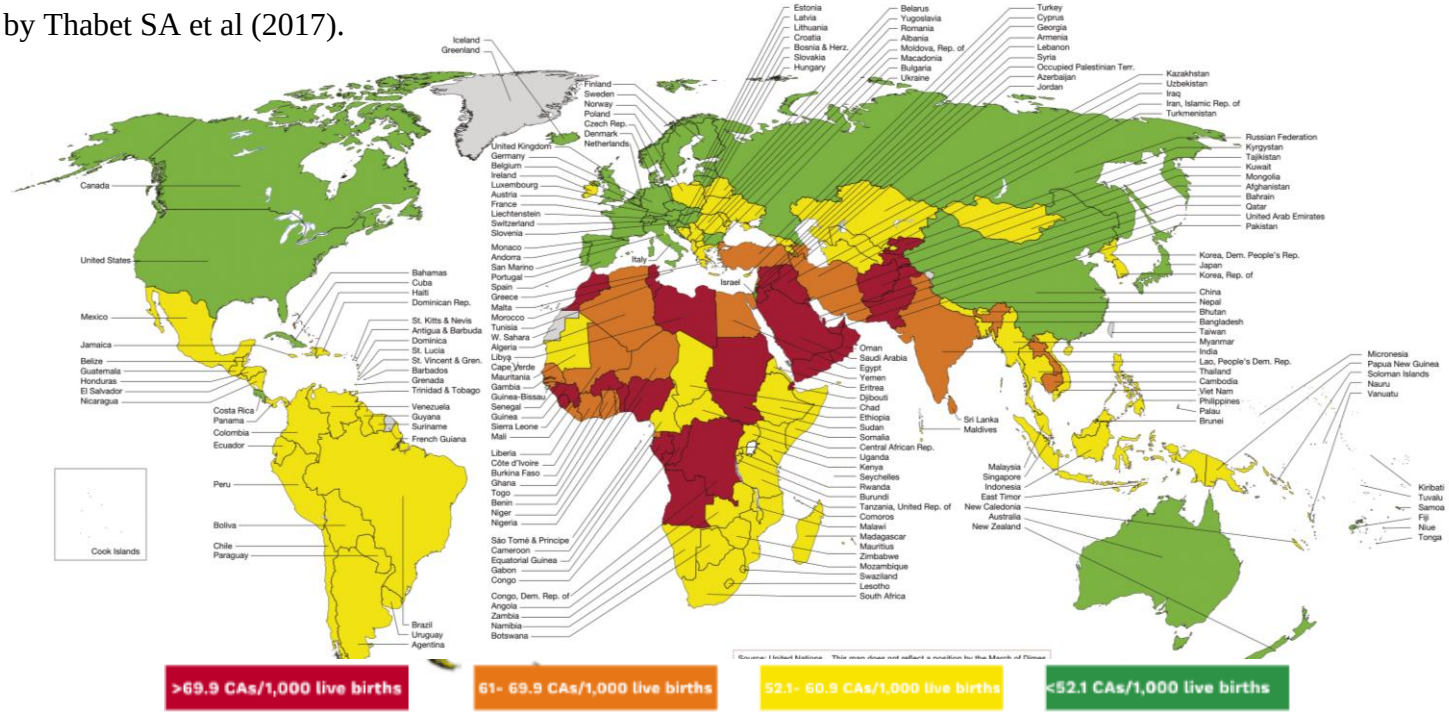


Figure 1. 1: Birth Defects Overview. Source: March of Dimes Global Report (2006)

Countries with middle-income and low-income levels often have higher birth prevalence of post-conception birth abnormalities caused by teratogens. It is highly unlikely that they have methods to diagnose or quantify defects caused by such exposure. As a result, they frequently have few, if any, laws governing the use of some of these chemicals, and their health services are rarely focused on recognizing and limiting exposure. Every year, an undetermined number of infants with severe birth abnormalities caused by teratogens are surely born, most likely in the hundreds of thousands. (25,26)

Moreover, the ongoing grave war in Yemen, a country on the southern tip of the Arabian Peninsula, has shattered what was once a prosperous country, resulting in the deterioration of the health infrastructure and the unprecedented doubling of CAs. In light of this, the study of CAs becomes not just a scientific endeavor, but a pressing humanitarian concern. Yet, research is scarce on CAs in Yemen, particularly regarding their patterns and associated factors. Studies that have already been conducted in Yemen primarily focus on conflict-related rates or are restricted to a certain hospital (27) or governorate (28) constituting a critical gap in knowledge. By conducting comprehensive and generalized research, we can contribute to the cross-cultural global understanding of CAs by providing valuable insights specific to Yemen's context to facilitate the development of global strategies for their prevention and management. This is imperative since treatment and rehabilitation of children with CAs is costly and complete recovery is usually impossible. (29)

Hence, eradication of risk factors and enhancement of protective factors can significantly mitigate the burden of CAs. Imperative interventions include regular Antenatal Care and maintaining a healthy weight and adequate nutrition, minerals, and vitamin intake, especially folic acid; abstaining from tobacco and other harmful substances; avoiding infections linked to CAs; and limiting exposure to radiation and heavy metals in the environment. (23)

Yemen's healthcare system faces resource constraints and limitations (30) making it crucial to allocate available resources efficiently by identifying high-risk populations and associated factors. This will enable policymakers and healthcare providers to carry out tailored health interventions, promote health literacy, and advocate for policy changes to reduce the incidence of CAs. This case-control study aims to estimate the pattern and associated factors of CAs in 14 Yemeni governorates.

1.2 Statement of the Problem

The increasing incidence of CAs and the financial burden of diagnosis, treatment, and rehabilitation among neonates in Yemen pose a major health concern. It is crucial to identify their patterns and associated factors to mitigate their impact on children's quality of life and the economic stability of their families. This study is beyond statistics; it is about the neonates grappling with CAs, their families, and communities. More importantly, it is about illuminating this dark corner of global health towards a healthier, more equitable world.

1.3 Study Justification

Considering the lack of generalized studies on CAs and the existence of few studies restricted to only certain hospitals, governorates, or body systems, this hinders a complete understanding of the patterns and distribution of these anomalies and their associated factors across Yemen. Thus, a broader comprehensive study can help inform healthcare strategies and interventions on a larger national level. Despite generalized research being limited, the statistics and reports on CAs are widely available in different hospitals across Yemen. Still, these scattered and fragmented sources of information require gathering and analysis to draw common patterns and factors associated with it.

The findings of this study will highlight the disease burden and identify associated factors. This will help policymakers and healthcare providers prioritize resources, put prevention strategies into practice, and create tailored interventions to meet the needs of affected individuals and communities. These interventions can include health education, screening programs, genetic counseling, and early prevention.

1.4 Aims and Objectives

1.4.1 General Objectives

To determine the patterns and associated factors of congenital anomalies (CAs) in 14 Yemeni governorates.

1.4.2 Specific Objectives

- To determine the most common patterns of CAs among neonates in Yemen according to distribution among governorates and according to body systems.
- To assess the relationship between CAs and maternal socioeconomic demographics.
- To assess the relationship between CAs and neonatal socioeconomic demographics.
- To determine the possible associated factors responsible for these anomalies.
- To determine the protective factors.

1.4.3 Research Questions

- What are the patterns of CAs among neonates in Yemen?
- Are there any differences in the CAs in various maternal and neonatal demographics?
- What are the most important associated factors of CAs among neonates in Yemen?

CHAPTER 2: LITERATURE REVIEW

2.1 Clinical Overview

Congenital anomalies (CAs), commonly referred to as birth defects, include structural, functional, or metabolic abnormalities that arise during fetal development and are present at birth. These anomalies can significantly impact the health and well-being of newborns, leading to long-term disabilities, morbidity, and mortality. Malformations, deformations, disruptions, and dysplasia are specific terms employed to describe CAs (Figure 2.1) accurately. Additionally, CAs can manifest as independent isolated cases affecting a single organ or system, or as distinctive patterns in the form of Syndromes, Sequences, Field Defects, and Associations (Figure 2.2). (22,23)

Figure 2. 1: Descriptive Terms of CAs. Source: Adapted from Uptodate (2023).

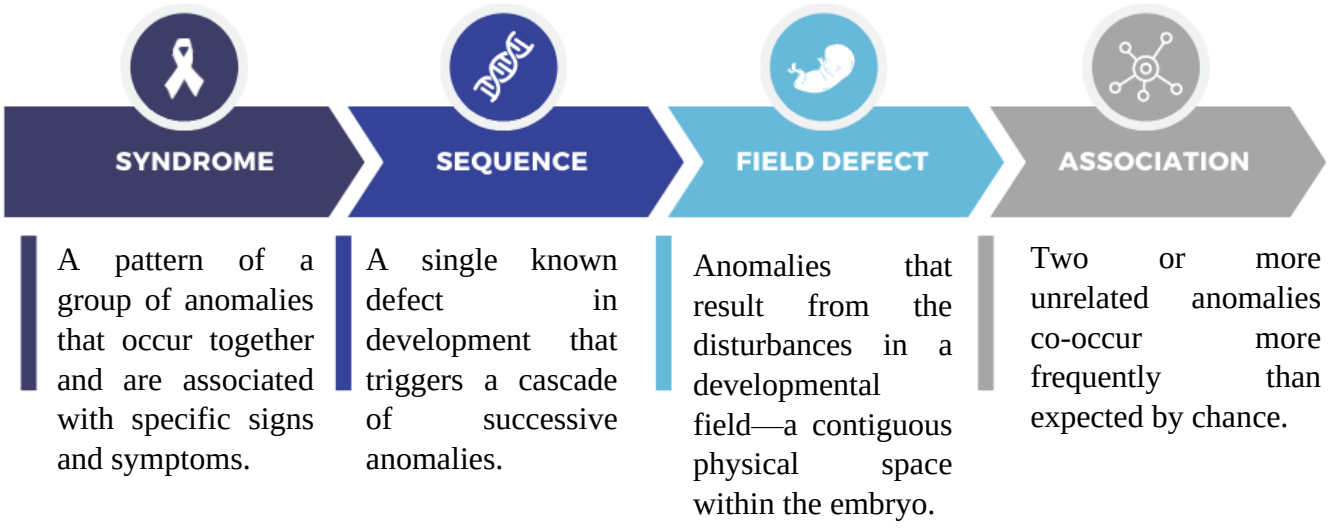


Figure 2. 2: Manifestations of CAs. Source: Adapted from Uptodate (2023).

Although the exact source of these impairments is frequently unknown, genetic abnormalities and/or environmental exposures are to blame. Several. Genetic causes of CAs include chromosomal disorders, single-gene disorders, somatic mutation/mosaicism, and multifactorial disorders. Environmental causes include multiple gestation pregnancies and teratogens. A teratogen is a substance that can cause abnormalities in the shape or function of a developing fetus (Table 2.1). The pattern and type of malformation are influenced by both the time of exposure and the site of gene action.

Table 2. 1: Common Environmental Causes of CAs. Source: Adapted from Uptodate (2023).

Substance	***Alleged fetal effects***	***Exposure Timing***
Drugs		
Angiotensin-converting enzyme inhibitors and angiotensin receptor blockers	Fetal hypotension: anuria ,oligohydramnios, renal tubular dysgenesis, pulmonary hypoplasia, cranial bone hypoplasia, fetal growth restriction and death.	2nd & 3rd Trimester
Antiseizure medications		
Carbamazepine	Facial dysmorphology, neural tube defects, cardiovascular defects, and urinary tract defects.	1st Trimester
Phenytoin	Fetal hydantoin syndrome	18 - 60 days postconception (organogenesis)
Valproic acid	Spina bifida, facial dysmorphology, autism, atrial septal defect, cleft palate, hypospadias,polydactyly,craniosynostosis, and limb abnormalities.	18 - 60 days post conception (organogenesis)
Antidepressants	Neonatal Respiratory Distress, preterm birth, major cardiac malformation, Spontaneous abortions, low birth weight, neonatal serotonin syndrome, neonatal behavioral syndrome (withdrawal), and persistent pulmonary hypertension of the newborn.	1st and 3rd Trimester
Antituberculous therapy	Paraaminosalicylic acid: ear and limb defects and hypospadias.	1st and 2nd trimester
Cyclophosphamide, chemotherapeutic agents and immunosuppressive agents	Cyclophosphamide: when used during organogenesis, fetal bone marrow inhibition may occur.	2nd and 3rd trimesters: fetal growth restriction and pancytopenia

Ethanol	Fetal alcohol syndrome (microcephaly, intellectual disability, growth restriction, facial dysmorphogenesis, small palpebral fissures.	1st Trimester: fetal alcohol-related CAs; 2nd and 3rd trimesters: fetal alcohol neurodevelopmental disorders
Glucocorticoids	low risk for cleft palate	1st Trimester
Lithium therapy	Ebstein anomaly	1st Trimester
Macrolides (eg, azithromycin, clarithromycin, erythromycin)	Cardiovascular and Genital Defects	1st Trimester for cardiac defects; 1st, 2nd and 3rd Trimesters for genital defects
Minoxidil	Hair growth in the fetus and hirsutism in newborns.	1st Trimester
Methimazole	Aplasia cutis, tracheoesophageal fistulas, patent vitellointestinal duct, choanal atresia, omphalocele, and omphalomesenteric duct anomaly.	1st trimester (especially weeks 6 - 10)
Methotrexate	Pregnancy loss, growth restriction, microcephaly, meningomyelocele, intellectual disability, decreased ossification of the calvarium, hypoplastic supraorbital ridges, small low-set ears, micrognathia, and limb defects.	18 - 60 days post-conception (organogenesis)
Misoprostol	Vascular disruptive phenomenon, such as limb-reduction defects and Mobius syndrome. (Low risk)	1st and 2nd trimester
Mycophenolate mofetil	1st trimester exposure associated with miscarriage, abnormalities of the brain, ears, eyes, distal limbs, heart, esophagus, kidney, and cleft lip/palate.	1st trimester
Penicillamine (D-penicillamine)	Lathyrism the results of poisoning by the seeds of the genus Lathyrus, causing collagen disruption, cutis laxa, and hyperflexibility of joints. The condition seems to be reversible, and the risk is low.	Timing is not clear
Progestin therapy	Fetal masculinization (High doses)	3rd Trimester

Propylthiouracil	Goiter in infants	Throughout gestation
Retinoids	Systemic retinoic acid, isotretinoin, and etretinate can cause increased risk of CNS, cardioaortic, ear, and clefting defects such as microtia, anotia, thymic aplasia, other branchial arch and aortic arch abnormalities, and certain congenital heart malformations.	1st trimester
Streptomycin	Low risk: Ototoxicity	Throughout gestation
Sulfa drugs and vitamin K	Hemolysis and kernicterus	2nd and 3rd Trimesters
Tetracycline	Bone and teeth staining	2nd and 3rd Trimesters
Trimethoprim	Neural tube defects, cardiovascular defects and, oral clefts.	1ST trimester
Vitamin A	Doses to produce CAs would have to be over 25,000 to 50,000 units/day.	1st trimester
Warfarin and warfarin derivatives	Early exposure during pregnancy can result in nasal hypoplasia, stippling of secondary epiphysis, and intrauterine growth restriction. CNS malformations can occur in late pregnancy exposure because of bleeding.	1st trimester
Radiation		
Ionizing radiation	Radiation exposure above a threshold of 20 rad (0.2 Gy) can increase the risk for microcephaly or growth retardation, but the threshold for intellectual disability is higher.	1st trimester
Radioactive isotopes	Tissue- and organ-specific damage depends on the radioisotope element and distribution (ie, high doses of Iodine-131 administered to a pregnant woman can cause fetal thyroid hypoplasia after the eighth week of development).	After 8th week
Chemicals		
Carbon monoxide	Very high exposure is linked to anomalies.	
Lead	Very high exposures more than 20 microgram/percent can cause pregnancy loss.	Throughout Pregnancy

Gasoline	Facial dysmorphology, intellectual disability, embryopathy from exposure due to gasoline addiction.	Throughout pregnancy
Methyl mercury	Minamata disease (cerebral palsy, microcephaly, intellectual disability, blindness, and cerebellum hypoplasia). Present environmental levels of mercury are unlikely to represent a teratogenic risk, but reducing or limiting the consumption of carnivorous fish has been suggested to avoid exceeding the maximum allowed exposure.	Throughout pregnancy
Toluene (used in paint)	Facial dysmorphology, intellectual disability, embryopathy from exposure due to toluene addiction.	
Embryonic and fetal infections		
Cytomegalovirus infection	Retinopathy, CNS calcification, microcephaly, intellectual disability. Occurs in 30 to 50% of primary infections.	1st 6 months of pregnancy
Rubella	Deafness, congenital heart disease, microcephaly, cataracts, intellectual disability. Occurs in up to 80% of fetuses with a primary infection.	Up to 16 weeks although more significant in the 1st 2 months of pregnancy
Herpes simplex	Fetal infection, liver disease, death.	Throughout pregnancy
HIV	Perinatal HIV infection.	Throughout pregnancy
Parvovirus infection, B19	Stillbirth, hydrops.	till 20 weeks gestation
Syphilis	Maculopapular rash, hepatosplenomegaly, deformed nails, osteochondritis at joints of extremities, congenital neurosyphilis, abnormal epiphyses, chorioretinitis.	Throughout pregnancy
Toxoplasmosis	Hydrocephaly, microphthalmia, chorioretinitis, intellectual disability.	Throughout pregnancy
Varicella zoster	Skin and muscle defects; intrauterine growth retardation; limb reduction defects, CNS damage (very low increased risk).	1st trimester
Zika virus	Microcephaly, intracranial calcifications, intellectual disability.	Up to 20 weeks gestation

Maternal disease states		
Corticosteroid-secreting endocrinopathy	Infantile hyperadrenocorticism.	
Iodine deficiency	Embryonic goiter and intellectual disability.	
Maternal androgen endocrinopathy (adrenal tumors)	Masculinization of female fetuses.	
Maternal diabetes with poor glycemic control	Increases the risk of a wide variety of CAs; cardiac abnormalities are most common.	
Maternal folic acid in low amounts	Neural tube defects.	
Maternal phenylketonuria	Abortion, microcephaly, and intellectual disability; very high risks in untreated patients.	
Maternal starvation	Intrauterine growth restriction, abortion, neural tube defects.	
Tobacco smoking	Fetal growth restriction, stillbirth, anomalies of the heart, limbs, skull, genitourinary system, feet, abdominal wall, small bowel, and muscles.	
Zinc deficiency	Neural tube defects.	

Furthermore, CAs can be classified into major and minor malformations (Figure 2.3). Major malformations are defined as those with substantial impacts on society and/or medicine. These are frequently fatal or necessitate surgical correction. Common significant abnormalities include neural tube anomalies such as meningomyelocele and orofacial clefts. They are seen in 2-4% of the population, depending on the population examined. While minor malformations are cosmetic. They seldom have a major medical impact or require surgery. They are a portion of the normal variance found in the overall population. A few examples of minor deformities are single transverse palmar creases, ear tags, and clinodactyly. (22,23)

Imaging, laboratory testing, and clinical examination are used to diagnose congenital abnormalities. A comprehensive physical assessment must be carried out. Measurements of particular bodily parts, such as arm span and lower/upper segment, are frequently taken in children in addition to normal measurements of weight, length, and head circumference. These measurements are done to assess certain illnesses, such as skeletal dysplasia and connective tissue disorders. (22,23)

Moreover, the placenta and umbilical cord in neonates and fetuses should also be checked, since congenital cardiac abnormalities are linked to a two-vessel cord, and a damaged placenta (chromosomal mosaicism in the placenta, vascular abnormalities such as thrombi or infarction) that interferes with growth might cause intrauterine growth retardation. In some cases, examining family members could help determine whether any anomalies exist. The infant with holoprosencephaly is one instance. A single incisor or hypotelorism in one of the parents could be a modest sign of the same condition, which may have gone unnoticed on earlier exams. (22,23)

The clinical presentation also guides laboratory studies. Initially, the presence of chromosomal abnormalities is investigated, and genetic testing is performed (for both the newborn affected and the parents) as the primary focus for the majority of newborns with birth defects. Furthermore, additional testing may be conducted to determine the presence of specific infectious agents, including TORCH (Toxoplasmosis, Other, Rubella, Cytomegalovirus, and Herpes virus), as well as maternal autoimmune disorders. (22,23)

A variety of imaging investigations, such as brain computed tomography (CT) and magnetic resonance imaging (MRI) scans, echocardiograms, and relevant radiography, should be carried out to help uncover abnormalities that are not readily noticed through physical examination. Postmortem pathology examinations are essential for making a diagnosis and offering suitable counseling in the event of stillbirths.(22)

Thus, understanding the patterns and associated factors of CAs is crucial for effective prevention, management, and intervention strategies. This literature review aims to provide a comprehensive overview of the most updated and highest-quality research on the patterns and associated factors of CAs among newborns. (22,23)

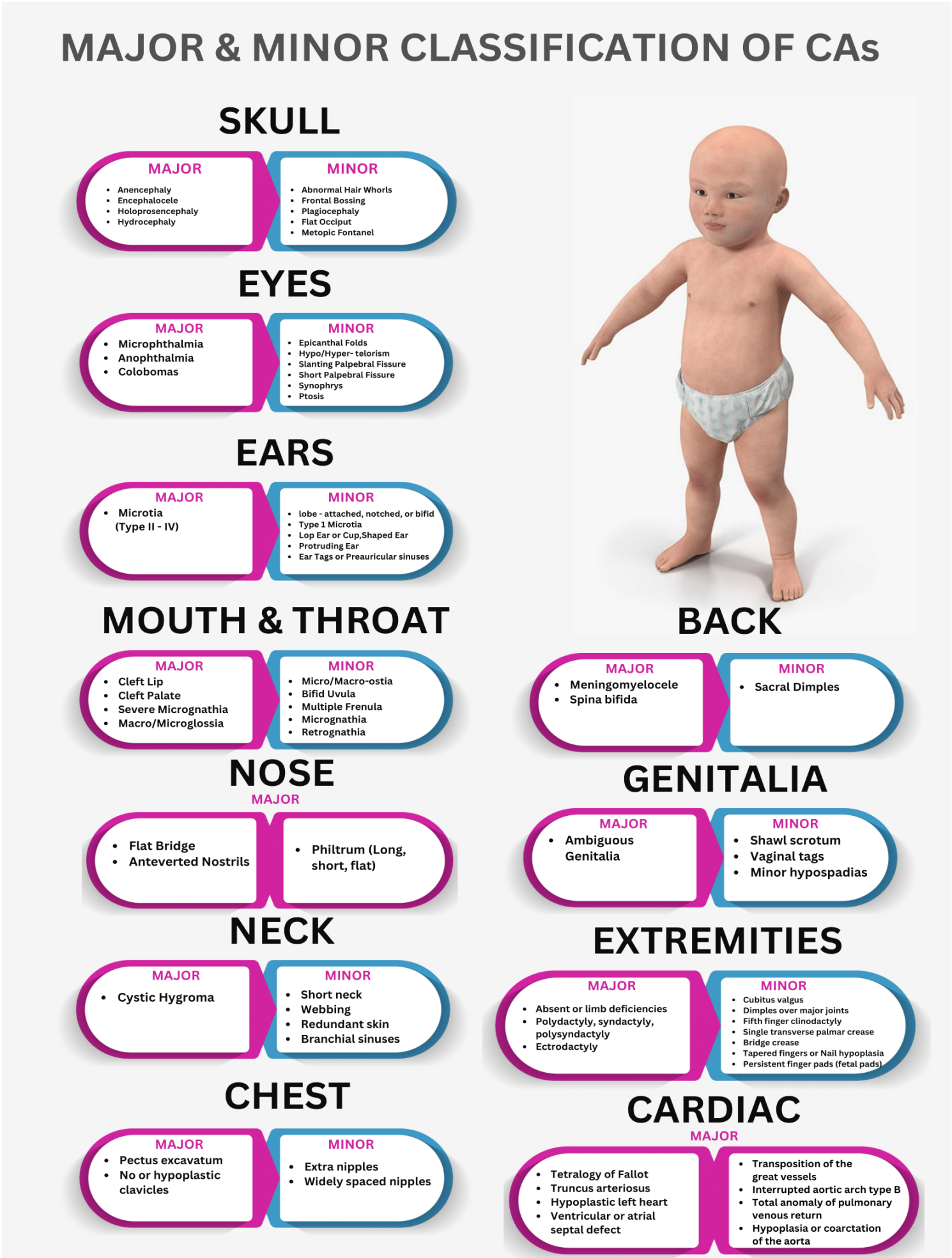


Figure 2. 3: Classification of CAs. Source: Adapted from the CDC and Uptodate (2023).

2.2 Review of Related Studies

Numerous studies have looked into the patterns and prevalence of CAs in various demographics and geographical areas. Among the various types of CAs, musculoskeletal anomalies, cardiovascular anomalies, neural tube defects, cleft lip and palate, and chromosomal abnormalities are the most prevalent. It is worth noting that the number of these birth abnormalities has tripled over the past thirty years. Additionally, Arabs in the Gulf region are more likely to have major congenital defects, which vary in rate and pattern among regions and have multiple etiologies and risk factors. (28)

A study conducted in Yemen by Ba-Saddik, Makki, and Aklan (2008) from January 2000 to December 2007 in Aden city, aimed to investigate the prevalence of major CAs. Their findings revealed that the most common major CAs were related to the digestive system (33.8%), followed by the circulatory system (21.7%), central nervous system (14.2%), urogenital system (10.5%), and musculoskeletal system (7.1%). Furthermore, the study indicated a higher prevalence of major CAs among males compared to females, with a male-to-female ratio of 2:1. (28)

In the United Kingdom, a multiethnic cohort study was conducted in Bradford from 2007 to 2011 to assess the incidence and risk factors for CA. It was found that the risk of CAs was nearly twice as high for mothers of Pakistani origin compared to those of white British origin. Consanguinity, or the marriage between first cousins, was identified as a major risk factor, associated with a doubling of risk for CAs. The same result was noted for mothers of white British origin older than 34 years. Consanguinity was a common practice among the Pakistani community, with (37%) of babies of Pakistani origin being the offspring of first-cousin unions. Maternal education to degree level was found to be protective, reducing the risk of CAs irrespective of ethnic origin.(31)

In Iraq, Zhraa Abd and Alkader Taboo conducted a study from January 2009 to December 2010 in Al-Mousel City to investigate the prevalence and risk factors of CAs. They found that the prevalence of CAs was (0.69%). Additionally, the most common anomalies were related to the central nervous system, and the majority of cases were seen in primigravida women, particularly those between the ages of 20-24. Consanguineous marriage was identified as a significant associated risk factor. (32)

In Egypt, Marwa Shawky, Mohammed Abdou, Aida Ali, Reda Sherif, Iman Helmy, and Khaled Saad El Din Ashour, conducted a study between 2010 and 2015 to estimate the frequency, describe the types, and identify the possible risk factors of CAs among infants attending a pediatric university hospital in Alexandria, Egypt. The study found that the most common types of CAs varied across different years. The study identified CAs of the digestive system (38.0%), musculoskeletal system (32.9%), and circulatory system (11.0%) were the most common types of CAs. Males were more affected by CAs than females (63% versus 37%). The major risk factors for CAs were old-aged parents, unprescribed medications and large vitamin A dosage intake during pregnancy, exposure to chemicals and pesticides during pregnancy, complications during pregnancy, and living near mobile strengthening stations. (33)

Furthermore, a descriptive study conducted at the 'Les Orangers' Maternity and Reproductive Health Hospital in Rabat, researchers collected data on congenital malformations diagnosed between January 1st, 2011, and June 31st, 2016. A total of 245 cases of congenital malformations were registered out of 43,923 recorded births, yielding a prevalence of 5.58 per thousand, and (19.2%) of these cases involved fetal deaths in utero (FDIU). The study found a poly malformation syndrome in (26.5%) of the cases, resulting in 470 anomalies. Musculoskeletal anomalies were the most prevalent (33%), followed by neurological abnormalities (18%), which included hydrocephalus (31%), anencephaly (26.2%), and spina bifida (20.24%). Eye, ear, face, and neck malformations were reported in (12%) of cases, while genetic abnormalities were detected in (8.5%), with Down Syndrome accounting for (87.5%). Antenatal diagnosis of congenital malformations was established in (28.6%) of cases. (34)

A similar hospital-based Egyptian study was conducted at Al-Zagazig Hospital in February 2013 by Mohamed A. El Koumi,1 Ehab A. Al Banna,1 Ibrahim Lebda. The study included all babies born in the obstetrics department over one year and it was found that the overall incidence of CAs among live-born neonates was (2.5%), with musculoskeletal and central nervous systems being the most commonly affected systems. (35)

Another cross-sectional study at the Khyber Teaching Hospital in Peshawar, patient records were analyzed from January to June 2014. In 1062 deliveries, 2.9% (31) of newborns had CAs. Significant anomalies included hydrocephalus (22.6%), anencephaly (12.9%), and spina bifida (9.7%). Maternal ages varied from

18 to 46 years. The majority of anomalies (35.5%) occurred among people aged 26 to 30. Of the 31 infants, 6.4% had multiple anomalies. CAs were more common in parity 1 (35.4%), while parities 2–4 had lower incidences (35.4%). The consanguinity rate was 67.7%, with only 32.3% of patients taking folic acid. Passive smoking history was found to be positive in 16.1% of cases.(36)

A study was conducted by Farid AW Ghrayeb in Palestine in 2014 to also investigate the impact of consanguineous marriage on offspring congenital malformations. The study found that the prevalence rate of consanguineous marriages was 61%, with first-cousin marriages accounting for 34.8% of all marriages. The genitourinary system was the most frequently affected in 17.4% of the 305 consanguineous married parents and 15.2% of the 105 non-consanguineous married parents. The gastrointestinal system defects were the second most frequent anatomical abnormalities, occurring in 6.2% of the 305 consanguineous married parents and 13.3% of the 105 non-consanguineous married parents. (37)

In a similar vein, a study conducted in the United Arab Emirates by Gazala A. Khan and Ayah Ziyada in 2018 delved deeper into the impact of consanguinity and its effects on non-communicable genetic diseases. It was found that 65% of marriages are consanguineous, harmed reproductive health factors, and posed a risk for the occurrence of non-communicable genetic diseases, congenital malformations, and various chronic and complex multifactorial diseases. (38)

In another retrospective cross-sectional study in Nigeria, in which a review of the records of all neonates admitted in the neonatal unit of the Bowen University Teaching Hospital, Ogbomoso over five years (January 2012–December 2016) was undertaken. It aimed to determine the occurrence rate, patterns, and associated factors of CAs. CAs were identified in 67 of 1057 newborn admissions, for a 6.3% incidence rate. The most common anomalies were those affecting the cardiovascular and digestive systems. A larger number of neonates referred from other facilities had CA, which was statistically significant. However, no significant connections with low birth weight, sex, maternal age, or parity were found. The death rate for newborns with CA was 10.4%, although they were associated with a lower risk of newborn mortality compared to those with other acute illnesses, the difference was not statistically significant.(39)

Another study performed in Yemen by Fawaz Mohammed et al conducted a four-year study from 2013-2014 before the war to 2016-2017 during the war. The study examined the impact of the war on CAs at Al-Thawrah Hospital in Sana'a. The findings revealed that the incidence rate of CAs doubled after 3 years of the war, increasing from 27.46 to 47.78 per 10,000 births. The noteworthy point in this study was that the genitourinary system replaced the central nervous system as the most affected system. (27)

A cross-sectional Iraqi study in Baghdad was conducted on the risk factors of CAs in neonates in the Neonatal Intensive Care Unit (NICU) between November 2014, and the first of May 2015. The study found that (60%) of the neonates were boys and (48.3%) of them were premature. Systematic bodily abnormalities were detected in the gastrointestinal (30%), cardiovascular (26.7%), and central nervous systems (23.3%). It was also found that (66.7%) of mothers were over 34 years old, had a BMI of 30 or higher, did not take folic acid, self-medicated, had consanguineous marriages, had a positive family history, suffered from hypertension, were anemic, lived near mobile stations, and had a low socioeconomic status. (40)

A hospital-based case-control study was conducted at a fetal medicine service in Brazil from October 2014 to February 2016 to estimate the frequency of CAs. The most common CAs were those of the central nervous system, followed by the genitourinary system, and finally multiple abnormalities. Previous children with CA, family history, and consanguinity among the parents were all potential maternal risk factors for structural CAs. (41)

Another case-control study conducted in Iraq aimed to identify the patterns and associated factors of the CAs among neonates at the Maternity Teaching Hospital, Erbil City between April 2015 and March 2016. The central nervous system (37.7%) compromised the highest percentage of CAs, followed by the musculoskeletal (23.1%) and gastrointestinal systems (20.8%). There was a statistically significant association between having a child with CAs and a maternal history of previous CAs, parental consanguinity, and medical disorder history. (42)

Furthermore, a retrospective study in Sub-Saharan Africa in 2017 was conducted on the prevalence of CAs and the association between maternal risk factors and birth defects in rural populations in south-eastern Gabon. Two populations were targeted: 3500 births in Koula-Moutou (a rural area) and 4212 births in

Franceville (a semi-rural area) in Gabon. The prevalence of CAs increased from rural to urban areas ($P < 0.001$). Maternal risk factors, including age over 35, multiparity, and employment status, were significantly associated with stillbirth rates. (43)

Researchers in southwest Ethiopia conducted a case-control study to identify risk variables related to congenital abnormalities in neonates. Between May 2016 and May 2018, neonates and their mothers from six hospitals that were specifically chosen were included in the study. The findings showed a strong correlation between congenital defects and risk factors, including using unknown medications during the first three months of pregnancy, being around pesticides, smoking passively, depending on surface water for drinking, and not taking folic acid supplements in the early stages of pregnancy. The aforementioned results underscore the significance of community health education in mitigating and preventing predisposing risk factors. (44)

Another retrospective cross-sectional study conducted in Yemen at Al-Thawra Modern General Hospital by Thabet SA et al (2017), found that one in ten neonates suffered from CAs. The majority of CAs identified were isolated (74.4%), whereas (25.6%) were multiple. The most common CAs were those of the gastrointestinal tract (43.9%), followed by the central nervous system (CNS) (18.9%), and musculoskeletal system (17.1%). Furthermore, more than half of neonates with CAs died, and 35.4% were discharged from the hospital without their CAs being corrected. (45)

Similarly, in a cohort study conducted at a Tertiary care center in Saudi Arabia in 2019, researchers enrolled Saudi women during pregnancy for three years, resulting in 28,646 eligible pregnancy outcomes (including births, stillbirths, and elective terminations for fetal anomalies). The birth prevalence of CAs was 412 per 10,000 births, with 1179 cases and 1262 unaffected controls included. Major anomalies included congenital heart disease (148 per 10,000), renal malformations (113), neural tube defects (19), and chromosomal abnormalities (27). Diabetes (7.3%), maternal age over 40 years (7.0%), and consanguinity (54.5%) were among the modifiable risks. The mortality rate for live births with CAs at two years of age was 15.8%. (46)

Another study conducted at the Special Care Baby Unit at Cape Coast Teaching Hospital in Ghana, a retrospective study covering the period from January 2010 to December 2019 was carried out. The

objective of the research was to examine the frequency, trends, and consequences of congenital defects in infants admitted to hospitals. 236 neonates with CAs were admitted to the facility, accounting for 8.6 births per 1000 and 2.8% of all neonatal admissions. Thirty-two percent of infants with congenital defects died, making up four percent of total neonatal mortality. The place of delivery and gravidity greater than five were factors that were strongly linked to death. The most common anomalies affected the central nervous system, particularly neural tube defects, followed by suspected chromosomal abnormalities and cardiac defects. Neonates with cardiac anomalies faced a higher risk of mortality. (3)

Additionally, a case-control study in Mysore, South India was conducted at the Department of Obstetrics and Gynecology at JSS Hospital. Data was analyzed from 47 mothers who had given birth to anomalous fetuses to determine the patterns and maternal risk factors of CAs. It was found that the most significant maternal risk factors were history of previous abortions (27.7%), consanguinity (10.6%), Rh-negative pregnancy (6.4%) and anomalous uterus (6.4%). However, the most prevalent CAs were mostly the central nervous system (74.5%), musculoskeletal system (29.8%) and cardiovascular system (12.6%). (47)

Furthermore, a descriptive cross-sectional study in Nawabasha, Pakistan, aimed to assess the frequency, risk factors, and pattern of congenital abnormalities of 300 neonates admitted to the NICU in a tertiary care hospital over six months from January to July 2020. The study found that neonates were born at an average age of 10.5±7.4 days and weighed 2.89±0.74 kg. Among the neonates, 174 (58.0%) were male and 126 (42.0%) were female, yielding a male-to-female ratio of 1.4 to 1. Furthermore, 77 (25.7%) newborns were classed as low birth weight. 35 (11.7%) newborns had birth defects, three of which had multiple anomalies. The incidence of birth abnormalities was considerably greater among women who did not take folic acid during pregnancy (14.8% vs. 5.2%) and in situations of cousin marriage (16.6% vs. 2.8%).(48)

Most recently, a study was conducted at Manipal Teaching Hospital by Basnet et al (2021) to determine the types of CAs among neonates and their immediate outcomes. During the study period, 24 out of 2515 live births had CAs, resulting in a rate of 9.42 per 1000 live births annually. In 79.2% of cases, only one system was involved, while 5.8% had multiple involvements. Of these, 54.2% were discharged, 33.3% died, 8.3% left without medical advice, and 4.2% were referred out. (49)

Figure 2. 4: Anencephaly. Source: Yemeni Ministry of Health and Population. (2023)

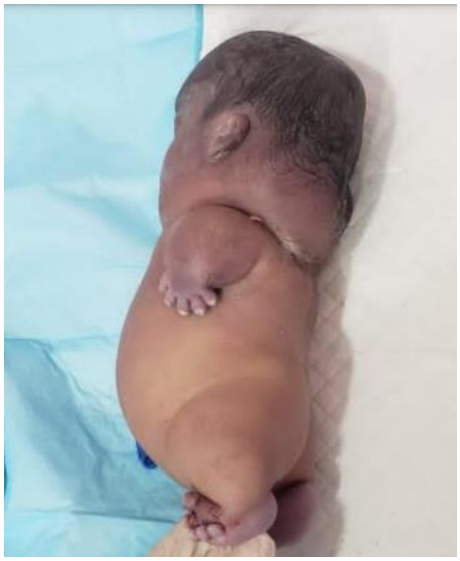


Figure 2. 5: Phocomelia. Source: Yemeni Ministry of Health and Population. (2023)

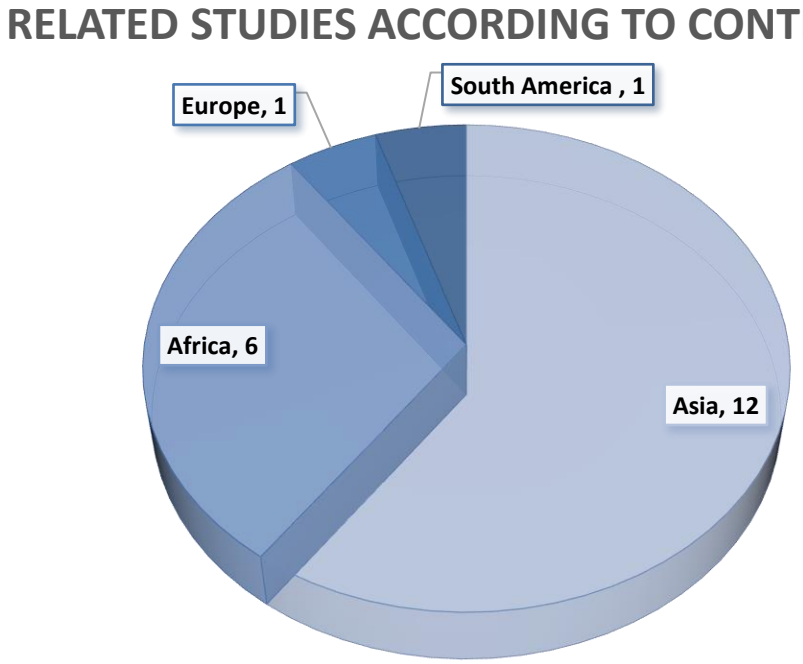


Figure 2. 6: Related Studies According to Continent.

CHAPTER 3: MATERIALS & METHODOLOGY

3.1 Study Design

The presented study was a 1:2 Case-Control Study.

3.2 Study Area

The study was carried out by reviewing the clinical files and hospital records of neonates diagnosed with CAs among various hospitals and health centers in 14 Yemeni governorates, namely: Hajjah, Al-Mahwit, Rad'a, Sa'dah, Raymah, Amran, Dhamar, Marib, Ibb, Taiz, Al-Hudaydah, Sana'a, Sana'a City, and Al-Dhalae.

3.3 Study Period:

The study was carried out from the 1st of October, 2023 till 1st of March, 2024.

3.4 Study population:

The case group was defined as all neonates diagnosed with CAs in their respective and aforementioned governorates from 2021-2023, whereas the control group was defined as healthy neonates of the same maternal and fetal socioeconomic demographics.

3.5 Sample Technique

Out of the 800 cases of all the cases CAs available from health facilities in the 14 Yemeni governorates, 612 cases were selected due to their complete documentation and absence of missing variables to study the patterns of CAs. To identify the associated factors, 1224 controls were matched by age, sex and governorate from the same health facilities.

3.5.1 Inclusion Criteria

- **For Cases:**

All neonates with a documented diagnosis of CAs between 2021-2023 in any of the hospitals and health facilities in the aforementioned 14 Yemeni governorates.

- **For Controls:**

All neonates not diagnosed with CAs between 2021-2023 in any of the hospitals and health facilities in the aforementioned 14 governorates, with their age, sex and governorate matched.

3.5.2 Exclusion Criteria

Hospital records of neonates with missing data variables and no way of contacting their families to complete their data.

3.6 Data Collection

The data was collected using pre-made online Google Sheets for recording information obtained from patients' documents in the archives of the hospitals and facilities. All the study procedures were conducted at convenient access, green-lit, and aided by the centers' employees. The procedures were regularly evaluated by the team's supervisor for quality assurance. Data was then classified according to the 11th version of the International Classification of Diseases (ICD-11). Finally, data was digitized and analyzed using Epi info version 7.2. Bivariate and multivariate Logistical regression was used to identify factors associated with CAs ($p<0.001$), in addition to T-test, and chi-square.

3.7 Ethical Consideration

The present study obtained ethical approval from Emirates International University and the Yemeni Ministry of Health and Population to gain access to all hospitals and health centers' management, staff, and archives. They were informed that participation is voluntary and that they can refuse this without stating any reason. Feedback about the results of the study was given to the participants and contributors at the end of the study. (Appendix 1)

CHAPTER 4: RESULTS

4.1 Patterns of Congenital Anomalies

In the present study, the patterns of CAs were analyzed within a 1:2 ratio case-control framework. The study population included 612 cases and 1,224 controls.

4.4.1 Distribution According to Governorates

The majority of the 612 cases were located in Al-Hudaydah (34%), Ibb (17.2%), and Sana'a (13.1%). Whereas Sa'dah (1%), Marib (0.5%), and Raymah (0.5%) had low rates of CAs. (Figure 4.1) (Table 4.1)

.

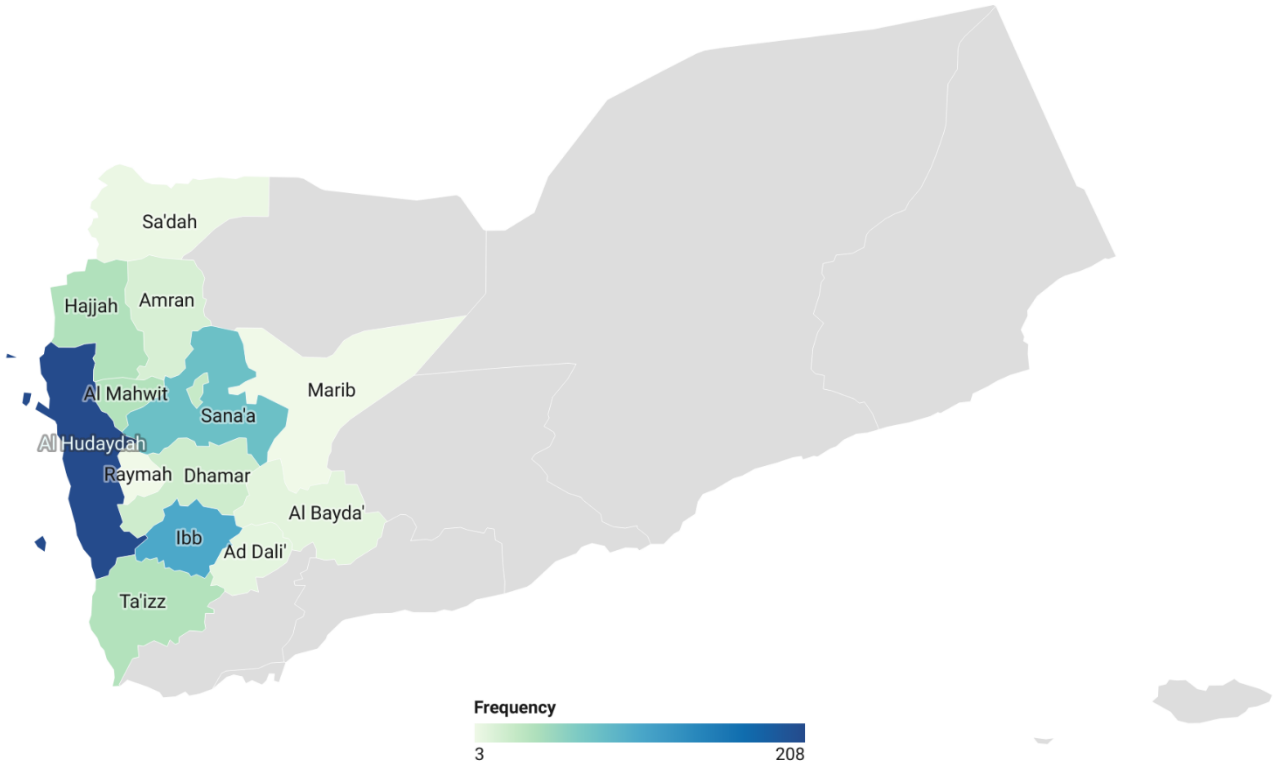


Figure 4. 1: Distribution of CAs Among Governorates.

Table 4. 1: Distribution of CAs According to Governorates.

Governorate	No of Cases	%
Al-Hudaydah	208	34.0%
Ibb	105	17.2%
Sana’a	80	13.1%
Hajjah	40	6.5%
Al-Mahwit	39	6.4%
Taiz	39	6.4%
Sana’a City	27	4.4%
Dhamar	23	3.8%
Amran	18	2.9%
Al-Bayda	11	1.8%
Al-Dhalae	10	1.6%
Sa'dah	6	1.0%
Marib	3	0.5%
Raymah	3	0.5%
Total	612	100.0%

4.1.2 Distribution According to Body System

The majority of the CAs were identified as isolated 518 (84.64%), whereas 94 (15.36%) were multiple—two or more anomalies on a single case involving two or more systems. The highest proportion of CAs were those of the nervous system (208, 33.9%), followed by the skeletal system (88, 14.8%) and oro-facial anomalies (65, 10.6%). Further details of the distribution of CAs are shown in Figure (4.2).

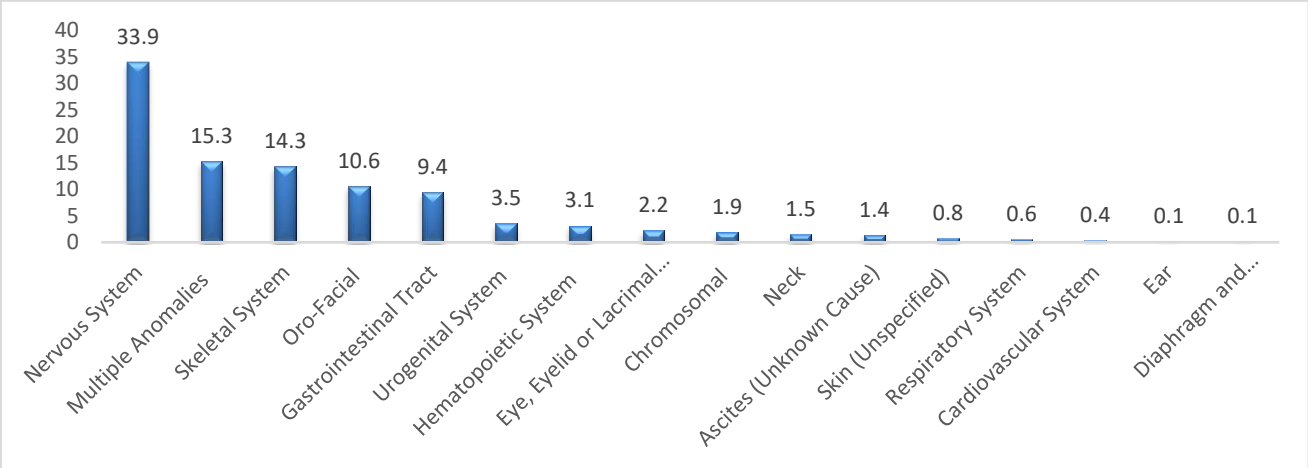


Figure 4. 2: Distribution of CAs According to Body Systems.

The most common nervous system anomalies were hydrocephalus (13.8%) and anencephaly (13.0%), followed by spina bifida (2.7%). The most common skeletal anomalies were unspecified limb anomalies (6%), amelia (4.2%), and club foot (2.4%). While the most common oro-facial anomalies were cleft lip (7.8%) and cleft lip and Palate (1.4%). Further details are shown in Table (4.2).

Table 4. 2: Distribution of CAs According to ICD-11.

Body System	ICD -11 Code	Anomaly	No	%
Nervous System	LA04	Congenital Hydrocephalus	85	13.8
	LA00	Anencephaly	80	13
	LA02	Spina Bifida	17	2.7
	LA01	Encephalocele	11	1.7
	LA0Y	Unspecified	10	1.6
	LA05.0	Microcephaly	3	0.4
	LA03	Arnol-Chiari Malformation	2	0.3
Multiple Anomalies	LD2Z	Unspecified	94	15.3
Skeletal System	LB9Z	Limbs Anomalies	37	6.0
	LB9A.0-LB99.0	Amelia	26	4.2
	LB98.00-LB98.22	Club foot	15	2.4
	LB78	Polydactyly	6	0.9
	LB79	Syndactyly	4	0.6
Oro-Facial Anomalies	LA40	Cleft Lip	48	7.8
	LA4Y	Cleft Lip and Palate	9	1.4
	LA5Z	Facial Anomalies	6	0.9
	LA42	Cleft Palate	2	0.3
Gastrointestinal Tract Anomalies	LB15.Z-LB16.Z	Intestinal CAs	17	2.7
	LB01	Omphalocele	16	2.6
	LB02	Gastroschisis	10	1.6
	LB17.0	Imperforated Anus	5	0.8
	DB50.2	Congenital Anorectal Fistula	3	0.4
	LB16.0	Intestinal Atresia	3	0.4
	LB16.1	Hirschsprung's Disease	2	0.3
	LB12.1	Esophageal Atresia	2	0.3

Body System	ICD -11 Code	Anomaly	No	%
Urogenital System	LB5Z	Genital Anomalies (Male)	12	1.9%
	LB31.0	Hydronephrosis	6	0.9%
	LB4Z	Genital Anomalies (Female)	3	0.4%
	GB8Y	Polycystic Kidney	1	0.1%
Hematopoietic System	KA85.Z	Hydrops Fetalis	19	3.1
Eye	LA10.1	Anophthalmia	8	1.3%
	9C61	Congenital Glaucoma	3	0.4%
	LA1Z	Unspecified	3	0.4%
Chromosomal Anomalies	LD40.0	Down Syndrome	7	1.1%
	LD40.1	Patau Syndrome	3	0.4%
	LD40.2	Edward Syndrome	2	0.3%
Neck	LA6Z	Neck Anomalies	7	1.1%
	LA60	Webbed neck	2	0.3%
Ascites (Unknown Cause)	ME04.Z		9	1.4
Skin	LC7Z	Unspecified	5	0.8
Respiratory System	KB2B	Lung Immaturity	4	0.6
Circulatory System	LA8Z	Congenital Heart Disease	3	0.4
Ear	LA2Z	Unspecified	1	0.1
Diaphragm and Abdominal Wall	LB00.0	Diaphragmatic Hernia	1	0.1

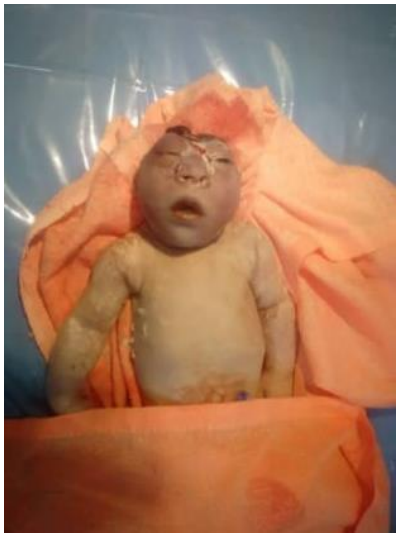


Figure 4. 3: Anencephaly. Source: Yemeni Ministry of Health and Population. (2023)

Figure 4. 3: Gastroschisis. Source: Yemeni Ministry of Health and Population. (2023)

Figure 4. 5: Cleft Lip. Source: Yemeni Ministry of Health and Population. (2023)

Figure 4. 6: Cleft Lip & Palate. Source: Yemeni Ministry of Health and Population. (2023)

Figure 4. 7: Congenital Ascites. Source: Yemeni Ministry of Health and Population. (2023)

Figure 4. 8: Congenital Hydrocephalus. Source: Yemeni Ministry of Health and Population. (2023)

4.2 Maternal Socioeconomic Demographics

The present study reveals a significant statistical association between maternal age, positive consanguinity, positive family history, parity, socioeconomic class, and CAs. Older mothers (≥35 years) and neonates born to parents with positive consanguinity are more likely to develop CAs. Positive family history, grand-multipara mothers (≥5 births), and low socioeconomic class are also associated with a higher occurrence of CAs. All associations were statistically significant ($p < 0.0001$). While mothers aged 20-<35 years old and those <20 years old, those of high socioeconomic class, and nulliparous or multiparous women are associated with a lower risk. Further details are shown in Table 4.3.

Table 4. 3: Maternal Socioeconomic Demographics and CAs.

Variable	Category	Studied Group *(n=612)*		Controlled Group *(n=1224)*		OR	99% CI		P-Value
		No	%	No	%		Lower	Upper	
Maternal Age	**Mean**	29.7 ±68							
	<20	22	3.5	48	3.9	2.315	1.365	3.925	<0.0013
	20-<35 *(Ref)*	192	31.3	970	79.2				
	≥35	398	65	206	16.8	9.760	7.766	12.268	<0.001
Consanguinity	**Yes**	385	62.9	60	4.9	32.903	24.206	44.725	<0.001
	No	227	37	1164	95.1				
Family History	**Yes**	169	27.6	100	8.1	4.287	3.271	5.620	<0.001
	No	443	72.3	1124	91.8				
Socioeconomic Class	**Low**	496	81	400	32.6	26.412	13.819	50.478	<0.001
	Middle	106	17.3	611	49.9	3.695	1.896	7.198	<0.001
	High *(Ref)*	10	1.6	213	17.4				
Parity	**Nullipara** *(Ref)*	61	9.9	161	13.1				
	Multipara	280	45.7	859	70.1	0.860	0.622	1.189	0.3625
	Grandpara	271	44.2	204	16.6	3.506	2.480	4.956	<0.001

4.4 Neonatal Socioeconomic Demographics

In the analysis of neonatal demographics (Table 4.4), the study indicates a significant association between gestational age, gender, birth weight, and CAs. Preterm (<37 weeks) and low-birth weight neonates (<2500g), and males are associated with a higher risk of CAs. Additionally, neonates with CAs have a higher risk of stillbirth and a lower survival rate at birth. Conversely, neonates born between 37 and 42 weeks, post-term neonates (≥42 weeks), those with a birth weight of ≥2500g, and female neonates are associated with a lower risk.

Table 4. 4: Neonatal Socioeconomic Demographics.

Variable	Category	Studied Group *(n=612)*		Controlled Group *(n=1224)*		OR	99.9 % CI		P-Value
		Number	%	Number	%		Lower	Upper	
Gestatioal Age	Mean ± (SD)	36.16 ± 4.37							
	<37 weeks	373	60.9	356	29	4.405	2.245	8.639	<0.001
	37-42 weeks	217	35.5	724	59.1	1.253	0.638	2.461	0.51120
	≥42 weeks *(Reference)*	22	3.6	144	11.6				
Sex	Male	478	78.1	525	42.8	4.749	3.801	5.933	<0.001
	Female	134	21.9	699	57.1				
Weight	Mean ± (SD)	2854.20 ±555							
	<2,500g	238	38.9	112	9.1	7.331	5.090	10.557	<0.001
	2,500-<3,500g	314	51.3	905	73.9	1.197	0.873	1.648	0.2623
	≥3,500g *(Reference)*	60	9.8	207	16.9				
Outcome	Alive	321	52.4	1199	97.9	0.02	0.015	0.035	<0.001
	Stillbirth	291	47.5	25	2.04				

4.5 Associated Factors of Congenital Anomalies

According to the multivariable analysis, we identified associations between multiple maternal variables during pregnancy and the development of CAs. Acute diseases (OR=2.48 CI=1.648-3.742), chronic diseases (OR=3.69 CI=2.065-6.761), drug intake (OR=2.68 CI=2.063-3.485), stress (OR=6.20 CI=4.202-9.319), and proximity to rocket attacks (OR=4.48 CI=3.078-6.607) all showed highly significant statistical associations with the development of anomalies (Table 4.5). Finally, other factors demonstrated a significant correlation; but, due to a lack of specific information and definitions for these categories in hospital records, we were unable to conduct a full analysis. The term "Others" was rarely elaborated on in the records. Thus, any inferences formed from this group should be handled with caution.

Table 4. 5: Associated Factors of CAs.

Variable		Studied Group (n=612)		Controlled Group (n=612)		OR	99.9% CI		P-Value
		No	%	No	%		Lower	Upper	
Acute Disease	Yes	53	8.6	45	3.6	2.484	1.648	3.742	<0.001
	No	559	91.3	1179	96.3				
Chronic Disease	Yes	32	5.2	18	1.4	3.696	2.057	6.641	<0.001
	No	580	94.7	1206	98.5				
Drugs	Yes	145	23.6	127	10.3	2.682	2.064	3.484	<0.001
	No	467	76.3	1097	89.6				
Vaginal Bleeding	Yes	40	6.5	36	2.9	2.301	1.455	3.659	<0.001
	No	572	93.5	1188	97.1				
Stress	Yes	97	15.8	36	2.9	6.215	4.182	9.237	<0.001
	No	515	84.1	1188	97.0				
Proximity to Rocket Attacks	Yes	86	14.0	43	3.5	4.490	3.070	6.567	<0.001
	No	526	85.95	1181	96.4				
Others	Yes	184	30.0	29	2.3	17.715	11.793	26.609	<0.001
	No	428	69.9	1195	97.6				

4.6 Logistical Regression with Factors Associated with Congenital Anomalies

Multivariate logistic regression analysis was conducted for 13 variables, namely acute disease, chronic disease, consanguinity, stress, vaginal bleeding, drugs, gestational age, maternal age, parity, fetal weight, sex, family history, and socioeconomic class. Ten variables were identified that significantly affecting (Table 4.6) the occurrence of CAs: acute diseases (OR=2.759), consanguinity (27.637), stress (OR=4.456),

gestational age (OR= 1.630), maternal age (OR=8.264), parity (OR=0.599), weight (OR=4.675), sex (OR= 0.1034), family history (OR=1.955), and socioeconomic class (OR=11.427).

Table 4. 6: Logistic Regression of Variables.

Term	OR	95%	C.I	Coefficient	S.E	Z-Statistic	P-Value
Consanguinity (Yes/No)	27.6374	17.6873	43.1851	3.3192	0.2277	14.5756	0.0000
Socioeconomic Class	11.4274	7.6868	16.9883	2.4360	0.2023	12.0414	0.0000
Maternal Age	8.2641	5.4053	12.6349	2.1119	0.2166	9.7501	0.0000
Weight	4.6750	2.8058	7.7895	1.5422	0.2605	5.9205	0.0000
Stress	4.4560	2.2816	8.7023	1.4942	0.3415	4.3754	0.0000
Acute Disease (Yes/No)	2.759	1.2361	6.1579	1.0149	0.4096	2.4775	0.0132
Family History	1.9555	1.2018	3.1821	0.6707	0.2484	2.6998	0.0069
Gestational Age	1.6306	1.0668	2.4923	0.4889	0.2165	2.2578	0.0239
Parity	0.5992	0.3813	0.9416	-0.5121	0.2306	-2.2207	0.0264
Sex	0.1034	0.0693	0.1543	-2.2688	0.2041	-11.1183	0.0000

4.7 Associated versus Protective Factors

Table 4. 7: Comparison Between Associated and Protective Factors.

Associated Factors		Protective Factors
⩾ 35 y	Maternal Age	20- <35y and <20y
Yes	Consanguinity	No
Yes	Family History	No
Low	Socioeconomic Class	High
Grandmultipara	Parity	Nullipara
♂	Sex	♀
<37 weeks	Gestational Age	37 - ⩾42 weeks
<2500g	Weight	2500 - ⩾3500
Stillbirth	Outcome	Alive
Yes	Acute Diseases	No
Yes	Chronic Diseases	No
Yes	Drugs	No
Yes	Rocket Attacks Prox.	No
Yes	Vaginal Bleeding	No
Yes	Stress	No

CHAPTER 5: DISCUSSION

CAs pose a significant burden, influencing neonates' health, mortality, and morbidity while also imposing financial and psychological strain on their parents. In Yemen, where the frequency of these abnormalities is increasing, our study highlights its singularity as one of the few studies to identify their patterns and potential associated factors. The study's findings are designed to help policymakers and decision-makers develop targeted preventative measures and enhance health education.
This section delves into our study's primary findings, comparing them to previous research to highlight their implications.

5.1 Patterns of Congenital Anomalies

In our study, the majority of the CAs detected were isolated, and a minority being multiple. The central nervous system had the highest proportion of CAs followed by the musculoskeletal system and oro-facial abnormalities. These findings align with studies from South India (50), Bangladesh (51), Ethiopia (52), Egypt (35), and Iraq (42), which also found that the central nervous system and the musculoskeletal systems were the most predominant. Similarly, the Brazilian study showed a predominance of the central nervous system and multiple anomalies.

On the contrary, a retrospective analytic study conducted in Aden, Yemen (53) shows the digestive system, the cardiovascular system, and urogenital system as the most predominant alongside the central nervous and musculoskeletal systems. This falls in line with other studies in Nigeria (54) and Saudi Arabia (55). This discrepancy could be attributed to the fact that anomalies involving the digestive, cardiovascular, and urogenital systems were present in conjugation with other anomalies, classifying them as multiple anomalies in our study. Furthermore, in this study, only a minority of neonates were diagnosed with cardiac anomalies when further specialized investigations, such as echocardiography, were warranted after clinical examination, and the majority were referred to specialized cardiac centers for documented diagnosis. This highlights the need for more thorough diagnostic procedures in neonatal care and comprehensive documentation follow-up for neonates referred to specialized centers.

5.2 Maternal Socioeconomic Demographics

In terms of maternal demographics, the current study found a strong statistical relationship between mothers ≥35 years, consanguinity, positive family history, low socioeconomic status, grand parity, and CAs.

5.2.1 Maternal Age

Significant correlations between mothers ≥35 years old and the presence CAs are present in our study, while those under 35 years old (mainly those between 20 and 35 years followed by those <20 years old) were shown to be protective against CAs. Many studies concerning the risk factors of CAs showed associations between increasing maternal age and incidence of CAs (31,56–58). This also aligns with similar studies conducted in Baghdad, Iraq (40) and Alexandria, Egypt (33)where mothers ≥35 were at a higher risk of having CAs.

Moreover, a study conducted in Southeast Iran, in 2009-2019 (59) and a study conducted in Ain Shams University, Cairo, in 1995–2009 (60), and a study conducted in China (2013-2017) (61) also showed a similar significant association. This could be owing to the risk-increasing effect of chromosomal aberrations, which become more common with advanced maternal age. Hollier et al. (62) propose that the accumulation of environmental exposures over time may also increase the risk. On the other hand, our study found that mothers between the age of 20-<35 years were a protective factor against CAs.

Conversely, studies conducted in Mousel, Iraqand Ethiopia (44) found that younger mothers have a higher risk, which were attributed to nuclear waste and the effect of environmental factors, such as teratogenic drug intake during early pregnancy, respectively. Particular attention should be devoted to more frequent discrepancies in maternal age groups. Examining what may be driving each age group's risk-increasing effects will assist find the best preventative approaches. The teratogenic effects associated with mothers becoming pregnant at a young age, as well as the lack of primary prevention options, may largely explain this age group's vulnerability, including smoking and drug intake, lower social status, lower educational attainment, and a lack of adequate folic acid supplementation. (63,64)

5.2.2 Consanguinity

This study found a strong link between consanguinity and the probability of developing new defects. Consanguineous marriages are popular in various parts of the Middle East, Africa, and the Indian subcontinent,(38,55,59,65–71), with one estimate claiming that "one billion people live in communities with a preference for consanguineous marriage" (Hamy, 2012) (66). This predilection has significant societal roots. Nonetheless, education, combined with preconception and premarital counseling, can be effective preventative techniques by raising awareness and enabling couples to make more educated decisions. Consanguinity is a known risk factor for CAs (35,55,67,72–74), as well as Mendelian diseases, such as inborn metabolic errors as established in previous Saudi Arabian and international reports. (75,76)

5.2.3 Family History

Significant correlations were found between positive family history and the risk of developing CAs in single and multiple CAs in our current research. This builds up on previous studies conducted in Bangladesh(69), Iran(59), Pakistan (71), Egypt (35), and Iraq(42). Furthermore, a hospital-based study in Egypt found that the presence of a congenital deformity associated to a chromosomal abnormality, whether live-born or stillborn, increased the chance of chromosomal problems in subsequent pregnancies (35). To further aid this, it was shown that couples who have one child with a neural tube defect but no other family history have a recurrence rate of 2-5%, whereas couples who have one child with Down syndrome have a recurrent risk of 1%. (77)

5.2.4 Socioeconomic Class

In our current study, mothers of low socioeconomic status were at a higher risk of developing CAs, while those of higher class were at a lower risk. This is congruent to the study conducted in Baghdad (78), where Low socioeconomic status affects the health of the mother and the fetus via inadequate nutrition and poor obstetric follow-up. While CAs affect children globally, the burden is evidently higher in developing countries, particularly among the lowest socioeconomic groups (79). Developing countries face various obstacles in combating CAs, including limited access to healthcare facilities, insufficient antenatal care, and environmental variables that contribute to congenital disability. These obstacles are worsened by social and economic inequality in low-income communities, where individuals and families frequently face poverty,

poor education, and a lack of resources (80,81). This multifaceted interplay of factors highlights the grave need for comprehensive interventions to mitigate the incidence of CAs in these vulnerable populations.

5.2.5 Parity

Our study found that grand-multipara mothers were more likely to have children with CAs, while nulliparous women were less likely. This is congruent to a 10-year study conducted using the data from Texas Birth Defects Registry from 1999–2009, which showed that the risk of CAs occurring in a first, third, or fourth or more birth was higher compared to the risk of CAs occurring in the second birth. (82)

Additionally, a hospital- based study in Peshawar, Pakistan (83), and the Addis Ababa study in Ethiopia (84), found that multigravidas were also connected with a higher risk of CAs. This implies that the higher number of parities, the higher the risk of CAs.

Furthermore, increasing parity can increase the risk of CAs through 3 main paths: First, as a woman matures, her chances of having a child with CA rises. This is because a woman's egg quality declines with age, and older eggs are more likely to have chromosomal abnormalities. As a result, women who have given birth multiple times are typically older and hence at a higher risk (32). Second, each pregnancy and childbirth have physical effects on a woman's body that may raise the likelihood of congenital abnormalities in future pregnancies. For example, certain dietary deficits can worsen with each pregnancy, potentially impairing fetal development (39). Third, socioeconomic variables can play a role. Women with several children may have less time and resources to devote to antenatal care, raising the incidence of CAs. (23)

In contrast, a study conducted in Mosul, Iraq (32) found that primigravida are linked to CAs, which was attributed to war waste products and uranium enrichment.

5.3 Neonatal Socioeconomic Demographics

5.2.1 Prematurity and Low-Birth Weight

Our study found that preterm neonates and those with a birth weight of less than 2500g are associated with a higher risk of CAs, while those weighing 2500- ≥3500g are associated with a lower risk. In a similar vein, a study conducted in Baghdad, Iraq, (40) also showed that LBW neonates were born prematurely were at a higher risk of developing CAs. This falls in line with studies conducted in Punjab (85), and Egypt (33) .

5.3.1 Sex

This study found that males are more likely to have CAs than females, while the birth of a female is shown to be a protective factor. This is in agreement with several other case-control studies conducted in Egypt (33), China (86), Pakistan (83), and the United Kingdome (87). On the other hand, a study conducted in California from 1989 to 1997 showed that the sex ratios of various deformity subgroups differed, where females were more likely to have nervous system anomalies (except for spina bifida without hydrocephaly), endocrine system disorders, and congenital hip dislocation. (88,89)This discrepancy could be clarified by genetic studies, in addition to ruling out environmental and biological factors.

5.3.2 Stillbirth

Our study found that newborns with CAs have a higher risk of stillbirth and a lower survival rate at birth. Stillbirth is a likely outcome of serious CAs. This falls in line with a study conducted in Gabon (43). Furthermore, a multicenter study conducted of 59 hospitals in the United States (90), found that of the 465 singleton stillbirths examined, 23.4% had one or more significant abnormalities, compared to 4.3% of the 1871 live births. Having an abnormality increased the likelihood of stillbirth, and an increasing number of anomalies was more strongly related with stillbirth.

5.4 Associated Factors of Congenital Anomalies

5.4.1 Maternal Diseases During Pregnancy

We identified statistically significant associations between Acute diseases and chronic diseases in our study. This is congruent to a cross-sectional design conducted in Indonesia, where maternal infection (22%), maternal diabetes mellitus (4%), and maternal hypertension (4%) increased the likelihood of CAs (91). When compared to women without a history of medical illness, infants born to those mothers are 4.72 times more likely to have congenital defects. Infants are more prone to have CAs, such as congenital heart defects, if their mothers have certain medical disorders or diseases. (92) For example, CAs have been reported in 8-12% of all diabetic pregnancies with the neurological and cardiovascular systems most commonly affected (93) Furthermore, acute infections such as Rubella, TORCH, and Cytomegalovirus have been linked to variable CAs, such as congenital heart disease and neurological defects, and musculoskeletal defects (22) A study conducted in South India (47), found that Toxoplasmosis was a significant factor in pregnant women with CAs in present pregnancy with previous normal pregnancies (OR = 4.45, p = 0.009). The nature of chronic diseases was rarely elaborated on in the records of our study without any means of contacting the families. Specification of the chronic disease and digital storage of patient records would enable further studies to be conducted to identify the types of chronic diseases present in patients. Clinicians can benefit from knowing how chronic conditions and medical therapy during pregnancy affect the chance of significant CAs.

5.4.2 Maternal Drug Intake During Pregnancy

Maternal drug use, particularly during the periconceptional phase, has been linked to an increased risk of CAs. For example, over 25,000 to 50,000 units/day of vitamin A intake during the first trimester of pregnancy has been linked to CAs. Moreover, the ingestion of Macrolides in the 3rd trimester has been linked with genitourinary defects (22). Hence, the timing of drug exposure during pregnancy can have an impact on the likelihood of CAs and may provide a hint to the type of anomaly. As a general rule, exposure to drugs during the first trimester of pregnancy impacts fetal organogenesis. In contrast, usage during the second and third trimesters mostly causes growth and functional abnormalities or deficits in the newborn.

(22). This is in agreement with the Ethiopian study, in which unidentified medicinal usage in the first three months of pregnancy (AOR = 3.435; 99% CI: 2.012–5.863), was a significant risk factor. (44)

5.4.3 Stress

Our study showed that stress was a significant factor associated with CAs. A Population-based case-control in 1987-1989 showed that having at least one stressful incident during the periconceptional period was linked to a prevalence odds ratio of 1.4-1.5 for the birth of infants with conotruncal heart abnormalities, neural tube anomalies, and isolated cleft lip with or without palate. According to this study, women who endure stressful life events around conception or early gestation may be more likely to give birth to infants with certain congenital abnormalities (94). In another study, pregnant women experiencing positive events during pregnancy had a lower risk of CHD in offspring than those without positive events (OR = 0.38, 95%CI: 0.30 ~ 0.48). The risk of CHD in offspring could increase by 62% among the pregnant women experiencing the negative events compared to those without (OR = 1.62, 95%CI: 1.29 ~ 2.03). (95)

5.4.4 Proximity to Rocket Attacks

Proximity to rocket attacks showed a highly significant statistical association with the development of anomalies. Several studies are in agreement with this. CAs were shown to be more common in Baghdad children exposed to war pollutants, which was associated with greater levels of Tungsten and Chromium than in the control group. This research adds to the extensive literature supporting a link between conflict pollution and the emergence of congenital abnormalities in Iraqi cities (78) During a conflict, the ecology is affected, and war pollution increases human metal exposure. Populations in post-war eastern Croatia who resided near intense war activity had higher metal levels than communities farther away from the war. Congenital abnormalities and malignancies are more common during wartime. US wars, particularly in Japan and Vietnam, are among the most well-known causes of congenital abnormalities and cancer in humans (96). Furthermore, another study was carried out from 2017 to 2019 in the north-western war-affected territories of Pakistan to determine the range of CAs. A high incidence of neurological, sensorineural, and limb defects, the preponderance of sporadic cases, and low level of parental consanguinity were found (97). Additionally, the incidence of CHD increased nearly immediately following

the end of the Gulf War in Kuwait. The cause of this surge is yet unclear. Environmental pollution may be an influence, while others, such as psychological stress, are still unknown.

5.4.5 Vaginal Bleeding

Our study found that bleeding during pregnancy was associated with CAs. It is a well-established fact that early gestational bleeding is associated with adverse pregnancy outcomes, including low birth weight, prematurity, growth retardation, perinatal death, and CAs as stated by WHO (98). In agreement with this, is a pivotal prospective study of 3,531 women seeking antenatal care in New York City from 1975-1985. It was found that First-trimester bleeding of any severity was marginally associated with CAs in the offspring (OR = 1.7, 95% Cl 1.0-2.9) (99). Further studies build on this, such as a study conducted in 2022. in which Bleeding in early pregnancy was found to increase the risk of pregnancy complications such as preterm delivery, abortion, antepartum hemorrhage, placenta previa, PPROM, fetal growth restriction, and low birth weight in neonates. (100). A systematic review and meta-analysis of 46 relevant studies, with a sample size of 1,554,141 also found similar results. (101)

5.4.6 Others

The term “Others” was rarely elaborated on in the records, making it difficult to understand what this category encompasses. It could potentially include a wide range of factors not covered by the other categories, such as lifestyle factors as smoking, or even unknown variables that have yet to be identified. Hence, we were unable to conduct a full analysis. Without sufficient data, any statistical analysis or modeling would be incomplete and potentially misleading, and any inferences formed from this group should be handled with caution.

Our study bridged the gap in Yemen regarding CAs and utilized all abundant but fragmented statistics, reports, and records, across 14 Yemeni governorates. Since national referencing published studies were limited to hospitals in a single governorate, this resulted in a limited insight into the patterns and associated factors of these anomalies in a broader more comprehensive scope. Further research is needed to cover southern governorates, and further delve into specific associated factors to determine their causality and

relations to the timing of exposure. Additionally, genetic testing is crucial for early detection of CAs, and understanding their etiology, since a quarter of CAs are caused by genetic defects. This will also help healthcare providers make informed decisions regarding the planning of pregnancy and antenatal care.

CHAPTER 6: CONCLUSION, LIMITATIONS, AND RECOMMENDATIONS

6.1 Conclusion

- CAs pose a significant public health risk due to the rising incidence rate among neonates, in addition to their financial and psychological burdens of diagnosis and treatment.
- This study identified that most of the CAs were located in Al-Hudaydah, followed by Ibb and Sana'a.
- The majority of the CAs identified were isolated, and the most predominant CAs were those of the nervous system (mostly hydrocephalus and anencephaly) and musculoskeletal system (mostly unspecified limb anomalies, amelia, and clubfoot) and Oro-facial anomalies (mostly cleft lip and cleft lip and palate).
- Statistically significant correlations between CAs and mothers >35 years old, positive consanguinity, positive family history, grand-multipara mothers, low socioeconomic class, preterm birth, low birth weight, and male neonates. Additionally, neonates with CAs have a higher risk of stillbirth and a lower survival rate at birth.
- The study also found substantial associations with acute diseases and stress regarding maternal health throughout pregnancy. These findings highlight the diverse characteristics of CAs and the need to evaluate a variety of factors in their development.

6.2 Limitations

- Large sets of data were obtained but the vast majority were excluded due to incomplete documentation, in addition to missing important variables, such as consanguinity, from the Ministry of Health’s Notification of CAs Form. We have updated the form.
- NO specifications on the types of chronic diseases, acute illnesses, drug intake, and other variables mentioned, which limits the ability to conclude the association between some associated factors and CAs.
- The lack of awareness regarding the importance of documentation and notification of CAs.
- The diagnosis of CAs was determined only through clinical examinations, without additional cytogenetic and metabolic analyses due to a lack of resources in health facilities, potentially resulting in some CAs being missed.

6.3 Recommendations

6.3.1 Ministry of Health and Population

- The Ministry of Health's Notification of CAs Form (Appendix 2) must be updated to include important associations mentioned in international literature and guidelines. We have attached the updated form in the appendix. (Appendix 3,4)
- Public and Private health facilities must employ a digital monitoring system to ensure the complete filling of the notification form by assigned personnel and adequate archiving.
- Allocating resources for advanced diagnostic methods in neonatal care, such as cytogenic and metabolic analyses, in addition to genetic screening of high-risk mothers and families to decrease the incidence of CAs.
- Investigate the potential factors associated with the high prevalence of CAs in governorates such as Al-Hudaydah, Ibb, and Sana'a.
- Legally mandate premarital counseling and raise awareness against consanguineous marriage.

6.3.2 Healthcare Providers

- Adequate management and control of acute and chronic diseases during pregnancy by certified medical specialists.
- Provide adequate and optimized antenatal care to pregnant women.
- Promote health awareness and advise against self-prescribed drugs.
- Advise against pregnancy after the age of 35.
- Enhance health literacy regarding having too many pregnancies (grandmultiparity).

6.3.3 Parents

- Abide to antenatal care appointments arranged by healthcare specialists.
- Consultation of healthcare specialists if they encounter any acute disease and avoid self-prescribing drugs.
- Pregnant women must avoid stress.

REFERENCES

1. Shawky RM, Sadik DI. Congenital malformations prevalent among Egyptian children and associated risk factors. Egyptian Journal of Medical Human Genetics. 2011 May 1;12(1):69–78.
2. Christianson RE, van den Berg BJ, Milkovich L, Oechsli FW. Incidence of congenital anomalies among white and black live births with long-term follow-up. Am J Public Health. 1981 Dec;71(12):1333–41.
3. Anane-Fenin B, Opoku DA, Chauke L. Prevalence, Pattern, and Outcome of Congenital Anomalies Admitted to a Neonatal Unit in a Low-Income Country—a Ten-Year Retrospective Study. Matern Child Health J. 2023 May 1;27(5):837–49.
4. Czeizel AE. Birth Defects Are Preventable. Int J Med Sci. 2005;91–2.
5. World Health Organization (WHO). International Statistical Classification of Diseases and Related Health Problems (ICD) [Internet]. 2023 [cited 2024 Jun 23]. Available from: https://www.who.int/standards/classifications/classification-of-diseases
6. O'Leary DS, O'Leary MR. Care of the VIP patient. N Engl J Med. 1989 Apr 13;320(15):1016.
7. Stevenson RE HJEDSBB. Human Malformations and Related Anomalies. Stevenson RE, Hall JG, Everman DB, Solomon BD, editors. Oxford University Press; 2015.
8. Narapureddy BR, Zahrani Y, Alqahtani HEM, Mugaiahgari BKM, Reddy LKV, Mohammed Asif S, et al. Examining the Prevalence of Congenital Anomalies in Newborns: A Cross-Sectional Study at a Tertiary Care Maternity Hospital in Saudi Arabia. Children. 2024 Feb 2;11(2):188.
9. Bhide P, Gund P, Kar A. Prevalence of Congenital Anomalies in an Indian Maternal Cohort: Healthcare, Prevention, and Surveillance Implications. PLoS One. 2016 Nov 10;11(11):e0166408.
10. Rankin J. Prevalence of congenital anomalies in five British regions, 1991-99. Arch Dis Child Fetal Neonatal Ed. 2005 Sep 1;90(5):F374–9.
11. Daliri S, Sayehmiri K, Asadollahi K, Rezaei N, Saroukhani D, Karimi A. Prevalence of congenital anomalies in iran: A systematic review and meta-analysis. Iranian Journal of Neonatology. 2018 Mar 1;9(2):22–32.
12. Clegg JB, Weatherall DJ. Thalassemia and Malaria: New Insights into an Old Problem. Proc Assoc Am Physicians. 1999 Jul 31;111(4):278–82.
13. World Health Organization (WHO). Control of hereditary diseases : report of a WHO scientific group [Internet]. 1996 [cited 2024 Jun 23]. Available from:

https://pubmed.ncbi.nlm.nih.gov/8952444/#:~:text=This%20report%20of%20a%20WHO,cancer%2C%20asthma%2C%20diabetes%20and%20mental

14. Mockenhaupt FP, Ehrhardt S, Gellert S, Otchwemah RN, Dietz E, Anemana SD, et al. α+-thalassemia protects African children from severe malaria. Blood. 2004 Oct 1;104(7):2003–6.

15. Modell B, Kuliev AM. Impact of public health on human genetics. Clin Genet. 1989 Nov;36(5):286–98.

16. Adeboye M, Abdulkadir M, Adegboye O, Saka A, Oladele P, Oladele D, et al. A prospective study of spectrum, risk factors and immediate outcome of congenital anomalies in Bida, North Central Nigeria. Ann Med Health Sci Res. 2016;6(6):380.

17. Birhanu K, Tesfaye W, Berhane M. Congenital Anomalies in Neonates Admitted to a Tertiary Hospital in Southwest Ethiopia: A Cross Sectional Study. Tertiary Hospital in Southwest Ethiopia: A Cross Sectional Study Ethiop J Health Sci [Internet]. 2021;31(6):1155. Available from: http://dx.doi.org/10.4314/ejhs.v31i6.

18. ElAwady H, AlGameel A, Ragab T, Hassan N. Congenital anomalies in neonates in fayoum governorate, Egypt. Eastern Mediterranean Health Journal. 2021 Aug 1;27(8):790–7.

19. Mumpe-Mwanja D, Barlow-Mosha L, Williamson D, Valencia D, Serunjogi R, Kakande A, et al. A hospital-based birth defects surveillance system in Kampala, Uganda. BMC Pregnancy Childbirth. 2019 Dec 22;19(1):372.

20. Wagathu R, Ongeso A. P.O Box 81-20319 South Kinangop 2 PhD in Community Health and Development-Reproductive Health. International Journal of Health Sciences and Research MScN-Midwifery and Obstetric Nursing [Internet]. 2019;9(4):107. Available from: www.ijhsr.org

21. Wilson RD, O'Connor DL. Guideline No. 427: Folic Acid and Multivitamin Supplementation for Prevention of Folic Acid–Sensitive Congenital Anomalies. Journal of Obstetrics and Gynaecology Canada. 2022 Jun;44(6):707-719.e1.

22. Bacino C. UpToDate. 2023 [cited 2024 Jun 7]. Congenital Anomalies: Epidemiology, Types, and Patterns. Available from: https://www.uptodate.com/contents/birth-defects-epidemiology-types-and-patterns

23. World Health Organization. Birth defects Facts Sheet [Internet]. 2023 [cited 2024 Jun 7]. Available from: https://www.who.int/news-room/fact-sheets/detail/birth-defects

24. Yemen National Health and Demographic Survey 2013 Ministry of Public Health and Population and Central Statistical Organization World Bank [Internet]. 2015. Available from: www.papfam.org.

25. Christianson A, Zimmern R, Kristoffersson U, Schmidtke J, Kent A, Raouf R, et al. Health needs assessment for medical genetic services for congenital disorders in middle- and low-income nations. J Community Genet. 2013 Jul;4(3):297–308.

26. Penchaszadeh VB. Preventing Congenital Anomalies in Developing Countries. Public Health Genomics. 2002;5(1):61–9.

27. Abol–Gaith F, Ismail N, Al-Mutawakel A. The Neonatal Congenital Anomalies: Incidence and Risk Factors Before and After the war at Al-Thawrah Hospital- Sana'a,Yemen. Assiut Scientific Nursing Journal. 2019 Dec 1;7(19.1):32–40.

28. Ba-Saddik IA, Makki AT, Aklan IM. Pattern of congenital anomalies among newborns, infants and children in Aden city. University of Aden Journal of Natural and Applied Sciences. 2020 Apr 30;24(1):239–49.

29. Tayebi N, Yazdani K, Naghshin N. The Prevalence of Congenital Malformations and its Correlation with Consanguineous Marriages. Oman Med J. 2010 Jan;25(1).

30. World Bank. Health Sector in Yemen-Policy Note [Internet]. 2021 [cited 2024 Jun 2]. Available from: https://thedocs.worldbank.org/en/doc/8aca65c4db5338cd3a408c0d4a147123-0280012021/original/Yemen-Health-Policy-Note-Sep2021.pdf

31. 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. Lancet. 2013 Oct 19;382(9901):1350–9.

32. Taboo ZAA. Prevalence and Risk Factors for Congenital Anomalies in Mosul City. In 2012. Available from: https://api.semanticscholar.org/CorpusID:49529715

33. Abdou MSM, Sherif AAR, Wahdan IMH, Ashour KSE din. Pattern and risk factors of congenital anomalies in a pediatric university hospital, Alexandria, Egypt. Journal of the Egyptian Public Health Association. 2019 Dec 9;94(1):3.

34. Forci K, Alami MH, Bouaiti E, Slaoui M, Mdaghri Alaoui A, Thimou Izgua A. Prevalence of congenital malformations at the "les Orangers" maternity and reproductive health Hospital of Rabat: Descriptive study of 470 anomalies. BMC Pediatr. 2020 Jun 3;20(1).

35. El Koumi MA, Al Banna EA, Lebda I. Pattern of congenital anomalies in newborn: A hospital-based study. Pediatr Rep. 2013;5(1):20–3.

36. Zuhiad M, Khan A, Khan A, Zuhaid M, Fayaz M, Ali F, et al. Maternal Health in Tertiary Care Hospital in Peshawar [Internet]. Vol. 3, The International Journal of Medical Students Int J Med Students •. 2015. Available from: http://apps.who.int/gb/ebwha/pdf_files/EB126/B126_10-en.

37. Ghrayeb F. Consanguineous Marriage and Its Effect on Offspring Congenital Malformation: A Study among Palestinian Rural Community. international medical journal (IMJ). 2016 Jun;23:355–7.

38. Khan GA, Al Hammadi G, Ziyada A, Al Waeel K, Ayman L, Elddin Elgailani ES. Prevalence of Consanguineous Marriages in UAE Nationals and the Risk of Genetic Diseases. Journal of Medicine (Bangladesh). 2023 Jul 2;24(2):82–8.

39. Ajao AE, Adeoye IA. Prevalence, risk factors and outcome of congenital anomalies among neonatal admissions in OGBOMOSO, Nigeria. BMC Pediatr. 2019 Dec 3;19(1):88.

40. Al-Musawi KM, Shawq AH, Majeed Z, Zaid S, Ibraheem H. Risk Factors for Congenital Anomalies in Neonatal Intensive Care Unit in Baghdad City. Medico-legal Update. 20(1).

41. Moraes CL de, Melo NC e, Amaral WN do. Frequency of Congenital Anomalies in the Brazilian Midwest and the Association with Maternal Risk Factors: Case-control Study. Revista Brasileira de Ginecologia e Obstetrícia / RBGO Gynecology and Obstetrics. 2020 Apr 24;42(04):188–93.

42. Ameen SK, Alalaf SK, Shabila NP. Pattern of congenital anomalies at birth and their correlations with maternal characteristics in the maternity teaching hospital, Erbil city, Iraq. BMC Pregnancy Childbirth. 2018 Dec 18;18(1).

43. Mombo LE, Yangawagou-Eyeghe LM, Mickala P, Moutélé J, Bah TS, Tchelougou D, et al. Patterns and risk factors of birth defects in rural areas of south-eastern Gabon. Congenit Anom (Kyoto). 2017 May 1;57(3):79–82.

44. Abebe S, Gebru G, Amenu D, Mekonnen Z, Dube L. Risk factors associated with congenital anomalies among newborns in southwestern Ethiopia: A case-control study. PLoS One. 2021 Jan 1;16(1 January).

45. Thabet SA, Hudna AS, Alhadi AM, Al-Kherbash H. Congenital Anomalies in Yemeni Newborns: A Retrospective Study at a Tertiary Care Hospital in Sana'a City. University of Science and Technology Journal for Medical Sciences. 2024 Jan 16;2(2).

46. Kurdi AM, Majeed-Saidan MA, Al Rakaf MS, Alhashem AM, Botto LD, Baaqeel HS, et al. Congenital anomalies and associated risk factors in a Saudi population: A cohort study from pregnancy to age 2 years. BMJ Open. 2019 Sep 1;9(9).

47. Shivanagappa M, Hassan Kumarachar S, Mahadevaiah M, Mahesh M. Pattern of congenital anomalies and associated maternal risk factors: A study from Mysore, South India. Indian Journal of Obstetrics and Gynecology Research. 2019;6(4):444–7.

48. Arijo S, Ali Jamali A, Langah A, Nadeem Jamali A, Siyal H, Ali Jamali S, et al. Frequency Risk Factors and Pattern of Congenital Anomalies in Neonates in Nawabshah Pakistan. J Pharm Res Int. 2022 Apr 5;39–45.

49. Basnet S, Gauchan E, Shrestha J, Jha J. Patterns of Clinically Identifiable Congenital Defects in Neonates. J Nepal Health Res Counc. 2021 Apr 23;19(1):62–5.

50. Hassan Kumarachar S, Shivanagappa M, Mahadevaiah M, Mahesh M. Pattern of congenital anomalies and associated maternal risk factors : A study from Mysore, South India. Indian Journal of Obstetrics and Gynecology Research. 2019 Dec 28;6(4):444–7.

51. Jahan UR, Mirza TT, Latif T, Sarker K, Shamsi S, Khan MK, et al. Pattern of Fetal Congenital Anomalies and Its Relation with Maternal Factors. Mymensingh Med J. 2022 Jul;31(3):656–65.

52. Abebe S, Gebru G, Amenu D, Mekonnen Z, Dube L. Risk factors associated with congenital anomalies among newborns in southwestern Ethiopia: A case-control study. PLoS One. 2021 Jan 28;16(1):e0245915.

53. Ba-Saddik IA, Makki AT, Aklan IM. Pattern of congenital anomalies among newborns, infants and children in Aden city. University of Aden Journal of Natural and Applied Sciences. 2020 Apr 30;24(1):239–49.

54. Ajao AE, Adeoye IA. Prevalence, risk factors and outcome of congenital anomalies among neonatal admissions in OGBOMOSO, Nigeria. BMC Pediatr. 2019 Apr 3;19(1).

55. Kurdi AM, Majeed-Saidan MA, Al Rakaf MS, AlHashem AM, Botto LD, Baaqeel HS, et al. Congenital anomalies and associated risk factors in a Saudi population: a cohort study from pregnancy to age 2 years. BMJ Open. 2019 Sep 5;9(9):e026351.

56. Rychtarikova J, Gourbin C, Wunsch G, Šípek A. Impact of parental ages and other characteristics at childbearing on congenital anomalies. Demogr Res. 2013 Jan 15;28:137–76.

57. Almeida LFG, Araujo Júnior E, Crott GC, Okido MM, Berezowski AT, Duarte G, et al. Epidemiological Risk Factors and Perinatal Outcomes of Congenital Anomalies. Rev Bras Ginecol Obstet. 2016 Jul;38(7):348–55.

58. Jabeen N, Malik S. Prevalence of Congenital Anomalies and Non-Communicable Diseases in Women of Age 12-75 Years in District Bhimber, Azad Jammu and Kashmir, Pakistan. Iran J Public Health. 2014 Jan;43(1):42–9.

59. Asemi-Rad A, Heidari Z, Mahmoudzadeh-Sagheb H, Mehdipour Y, Moudi B, Sheibak N, et al. Prevalence of congenital anomalies and related factors in live births in Zahedan, Southeast of Iran: A cross-sectional study. Int J Reprod Biomed. 2023 Aug;21(8):647–56.

60. Shawky RM, Sadik DI. Congenital malformations prevalent among Egyptian children and associated risk factors. Egyptian Journal of Medical Human Genetics. 2011 May;12(1):69–78.

61. Zhang X, Chen L, Wang X, Wang X, Jia M, Ni S, et al. Changes in maternal age and prevalence of congenital anomalies during the enactment of China's universal two-child

policy (2013-2017) in Zhejiang Province, China: An observational study. PLoS Med. 2020 Feb;17(2):e1003047.

62. Hollier LM, Leveno KJ, Kelly MA, MCIntire DD, Cunningham FG. Maternal age and malformations in singleton births. Obstetrics and gynecology. 2000 Nov;96(5 Pt 1):701–6.

63. Miranda VIA, da Silva Dal Pizzol T, Silveira MPT, Mengue SS, da Silveira MF, Lutz BH, et al. The use of folic acid, iron salts and other vitamins by pregnant women in the 2015 Pelotas birth cohort: is there socioeconomic inequality? BMC Public Health. 2019 Jul 5;19(1):889.

64. Wong SPW, Twynstra J, Gilliland JA, Cook JL, Seabrook JA. Risk Factors and Birth Outcomes Associated with Teenage Pregnancy: A Canadian Sample. J Pediatr Adolesc Gynecol. 2020 Apr;33(2):153–9.

65. El-Mouzan MI, Al-Salloum AA, Al-Herbish AS, Qurachi MM, Al-Omar AA. Regional variations in the prevalence of consanguinity in Saudi Arabia. Saudi Med J. 2007 Dec;28(12):1881–4.

66. Hamamy H. Consanguineous marriages. J Community Genet. 2012 Jul 22;3(3):185–92.

67. Majeed-Saidan MA, Ammari AN, AlHashem AM, Al Rakaf MS, Shoukri MM, Garne E, et al. Effect of consanguinity on birth defects in Saudi women: Results from a nested case-control study. Birth Defects Res A Clin Mol Teratol. 2015 Feb 31;103(2):100–4.

68. ElAwady H, AlGameel A, Ragab T, Hassan N. Congenital anomalies in neonates in Fayoum Governorate, Egypt. East Mediterr Health J. 2021 Aug 26;27(8):790–7.

69. Jahan UR, Mirza TT, Latif T, Sarker K, Shamsi S, Khan MK, et al. Pattern of Fetal Congenital Anomalies and Its Relation with Maternal Factors. Mymensingh Med J. 2022 Jul;31(3):656–65.

70. Mahdi SA, Kareem TF, Abdullah DF. PRETERM DETECTION OF CONGENITAL ANOMALIES BY ULTRASOUND AND CORRELATION WITH POSSIBLE ASSOCIATED RISK FACTORS. Wiad Lek. 2022;75(1 pt 2):268–74.

71. Shaheen F, Humayoon QS, Malik S, Mumtaz S. Clinical and genetic attributes of congenital anomalies ascertained at a tertiary care hospital in Rawalpindi, Pakistan. Pak J Med Sci. 2023;39(6):1673–9.

72. 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):868–75.

73. Ochieng J, Kiryowa H, Munabi I, Ibingira CBR. Online) ISSN 2073 East Cent. Afr. j. surg. (Online) ISSN 2073 East Cent. Vol. 16, East and Central African Journal of Surgery East and Central African Journal of Surgery East and Central African Journal of Surgery East and Central African Journal.

74. Al Hosani H, Salah M, Abu-Zeid H, Farag HM, Saade D. The National Congenital Anomalies Register in the United Arab Emirates. East Mediterr Health J. 2005 Jul;11(4):690–9.

75. Moammar H, Cheriyan G, Mathew R, Al-Sannaa N. Incidence and patterns of inborn errors of metabolism in the Eastern Province of Saudi Arabia, 1983-2008. Ann Saudi Med. 2010 Jul;30(4):271–7.

76. Mak CM, Lee HCH, Chan AYW, Lam CW. Inborn errors of metabolism and expanded newborn screening: review and update. Crit Rev Clin Lab Sci. 2013 Nov 2;50(6):142–62.

77. World Health Organization. WHO. antenatal care randomized trial: manual for the implementation of the new model. http://apps.who.int/iris/bitstream/10665/42513/1/WHO_RHR_0130.pdf .

78. Al-Musawi KM, Shawq AH, Majeed Z, Zaid S, Ibraheem H. Risk Factors for Congenital Anomalies in Neonatal Intensive Care Unit in Baghdad City. Medico-legal Update. 20(1).

79. DeSilva M, Munoz FM, Mcmillan M, Kawai AT, Marshall H, Macartney KK, et al. Congenital anomalies: Case definition and guidelines for data collection, analysis, and presentation of immunization safety data. Vaccine. 2016 Dec;34(49):6015–26.

80. Chimah OU, Emeagui KN, Ajaegbu OC, Anazor C V., Ossai CA, Fagbemi AJ, et al. Congenital malformations: Prevalence and characteristics of newborns admitted into Federal Medical Center, Asaba. Health Sci Rep. 2022 May 13;5(3).

81. Shetty N, Mantri S, Agarwal S, Potdukhe A, Wanjari MB, Taksande AB, et al. Unraveling the Challenges: A Critical Review of Congenital Malformations in Low Socioeconomic Strata of Developing Countries. Cureus. 2023 Jul 12;

82. McNeese ML, Selwyn BJ, Duong H, Canfield M, Waller DK. The association between maternal parity and birth defects. Birth Defects Res A Clin Mol Teratol. 2015 Feb 26;103(2):144–56.

83. Zuhiad M, Khan A, Khan A, Zuhaid M, Fayaz M, Ali F, et al. Maternal Health in Tertiary Care Hospital in Peshawar [Internet]. Vol. 3, The International Journal of Medical Students Int J Med Students •. 2015. Available from: http://apps.who.int/gb/ebwha/pdf_files/EB126/B126_10-en.

84. Taye M, Afework M, Fantaye W, Diro E, Worku A. Congenital anomalies prevalence in Addis Ababa and the Amhara region, Ethiopia: a descriptive cross-sectional study. BMC Pediatr. 2019 Dec 11;19(1):234.

85. Marwah S, Sharma S, Kaur H, Gupta M, Goraya S. Surveillance of congenital malformations and their possible risk factors in a teaching hospital in Punjab. Int J Reprod Contracept Obstet Gynecol. 2014;162–7.

86. Liu Q, Fan X, Liu S, Wang L, Jiang Y, Chen X. Maternal risk factors for severe microtia/atresia in China: A case-control study. Int J Pediatr Otorhinolaryngol. 2018 Dec;115:139–44.

87. Sokal R, Tata LJ, Fleming KM. Sex prevalence of major congenital anomalies in the United Kingdom: a national population-based study and international comparison meta-analysis. Birth Defects Res A Clin Mol Teratol. 2014 Feb;100(2):79–91.

88. Shaw GM, Carmichael SL, Kaidarova Z, Harris JA. Differential risks to males and females for congenital malformations among 2.5 million California births, 1989–1997. Birth Defects Res A Clin Mol Teratol. 2003 Dec 11;67(12):953–8.

89. Zhang M, Su Y, Sun Y pu. Gender bias in fetal malformations: A cross-sectional study in Asian populations. Front Endocrinol (Lausanne). 2023 Mar 30;14.

90. Son SL, Allshouse AA, Page JM, Debbink MP, Pinar H, Reddy U, et al. Stillbirth and fetal anomalies: secondary analysis of a case-control study. BJOG. 2021 Jan;128(2):252–8.

91. Maritska Z, Theofilus Aswadi. Risk Factors of Congenital Anomalies in South Sumatera Indonesia. Bioscientia Medicina : Journal of Biomedicine and Translational Research. 2020 Oct 3;4(4):60–9.

92. Moges N, Anley DT, Zemene MA, Adella GA, Solomon Y, Bantie B, et al. Congenital anomalies and risk factors in Africa: a systematic review and meta-analysis. BMJ Paediatr Open. 2023 Jul 10;7(1):e002022.

93. Jenish Bhandari; Pawan K. Thada; Divya Khattar. Diabetic Embryopathy. National Library of of Medicine . 2023 Sep 15;

94. Carmichael SL, Shaw GM. Maternal life event stress and congenital anomalies. Epidemiology. 2000 Jan;11(1):30–5.

95. Li J, Du Y, Liu Y. Maternal exposure to life events during pregnancy and congenital heart disease in offspring: a case-control study in a Chinese population. BMC Pregnancy Childbirth. 2021 Oct 6;21(1):677.

96. Savabieasfahani M, Ahamadani F, Fadhel BT. Congenital anomalies in Baghdad children born near US military burn-pits: A case-control study showing tungsten and chromium association with increased odds of disease. Hygiene and Environmental Health Advances. 2024 Mar;9:100090.

97. Naeem M, Ahmad B, Malik S. Burden of congenital and hereditary anomalies in the war-affected territory at Pakistan-Afghanistan border. Asian Biomed (Res Rev News). 2022 Dec;16(6):299–309.

98. Arafa M, Abdel-Fataah M, Zeid HA, el-Khouly A. Outcomes of pregnancies complicated by early vaginal bleeding. East Mediterr Health J. 2000;6(2–3):457–64.

99. Strobino B, Pantel-Silverman J. Gestational vaginal bleeding and pregnancy outcome. Am J Epidemiol. 1989 Apr;129(4):806–15.

100. Bhatti D, Dhar T, Mandrelle K, Sohi I. Pregnancy outcomes in women with vaginal bleeding in early pregnancy. CHRISMED Journal of Health and Research. 2022;9(3):188.

101. Karimi A, Sayehmiri K, Vaismoradi M, Dianatinasab M, Daliri S. Vaginal bleeding in pregnancy and adverse clinical outcomes: a systematic review and meta-analysis. J Obstet Gynaecol. 2024 Dec;44(1):2288224.

الجمهورية اليمنية
وزارة التعليم العالي والبحث العلمي
الجامعة الإماراتية الدولية
كلية الطب والعلوم الصحية
قسم طب المجتمع

الأنماط والعوامل المرتبطة بتشوهات الأجنة بين حديثي الولادة في 14 محافظة في اليمن 2021-2023

بحث مقدم لنيل درجة البكالوريوس في الطب والعلوم الصحية

الملخص

المقدمة: تظهر تشوهات الأجنة كشذوذ في البنية أو الوظيفة أو الأيض، مما يؤدي إلى إعاقة طويلة الأمد وانخفاض في جودة الحياة، وتوفر هذه الدراسة نظرة شاملة على تشوهات الأجنة في14 محافظة في اليمن، وهي مشكلة صحية عامة مهمة ولكنها مُهملة.

الأهداف: تحديد أنماط تشوهات الأجنة بين الأطفال حديثي الولادة العوامل المرتبطة بها في 14 محافظة في اليمن خلال 2021-2023.

منهجية البحث: تم استخدام دراسة الحالة والمرجع بنسبة 2:1، واستخدمت البيانات الثانوية من مختلف المرافق الصحية خلال الفترة من 2021 إلى 2023 في 14 محافظة في اليمن، وقارنت الدراسة بين 612 من الأطفال حديثي الولادة تم تشخصيهم بالتشوهات الخلقية مع 1224 من الأطفال السليمين من خلفيات اقتصادية اجتماعية مماثلة، وتم تحليل البيانات عبر Epi info 7.2 ، وتم استخدام الانحدار اللوجستي ثنائي المتغير لتحديد العوامل المرتبطة بالتشوهات ($p < 0.001$)بالإضافة إلى اختبار T ومربع كاي.

النتائج: كانت غالبية تشوهات الأجنة فردية 518 (84.64%)، في حين كانت 94 (15.36%) متعددة، وكانت أعلى نسبة من التشوهات تتعلق بالجهاز العصبي المركزي (33.9%)، يليه الجهاز العضلي الهيكلي (14.8%) والتشوهات الفموية الوجهية (10.6%)، ووجدت الدراسة أيضًا ارتباطات إحصائية مع تشوهات الأجنة وزواج الأقارب (OR=27.637)، والطبقة الاقتصادية المنخفضة (OR=11.427) ، والأمهات اللاتي يبلغن من العمر 35 سنه فأكثر (OR=8.264) ، ووزن الجنين المنخفض عند الولادة 2500> جرام (OR=4.675) ، والتوتر النفسي (OR=4.456) ، وإصابة الأم بالأمراض الحادة أثناء الحمل (OR=2.759) ، والتاريخ العائلي الإيجابي (OR=1.955) ، والأجنة الذين تقل أعمارهم عن ال37 أسبوعا (OR=1.630) ، والخمس الولادات المتعددة فأكثر (OR=0.599) ، والأجنة الذكور (OR=0.1034).

الخاتمة: توصلت هذه الدراسة إلى أن معظم تشوهات الأجنة في 14 محافظة يمنية كانت فردية, وغالبية التشوهات كانت في الجهاز العصبي المركزي, والجهاز العضلي الهيكلي, والتشوهات الفموية الوجهية, وكانت أبرز الارتباطات ذات الدلالة الإحصائية مع تشوهات الأجنة هي زواج الأقارب، والطبقة الاقتصادية المنخفضة ، والأمهات اللاتي يبلغن من العمر 35 سنه فأكثر ، ووزن الجنين المنخفض عند الولادة 2500>جرام ، والتوتر النفسي، وإصابة الأم بالأمراض الحادة أثناء الحمل ، والتاريخ العائلي الإيجابي ، والأجنة الذين تقل أعمارهم عن ال37 أسبوعا ، والخمس الولادات المتعددة فأكثر ، والأجنة الذكور.

الكلمات الدالة: تشوهات الأجنة، عوامل ارتباط.

APPENDICES

❖ Appendix 1 (Ethical Consent):

Republic of Yemen
Emirates International University
College of Medicine & Health Sciences

الجمهورية اليمنية
الجامعة الإماراتية الدولية
كلية الطب والعلوم الصحية

الأخ الدكتور / نجيب القباطي – وكيل وزارة الصحة العامة والسكان المحترم

تحية طيبة وبعد،

الموضوع/ السماح لطلاب الطب البشري المستوى الخامس بتجميع المادة العلمية لاستكمال بحث التخرج

تهديكم الجامعة الإماراتية الدولية اطيب تحياتها متمنية لكم دوام التوفيق والنجاح في اعمالكم.

بالإشارة الى الموضوع أعلاه فأننا نرجو من سيادتكم التكرم بالتوجيه لمن يلزم بالسماح لطلاب المستوى الخامس – طب بشري – للدخول لمركزكم حتى يتسنى للطلاب أخذ البيانات المطلوبة لخدمة بحث تخرجهم والذي سيحمل عنوان

(Patterns and Associated Factors of congenital Anomalial in some Yemeni Governorates 2022-2023)

شاكرين تعاونكم سلفاً، مع فائق التقدير والاحترام،

عميد كلية الطب والعلوم الصحية
أ.د. صالح الظاهري

مرفق لكم أسماء الطلاب

Sana'a, Hada Beurit Street, Tel: +9671432222, Fax: +9671415929

صنعاء - حدة شارع بيروت/ تليفون: ٩٦٧١٤٣٢٢٢٢+ ،فاكس: ٩٦٧١٤١٥٩٢٩

Republic of Yemen
Emirates International University
College of Medicine & Health Sciences

الجمهورية اليمنية
الجامعة الإماراتية الدولية
كلية الطب والعلوم الصحية

أسماء الطلاب المشاركين بالبحث :

- انس نجيب خليل القباطي
- هيام عبدالرحمن احمد العطنه
- صالح محمد عي الشاوش
- اميرالدين مصلح خالد الحاشدي
- معاذ علي محمد السعيدي
- محمد رجائي جابر دماج
- صالح علي صالح البسارة
- عبدالله علي عبدالله جرعون
- وسام فتحي عبده البصير
- جمال جميل هزاع عبده
- احمد خالد حزام العامري
- عبدالرحمن يحيى عبدالرحمن الثور
- ناصرمحمد مصلح المنتصر

Sana'a, Hada Beurit Street, Tel: +9671432222, Fax: +9671415929

صنعاء - حدة شارع بيروت/ تليفون: ٩٦٧١٤٣٢٢٢٢+ ،فاكس: ٩٦٧١٤١٥٩٢٩

- **Appendix 2 (The Notification Form of CAs- Ministry of Health and Population in Yemen):**

الجمهورية اليمنية
وزارة الصحة العامة والسكان
قطاع السكان
الإدارة العامة لصحة الأم والمواليد

تاريخ الإبلاغ / / 20م
رقم القيد : ( )
رقم الإستمارة ( )

استمارة الإبلاغ والتحري عن حالة تشوهات الأجنة

1. **معلومات عن المرفق :**

المحافظة :	المديرية :	حي/عزلة
حارة /قرية:	اسم المرفق :	القسم:

2. **بيانات الابوين**

اسم الاب رباعياً :		عمل الأب : □مغترب □موظف حكومي □موظف قطاع خاص(مصنع) □مزارع
اسم الأم رباعياً :		عمل الأم: □ربة بيت □موظفة حكومي □موظفة قطاع خاص(مصنع) □مزارعة
عمر الأم : □اقل من 20سنة □20-39 سنة □40 سنة فأكثر	الزوج رقم ( )	فترة الزواج ( )
القرابة بين الزوجين:□درجة أولى □درجة ثانية □درجة ثالثة	الحالة الاقتصادية للأسرة : فقير □ متوسط □ غني □	
عدد الولادات السابقة □ صفر □1-4 □ 5فاكثر	إسقاطات ( ) مواليد مشوهين ( ) مواليد متوفيين( ) حمل عنقودي( )	

3. **محل الإقامة:**

المحافظة :	المديرية :	العزلة او القرية :

4. **التاريخ المرضي للأم**

□ امراض مزمنة:	□ استعمال ادوية خلال فترة الحمل	□ التعرض لإشعاع	□ أخرى تذكر
□ تعرض لحالات خوف شديد	□ تعرض لقصف صاروخي	□ أمراض مصاحبة	

5. **إجراءات متابعة الحمل**

□ عدد الزيارات لمتابعة الحمل ( )	□ فحص الهيموجلوبين	□ تناول أقراص الحديد	□ لقاح الكزاز

6. بيانات الولادة

تاريخ الولادة: / / م	نوع الولادة: □طبيعي □ قيصري □إسقاط	مكان الولادة : □منزل □مرفق □إحالة
جنس المولود: □ ذكر □ انثى	عمر الحمل بالاسابيع : □ أقل من 28 أسبوع □ 28 -36 أسبوع	وزن المولود : □ أقل من 2500جرام □ 2500-3500جرام
حالة المولود : □مولود حي □ مولود ميت □ توفي بعد الولادة □ تحت الملاحظة		

7. وصف التشوه الخاص بالمولود :

التشوهات الخلقية في الجهاز الهضمي :		التشوهات الخلقية في الجهاز العصبي المركزي:	
1) الإنسداد المريئي من دون ناسور		1) انعدام الدماغ Anencephal	
2) الإنسداد المريئي مع ناسور رغامي - مريئي		2) متلازمة أرنولد كياري Arnold Chiari Syndrome	
3) غياب، إنسداد وتضيق خلقي للأمعاء الغليظة		3) إلتهاب الدماغ/قيلة دماغية Encephalocel	
4) غياب، إنسداد وتضيق خلقي للأمعاء الدقيقة		4) الصلب المشقوق أو السنسنة المشقوقة Spina bifida	
5) ناسور المستقيم والشرج الخلقي		5) تضخم الرأس أو موه الرأس الخلقي Congenital hydrocephalus	
6) تشوهات خلقية في تثبيت الأمعاء		6) صغر الرأس Microcephaly	
7) داء هيرشبرنغ أو تضخم القولون اللاعقدي الخلقي		الشفة المشقوقة والحنك المشقوق)الفلح الحنكي(: Clefts	
8) الناسور المريئي الرغامي الخلقي، غير محدد		1) الشفة المشقوقة Cleft lip	
التشوهات الصبغوية الخلقية Chromosomal		2) الحلق المشقوق Cleft palat	
1) متلازمة داون Down's syndrome (T21		3) الشفة والحلق المشقوق Cleft lip and palate	
2) متلازمة إدوارد، غير المعي ن Edward's syndrome, T18) unspecified		التشوهات الخلقية في الجهاز العضلي الهيكلي Musculoskeletal	
3) متلازمة باتو، غير محدد: Patau's syndrome, T13) unspecified		1) خلع الورك الخلقي، غير محدد Congenital unspecified ,dislocation of the hip	
التشوهات الخلقية في الجهاز البولي التناسلي Genitourinary		2) فتق في حجاب الحاجز Diaphragmatic hernia	
1) الإحليل التحتاني Hypospadia		2) إنشقاق البطن الخلقي Gastroschisis	
2) عدم تخلق الكلى Renal agenesis		3) قيلة الحبل السري Omphalocele	
3) أعضاء تناسلية ملتبسة أو جنس غير محدد: Indeterminate sex, ambiguous genitalia		4) كثرة الأصابع أو عنش Polydactyly	
4) كيسات كلوية kidney disease Cystic		5) إلتصاق الأصابع Syndactyly	
5) إستسقاء/موه الكلوة الخلقي Congenital hydronephrosis		6) حنف القدم، غير محدد Clubfoot, NOS	
التشوهات الخلقية في العين، الأذن، الوجه والعنق - Eye, ear, face and neck		7) عيوب الطرف - الأطراف (النقصانية) Reduction defects of the limbs	

	1) انعدام وصغر وضخامة المقلة Anophthalmos, microphthalmos and	التشوهات الخلقية في الجهاز التنفسي Respiratory	
	2) الساد الخلقي cataract Congenital		1) إنسداد أو رتق قمع الأنف atresia Choanal
	3) رقبة وتراء of neck Webbing		2) نقص تنسج وخلل تنسج الرئة Hypoplasia and dysplasia of lung
	4) صغر صيوان الأذن/ انعدام الأذن الخارجية /Microtia Anotia		

إدراج صورة التشوه

8. بيانات القائم بالتوليد (للولادات تحت اشراف كادر صحي مؤهل)

إسم من قام بالتوليد	صفته	التوقيع
	□ طبيب/ة □ قابلة □ كادر طبي آخر ( )	

9. الجهة المؤكدة :

مسجل البيانات	مختص الإدخال
الإسم :	**الإسم :**
التوقيع:	**التوقيع:**
بيانات الجهة المؤكدة (المرفق الصحي)	
إسم المرفق الصحي:	**إسم مدير المرفق :**	**التوقيع والختم:**

- **Appendix 3 (The Proposed Updated Notification Form for CAs - Ministry of Health and Population in Yemen):**

الجمهورية اليمنية
وزارة الصحة العامة والسكان
قطاع السكان
الإدارة العامة لصحة الأم والمولود

تاريخ الإبلاغ / / ٢٠ م
الموافق / / ١٤ هجرية
رقم القيد ( )
رقم الاستمارة ( )

استمارة الإبلاغ والتحري عن حالة تشوهات الأجنة

١. بيانات الابوين

اسم الاب رباعياً : ..... العمر : ..... المستوى التعليمي : ..... رقم الهاتف:	**عمل الأب** □ مغترب □ موظف حكومي / خاص - (تحديد الوظيفة .....) □ مزارع
اسم الأم رباعيا : ..... العمر : ..... الوزن : ..... المستوى التعليمي : ..... عدد الولادات السابقة : (.....ولادة) رقم الهاتف :	**عمل الأم** □ ربة بيت □ موظفة حكومي / خاص - (تحديد الوظيفة .....) □ مزارعة
	□ إسقاطات ( ) □ أجنة مشوهة سابقين ( ) تحديد التشوه..... □ مواليد متوفيين ( ) □ حمل عنقودي ( )
القرابة بين الزوجين: □ درجة أولى □ درجة ثانية □ درجة ثالثة □ لا توجد (تحديد نوع القرابة : .....)	
محل الاقامة الابوين (المحافظة :..... / المديرية :..... / قرية / غزله :.....)	

٢. إجراءات متابعة الحمل

□ عدد الزيارات لمتابعة الحمل ( )	□ تناول أقراص حمض الفوليك	□ لقاح الحصبة الألمانية	□ فحص الهيموجلوبين	□ تناول أقراص الحديد

٣. أمراض مزمنة لدى الأم

ارتفاع ضغط مزمن	□ نعم □ لا				
اضطراب تخثر الدم	□ نعم □ لا				
داء الصرع	□ نعم □ لا				
خلل في وظيفة الغدة الدرقية	□ نعم □ لا	اذا نعم ، حدد النوع ،	□ قصور الدرقية ( )	□ فرط الدرقية ( )	
داء السكري	□ نعم □ لا	اذا نعم ، حدد النوع ،	□ معتمد على الأنسولين ( )	□ غير معتمد على الأنسولين ( )	
اخرى ، (تحدد) : _.....					

٤. استخدام ادوية خلال فترة الحمل

مضادات حيوية (Antibiotics)	□ نعم	□ لا	الاسم : .....
أدوية الكولسترول (Anti-cholesterol)	□ نعم	□ لا	الاسم : .....
أدوية الأعصاب (Anti-depressant)	□ نعم	□ لا	الاسم : .....
أدوية الصرع (Anti-epileptic)	□ نعم	□ لا	الاسم : .....
أدوية الضغط (Anti-hypertensive)	□ نعم	□ لا	الاسم : .....
أدوية للالتهابات (Anti-inflammatory)	□ نعم	□ لا	الاسم : .....
أدوية الأمراض الخبيثة (Anti-neoplastic)	□ نعم	□ لا	الاسم : .....
أدوية الكورتيزون (Corticosteroids)	□ نعم	□ لا	الاسم : .....
أدوية مدرات البول (Diuretic)	□ نعم	□ لا	الاسم : .....
أدوية الغدة الدرقية (Thyroid drugs)	□ نعم	□ لا	الاسم : .....
أخرى ، (تحدد)			

5. فترة الحمل

□ أمراض مصاحبة لفترة الحمل: حدد المرض: ..... الشهر :	□ التعرض لقلق نفسي تحديد الفترة خلال الحمل	□ تعرض لقصف صاروخي تحديد الفترة خلال الحمل.....
□ مضغ القات خلال فترة الحمل	□ حدوث نزيف مهبلي خلال فترة الحمل: فترة التعرض :	□ تعرض لحالات خوف شديد تحديد الفترة خلال الحمل.....
□ تدخين السجائر خلال فترة الحمل □ تدخين الشيشة او المداعة خلال فترة الحمل □ التعرض للتدخين السلبي	□ التعرض لمبيدات زراعية تحديد الفترة خلال الحمل.....	□ التعرض لإشعاع تحديد الفترة خلال الحمل.....

6. بيانات الولادة

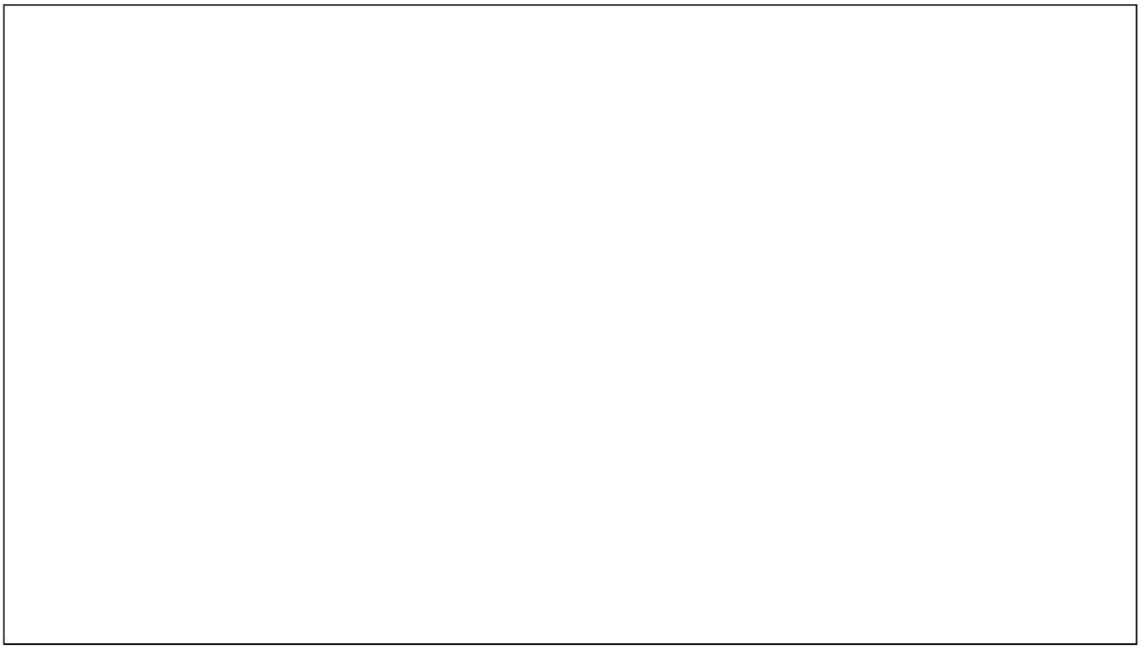
تاريخ الولادة : / / م	نوع الولادة : □ طبيعي □ قيصري	مكان الولادة: □ منزل □ مرفق □ إحالة
عمر الحمل بالأسابيع (..... اسبوع)	جنس المولود: □ ذكر □ انثى □ غير محدد	وزن المولود (.....جرام)
حالة المولود : □ مولود حي □ مولود ميت	□ توفي بعد الولادة □ تحت الملاحظة	

7. وصف التشوة الخاص بالمولود

	تشوهات الأجنة في الجهاز الهضمي GIT		تشوهات الأجنة في الجهاز العصبي المركزي CNS
	1) الانسداد المريئي من دون ناسور Esophageal atresia without fistula		1) انعدام الدماغ Anencephaly
	2) الانسداد المريئي مع ناسور رغامي - مريئي Esophageal atresia with tracheoesophageal fistula		2) متلازمة أرنولد كياري Arnold Chiari Syndrome
	3) غياب ، انسداد وتضيق خلقي للأمعاء الغليظة large intestine atresia		3) التهاب الدماغ / قيلة دماغية Encephalocele
	4) غياب ، انسداد وتضيق خلقي للأمعاء الدقيقة small intestine atresia		4) الصلب المشقوق أو السنسنة المشقوقة Spina bifida
	5) ناسور المستقيم والشرج الخلقي congenital anorectal fistula		5) تضخم الرأس أو موه الرأس الخلقي hydrocephalus
	6) تشوهات خلقية في تثبيت الأمعاء congenital anomalies of intestine fixation		6) صغر الرأس Microcephaly
	7) داء هيرشبرنغ أو تضخم القولون اللاعقدي Hirschsprung diseas		**الشفة المشقوقة والحنك المشقوق Clefts**
	8) الناسور المريئي الرغامي الخلقي، غير محدد (unspecified) tracheoesophageal fistula		1) الشفة المشقوقة Cleft lip
	9) انسداد فتحة الشرج imperforated anus		2) الحنك المشقوق Cleft palate
	تشوهات الأجنة الصبغية Chromosomal		3) الشفة والحنك المشقوق Cleft lip and palate
	1) متلازمة داون Down's syndrome (T21		**تشوهات الأجنة في الجهاز التنفسي Respiratory**
	2) متلازمة إدوارد T18) Edward's syndrome,		1) إنسداد أو رتق قمع الأنف atresia Choanal
	3) متلازمة باتو: T13) Patau's syndrome		2) نقص وخلل تنسج الرئةHypoplasia,dysplasia of lung
	تشوهات الأجنة في الجهاز البولي التناسلي Genitourinary		**تشوهات الأجنة في الجهاز العضلي الهيكلي Musculoskeletal**
	1) الإحليل التحتاني Hypospadias		1) خلع الورك الخلقي،غير محدد Congenital dislocation of the hip (unspecific)
	2) عدم تخلق الكلى Renal agenesis		2) فتق في حجاب الحاجز Diaphragmatic hernia
	3) أعضاء تناسلية ملتبسة أو جنس غير محدد: Indeterminate sex, ambiguous genitalia		3) إنشقاق البطن الخلقي Gastroschisis
	4) كيسات كلوية Cystic kidney disease		4) قيلة الحبل السري Omphalocele
	5) إستسقاء/موه الكلوة الخلقي Congenital hydronephrosis		5) كثرة الأصابع أو عنش Polydactyly
	تشوهات الأجنة في العين، الأذن، الوجه والعنق - Eye, ear, face and neck		6) إلتصاق الأصابع Syndactyly
	1) انعدام وصغر وضخامة المقلة Anophthalmos, microphthalmos and		7) حنف القدم، غير محدد Clubfoot, NOS
	2) الساد الخلقي cataract Congenital		8) عيوب الطرف - الأطراف (النقصانية) Reduction defects of the limbs
	3) رقبة وتراء Webbing of neck		**تشوهات أخرى**
	4) صغر صيوان الأذن/ انعدام الأذن الخارجية Microtia/ Anotia		1) تشوهات في الجلد skin anomalies
	اخرى (تذكر)		2) استسقاء البطن congenital ascites
			3) استسقاء كامل الجسم hydrops fetalis

إدراج صورة التشوه مع وصف التشوه .

الوصف .....



1. .معلومات عن المرفق

المحافظة:	المديرية:	حي/عزلة
حارة / قرية:	اسم المرفق:	القسم:

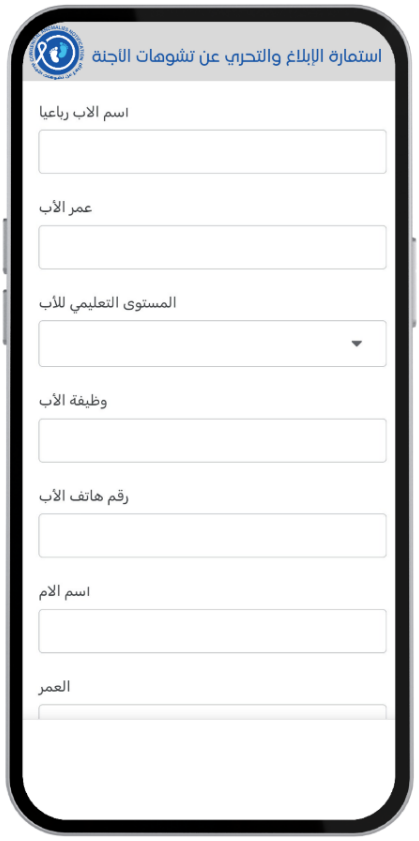
2. بيانات القائم بالتوليد (للولادات تحت اشراف كادر صحي مؤهل)

أسم من قام بالتوليد	صفته	التوقيع
	□ طبيب/ة □ قابلة □ كادر طبي آخر ( )	

3. الجهة المؤكدة:

مسجل البيانات	مختص الإدخال	
الاسم: التوقيع:	الاسم: التوقيع:	
بيانات الجهة المؤكدة (المرفق الصحي)		
أسم المرفق الصحي:	رقم الهاتف :	التوقيع والختم:
أسم مدير المركز الصحي:	رقم الهاتف :	

- **Appendix 4 (The Proposed Notification App for CAs -Ministry of Health and Population in Yemen):**



Scan the QR Code for Access