**Kerbala Journal of Pharmaceutical Sciences**

**ISSN**: 2221-7207(Print) / **ISSN**: 3006-7189 (Online)

# Epidemiological Trends and Risk Factor Analysis for Congenital Anomalies: A 2018–2023 Observational Study

**Ashwaq Ali Hussein**[1,2,3,*]

[1]Department of Pediatric/Medical College/ Kerbala University/ Karbala/ Iraq.
[2]Medical College/Warith Alanbeya University/ Karbala/ Iraq.
[3]Karbala Teaching Hospital for Children/Imam Alhuja Hospital/Karbala, Iraq

***Corresponding author**

**Ashwaq Ali Hussein: ashwaq.ali@uokerbala.edu.iq.**

**Received: 20/04/2026**
**Accepted: 08/06/2026**
**Published: 30/06/2026**

**Key word:** Congenital anomalies, Retrospective study, Neonate, Karbala city, Iraq



**DOI:10.62472/kjps.v17.i28.260-271**

**Abstract**

**Background:** Congenital disorders are one of the main causes of the global burden of disease, accounting for 94% of global cases and are one of the leading causes of under-five mortality.

Globally, the number of recognizable patterns of human malformations have more than tripled during the last 25 years

**Objectives**: To identify the sociodemographic features, types of congenital anomalies, and possible risk factors among births in Karbala City, Iraq during the period 2018–2023.

**Methods**: In this retrospective observational study, a total of 605 neonates with apparent congenital anomalies were enrolled from Karbala teaching hospital for pediatric where majority of sick newborn care occur at Karbala city, Iraq during the period extending between 2018- 2023. Hospital records were used for data collection. These data included the neonates' demographic and clinical characteristics, maternal sociodemographic data, Description of defects from hospital records was described according to ICD-10 (International classification of diseases &related health problems-10th revision) that's introduced by WHO.

statistical analysis was performed using Microsoft Excel & Graphical Pad Prism 9.

**Results:** The socio-demographic and clinical profile of the study group (N=605), slight Male infants accounted for 338 cases (55.9%), Regarding outcomes, 152 infants (25.1%) died, whereas 453 (74.9%) survived. The majority 415 (68.6%) had normal birth weight. Most mothers were aged 20–35 years 514(85.0%), 113 cases (18.7%) have abortion history. 593 (98.0%) of cases reported no risk exposure. The majority of mothers were healthy 587(97.0%) Urban residence accounted for 341 (56.4%), Positive Consanguinity was reported in 260 (43.0%) of cases and a history of previous congenital anomalies was present in 52 (8.6%) of mothers. Single pregnancy was reported in 594(98.2%) of cases. Gastrointestinal anomalies were the most frequent 200 (33.1%), followed by cardiovascular anomalies 148 (24.5%).

The highest Annual Distribution of congenital anomalies in 2021 includes 170 (28.1%) with variable distribution over the rest years.

Gastrointestinal (33.1%) and Cardiovascular (24.5%) anomalies, classified as "Critical Surgical" and "High Survival Risk,"

**Conclusion:** A six-year study in Karbala, Iraq, revealed a high burden of congenital anomalies, with gastrointestinal and cardiovascular defects accounting for 57.6% of cases and a 25.1% mortality rate. The findings indicate a high-acuity surgical population linked to a 43% rate of consanguinity, highlighting the need for improved prenatal screening and specialized pediatric surgical care.

# الاتجاهات الوبائية وتحليل عوامل الخطر المرتبطة بالتشوهات الخلقية: دراسة رصدية خلال الفترة 2018–2023

أشواق علي حسين

**الملخص**

**الخلفية :**تُعدّ الاضطرابات الخِلقية من الأسباب الرئيسة للعبء العالمي للمرض، إذ تمثل نسبة كبيرة من الحالات المسجلة عالميًا، كما تُعد من الأسباب الرئيسة للوفيات بين الأطفال دون سن الخامسة. وعلى المستوى العالمي، ازداد عدد الأنماط المعروفة للتشوهات البشرية بأكثر من ثلاثة أضعاف خلال السنوات الخمس والعشرين الماضية.

**الأهداف :**تحديد الخصائص الاجتماعية والديموغرافية، وأنواع التشوهات الخِلقية، وعوامل الخطر المحتملة بين الولادات في مدينة كربلاء، العراق، خلال الفترة 2018–2023.

**الطرائق :**أُجريت هذه الدراسة الرصدية الاستعادية على ما مجموعه 605 من حديثي الولادة المصابين بتشوهات خِلقية ظاهرة، والذين راجعوا مستشفى كربلاء التعليمي للأطفال، حيث تُقدَّم غالبية خدمات رعاية حديثي الولادة المرضى في مدينة كربلاء، العراق، خلال الفترة الممتدة من عام 2018 إلى عام 2023. استُخدمت سجلات المستشفى لجمع البيانات، وشملت الخصائص الديموغرافية والسريرية لحديثي الولادة، والبيانات الاجتماعية والديموغرافية للأمهات. وصُنفت التشوهات المسجلة في ملفات المستشفى وفقًا للتصنيف الدولي للأمراض والمشكلات الصحية ذات الصلة، المراجعة العاشرة(ICD-10) ، الصادر عن منظمة الصحة العالمية. وأُجري التحليل الإحصائي باستخدام برنامج Microsoft Excel وبرنامجGraphPad Prism ، الإصدار 9.

**النتائج :**شملت الدراسة 605 حالات. بلغ عدد الذكور 338 حالة (55.9%). وفيما يتعلق بالنتائج السريرية، توفي 152 رضيعًا (25.1%)، بينما نجا 453 رضيعًا (74.9%). كان وزن الولادة طبيعيًا لدى غالبية الحالات، إذ بلغ عددهم 415 حالة (68.6%). تراوحت أعمار معظم الأمهات بين 20 و35 عامًا، بعدد 514 أمًا (85.0%)، وكانت هناك سابقة إجهاض لدى 113 أمًا (18.7%). ولم يُسجَّل تعرض لعوامل خطر معروفة لدى 593 حالة (98.0%). كما كانت غالبية الأمهات بصحة جيدة، بعدد 587 أمًا (97.0%). وبلغ عدد المقيمين في المناطق الحضرية 341 حالة (56.4%). وسُجّل زواج الأقارب لدى 260 حالة (43.0%)، في حين وُجد تاريخ سابق لتشوهات خِلقية لدى 52 أمًا (8.6%). وكانت أغلب حالات الحمل مفردة، بعدد 594 حالة (98.2%). وكانت تشوهات الجهاز الهضمي الأكثر شيوعًا، إذ سُجلت لدى 200 حالة (33.1%)، تلتها تشوهات الجهاز القلبي الوعائي لدى 148 حالة.(24.5%) سُجل أعلى عدد سنوي من حالات التشوهات الخِلقية في عام 2021، إذ بلغ 170 حالة (28.1%)، مع تفاوت في التوزيع خلال السنوات الأخرى. وكانت تشوهات الجهاز الهضمي (33.1%) وتشوهات الجهاز القلبي الوعائي (24.5%) من أبرز الأنواع المصنفة ضمن حالات «الجراحة الحرجة» و«الخطورة العالية على البقاء.«

**الاستنتاج :**أظهرت هذه الدراسة التي امتدت ست سنوات في مدينة كربلاء، العراق، عبئًا مرتفعًا للتشوهات الخِلقية، إذ شكّلت تشوهات الجهاز الهضمي والجهاز القلبي الوعائي معًا 57.6% من الحالات، مع معدل وفيات بلغ 25.1%. وتشير النتائج إلى وجود نسبة مرتفعة من الحالات الجراحية الحرجة، بالتزامن مع معدل زواج أقارب بلغ 43%، مما يبرز الحاجة إلى تحسين برامج الفحص والتشخيص قبل الولادة، وتعزيز خدمات الرعاية الجراحية المتخصصة للأطفال.

## 1. Introduction

Congenital disorders are functional or structural abnormalities that arise during intrauterine life and can be discovered at birth, throughout pregnancy, or occasionally only later in infancy. (World Health Organization, 2023) Congenital diseases account for 94% of all cases worldwide and are one of the top causes of death for children under five. Eighty percent of this weight is placed on Southern and Central Asia and Sub-Saharan Africa (World Health Organization, 2023) According to a March of Dimes estimate, around 8 million babies are born with significant CAs annually. Approximately 300,000 newborn fatalities occur each year in the first four weeks after delivery as a result of these abnormalities (Al-Dewik et al., 2023) . The nature and incidence of CAs differ from nation to nation and even from region to region within a same nation. This depends on the definition of CAs used, how they are identified, how long they are monitored, the population being watched, and the socioeconomic and ethnic makeup of the community being studied (Daliri et al., 2018) . CAs are more common in low-income and middle-income nations than in high-income nations (Moges et al., 2023), including Iraq. Over the past 25 years, the number of identifiable patterns of human abnormalities has more than tripled worldwide (Nelson et al., 1996). Genetic causes include chromosomal abnormalities (6%), single-gene disorders (25%), and multifactorial inheritance (20–30%). Environmental teratogens, micronutrient deficiencies, infections, iodine and folic acid deficiencies, exposure to medicinal and recreational drugs, including alcohol and tobacco, and radiation (Kumar et al., 2021) But the cause is still unknown in about half of the cases (Balakumar et al., 2004). In roughly half to two-thirds of the instances, the precise etiology is frequently difficult to determine. CAs are divided as major and minor anomalies based on their severity (Anane-Fenin et al., 2023). Additionally, they fall into three categories: deadly, severe, and mild aberrations. Major abnormalities are considered deadly and extremely serious. Nonetheless, CAs are classified globally based on the affected body system (World Health Organization, 2023). Heart problems, neural tube anomalies, and Down syndrome are the most prevalent severe congenital conditions. Over half of birth abnormalities are represented by the first two (Strong et al., 2024). Several studies have identified old maternal age, multiparity, pregnancy status (singleton or multiple) preterm birth, residency in an urban area, smoking, previous sibling anomalies, positive family history of congenital anomalies and chronic maternal diseases as the main risk factors. (Taye et al., 2018) (Abdou et al., 2019) (Ameen et al., 2018) (Kurdi et al., 2019) (Hussein et al., 2025) Congenital abnormalities were significantly more common in older mothers, especially those over 35, as well as in mothers with lower levels of education and prior medical problems such diabetes and hypertension. By addressing these factors, the prevalence of congenital abnormalities may be decreased, which would improve neonatal health outcomes and lower neonatal morbidity and death (Singh et al., 2023) Vaccination, maintaining a healthy weight and consuming enough vitamins and minerals, particularly folic acid or iodine, receiving proper care before and during pregnancy, abstaining from smoking, and limiting exposure to dangerous substances like pesticides, heavy metals, and radiation from the environment can all help prevent some congenital disorders (Abdou et al., 2019) (Taruscio et al., 2015) .

However, doing epidemiological studies of CAs outside of a high-income setting is extremely difficult since many CAs might be hard to identify without sophisticated clinical and analytical capabilities (Webster, 2013). Even while many parts of Iraq have improved over the past ten years, problems still exist, especially for families living in refugee camps. This background led to a recent study in Karbala to ascertain the prevalence, kinds, and potential risk factors of birth abnormalities.

## 2. Patients and Methods

This is a single-Centre retrospective observational descriptive study was conducted in neonatal care unit of the Karbala teaching hospital for pediatric- Karbala/ Iraq in the period extended from January 2018 till December 2023.
All newborns with CA admitted during the study were included. Major malformations are defined as malformations that are life-threatening, require surgery, or present a significant disability. Newborns with incomplete records were excluded. Data were collected from the medical records of neonates with CA using data extraction form. The diagnosis was based on physical examination by the pediatrician on duty, and relevant investigations including imaging studies like x ray, ultrasound and echocardiography. Classification was done according to ICD-10 (International classification of diseases -10, Sociodemographic data includes sex, birth weight as well as outcomes, were recorded. Maternal information such as maternal parity, history of abortion or previous CA, maternal exposure, medical history, residence, occupation and organ classification. CA: congenital anomalies, GIS=gastrointestinal system, CNS=central nervous system, CVS=cardiovascular system, MSS=musculoskeletal system, GUS: genitourinary system, Unclassified= uncategorized cases at diagnosis and those cases which includes more than one system but not grouped alongside with any known genetic/chromosomal abnormality.

### 2.1.Ethical approval

This research was submitted in the Karbala university-medical college plan for researches and was formally approved by the Center for Training and Human Development affiliated with the Karbala Directorate of Health, Ministry of Health – Iraq

### 2.2.Statistical analysis

The statistical analysis was performed using Microsoft Excel for percentage calculations & graphical pad prism9 for generating figures. Tables provided absolute frequencies (n) and relative percentages (%) for the study population.

## 3. Results

A total of 605 neonate with congenital anomalies were enrolled. Table1 presented the socio-demographic and clinical profile of the study group (N=605) Male infants accounted for 338 cases (55.9%), while females represented 267 cases (44.1%). Regarding outcomes, 152 infants (25.1%) died, whereas 453 (74.9%) survived. The majority 415 (68.6%) had normal birth weight. Low birth weight was observed in 155 infants (25.6%), very low birth weight in 20 (3.3%), and extremely low birth weight in 2 (0.3%). Macrosomia was identified in 13 cases (2.1%).

**Table1: Sociodemographic and Clinical Profile of Infants with Congenital Anomalies (N=605)**

| Variable | Category | n | % |
|---|---|---|---|
| **Infant sex** | Male | 338 | 55.9 |
| | Female | 267 | 44.1 |
| **Infant outcome** | Alive | 453 | 74.9 |
| | Dead | 152 | 25.1 |
| **Birth weight** | Normal birth weight (2,500–3,999 g) | 415 | 68.6 |
| | Low birth weight (1,500–2,499 g) | 155 | 25.6 |
| | Very low birth weight (1,000–1,499 g) | 20 | 3.3 |
| | Extremely low birth weight (<1,000 g) | 2 | 0.3 |
| | Macrosomia (≥4,000 g) | 13 | 2.1 |

Table2 demonstrated the Maternal Characteristics. Most mothers were aged 20–35 years 514(85.0%), followed by <20 years (72, 11.9%) and >35 years (19, 3.1%). 113 cases (18.7%) have abortion history. 593 (98.0%) of cases reported no risk exposure. The majority of mothers were healthy 587(97.0%) Urban residence accounted for 341 (56.4%) and rural for 264 (43.6%). Positive Consanguinity was reported in 260 (43.0%) of cases and a history of previous congenital anomalies was present in 52 (8.6%) of mothers. Single pregnancy was reported in 594 (98.2%) of cases.

**Table2: Maternal Demographic and Clinical Characteristics of Mothers of Infants With Congenital Anomalies (N = 605)**

| Variable | Category | n | % |
|---|---|---|---|
| **Maternal age (years)** | <20 | 72 | 11.9 |
| | 20–35 | 514 | 85.0 |
| | >35 | 19 | 3.1 |
| **History of abortion** | Yes | 113 | 18.7 |
| | No | 492 | 81.3 |
| **Maternal exposure during pregnancy** | None | 593 | 98.0 |
| | Fever | 7 | 1.2 |
| | Drug exposure | 5 | 0.8 |
| | X-ray exposure | 0 | 0.0 |
| **Maternal medical condition** | Healthy | 587 | 97.0 |
| | Hypertension | 9 | 1.5 |
| | Diabetes mellitus | 5 | 0.8 |
| | Other diseases | 4 | 0.7 |
| **Maternal residency** | Urban | 341 | 56.4 |
| | Rural | 264 | 43.6 |
| **Parental consanguinity** | Yes | 260 | 43.0 |
| | No | 345 | 57.0 |
| **Previous child with congenital anomaly** | Yes | 52 | 8.6 |
| | No | 553 | 91.4 |
| **Type of pregnancy** | Singleton | 594 | 98.2 |
| | Multiple | 11 | 1.8 |

Regarding Distribution of Congenital Anomalies by Organ System according to ICD-10, it was illustrated in Table3 & Fig.1. Gastrointestinal anomalies were the most frequent 200(33.1%), followed by cardiovascular anomalies 148 (24.5%), other (unclassified) includes 109 (18%), central nervous system anomalies 75(12.4%), musculoskeletal 25(4.1%), genitourinary 19(3.1%), chromosomal 18(3%), respiratory system 9 (1.5%) and the least one is congenital anomalies of skin systems 2(0.3%) of cases. The distribution of annual case according to year (2018–2023) as detailed in Table4 & Fig.2, reveals a total of 605 cases with fluctuating annual frequencies. The highest incidence was recorded in 2021, accounting for 28.1% (n=170) of the total study population. This was followed by 2020 and 2018, which were 113(18.6%) and 100(16.5%) consequently, while the lowest frequency was observed in 2019 (n=59), (9.8%), The findings of this six-year observational study reveal a complex and persistent epidemiological profile of congenital anomalies from 2018 to 2023. A standout feature of the temporal analysis was the significant spike in recorded cases

during 2021(28.1%,). Table5 & Fig.3 shows the Distribution of congenital anomalies according to organ systems and ICD-10 classification which reveals fluctuating number all over the years despite more proportion at 2021.

**Table3: Distribution of Congenital Anomalies by Organ System according to ICD-10**

| System Group | Frequency |
|---|---|
| **Central Nervous System (CNS)** | 75(12.4%) |
| **Cardiovascular (CVS)** | 148(24.5%) |
| **Gastrointestinal system (GIS)** | 200(33.1%) |
| **Musculoskeletal system (MSS)** | 25(4.1%) |
| **Respiratory system** | 9(1.5%) |
| **Integumentary system (skin)** | 2(0.3%) |
| **Genitourinary system (GUS)** | 19(3.1%) |
| **Chromosomal** | 18(3%) |
| **Other / Unclassified** | 109(18%) |
| **Total** | **605** |

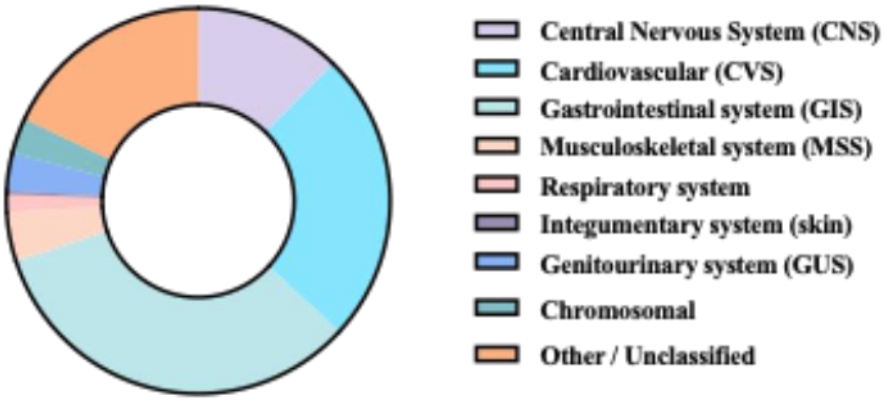


**Figure1: Cumulative Distribution of Congenital Anomalies by Organ System According To ICD-10 Over Six Years**

**Table4: Distribution Of Annual Case According To Year (2018–2023).**

| Year | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|
| n | 100 | 59 | 113 | 170 | 84 | 79 |
| % | 16.5% | 9.8% | 18.6% | 28.1% | 13.9% | 13.1% |

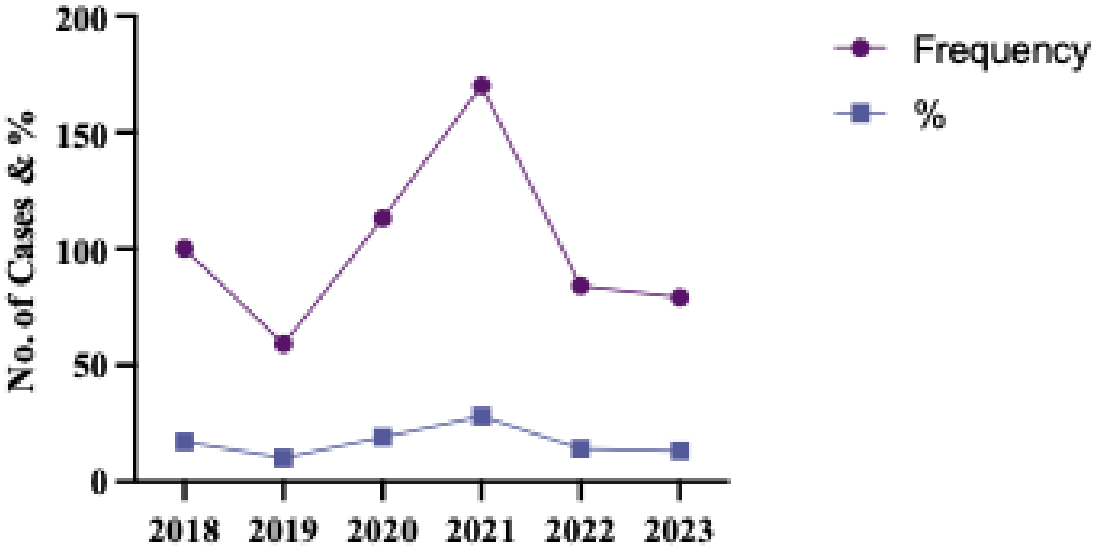


**Figure2: Annual Trend of Total Congenital Anomalies Cases Which Were Classified According to Organ Systems And ICD-10 Classification Since 2018 To 2023.** The graph displays both the absolute frequency and the corresponding percentage distribution of cases recorded over a six-year period.

**Table5: Distribution of Congenital Anomalies According to Organ Systems and ICD-10 Classification.**

| Year | CNS | CVS | GIS | MSS | UGS | Respiratory | Skin | Chromosomal | Other (Unclassified) | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| **2018** | 21 | 26 | 31 | 9 | 1 | 1 | 2 | 3 | 6 | 100 |
| **2019** | 9 | 15 | 17 | 3 | 1 | / | / | 5 | 10 | 59 |
| **2020** | 10 | 21 | 36 | 4 | 4 | 2 | / | 3 | 33 | 113 |
| **2021** | 21 | 35 | 57 | 6 | 5 | 2 | / | 4 | 40 | 170 |
| **2022** | 9 | 25 | 32 | 3 | 5 | 1 | / | / | 9 | 84 |
| **2023** | 5 | 26 | 27 | / | 3 | 3 | / | 3 | 11 | 78 |
| **Total** | 75 | 148 | 200 | 25 | 19 | 9 | 2 | 18 | 109 | 605 |

CNS: Central nervous system
CVS: Cardiovascular system
GIS: Gastrointestinal system
MSS: Musculoskeletal system
UGS: Urogenital system

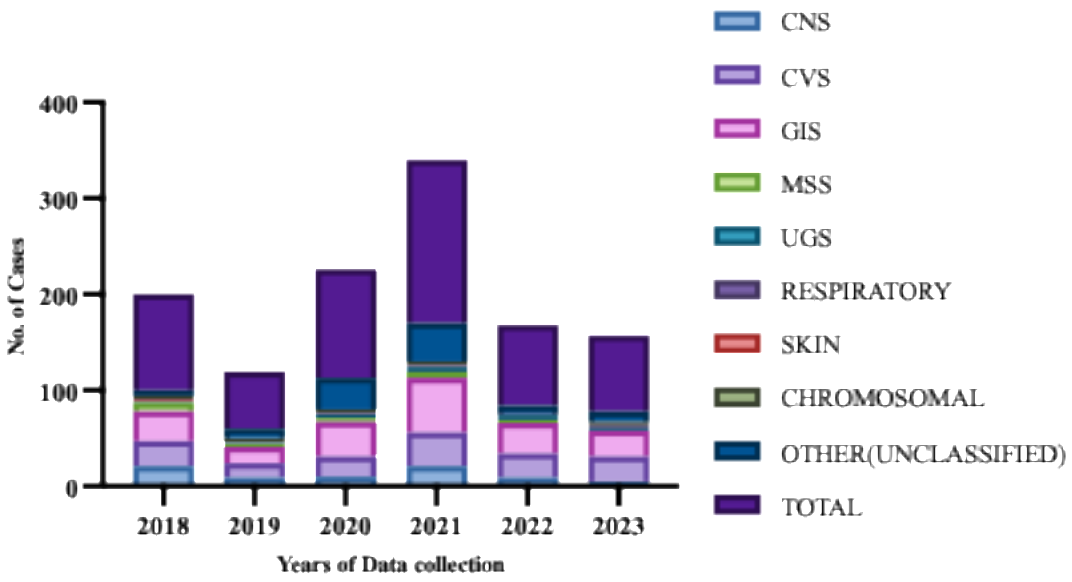


**Figure3: Annual Distribution and Classification of Congenital Anomalies According to Organ Systems And ICD-10 Classification From 2018 To 2023.**

## 4. Discussion

The study group (n=605) shows slightly more male infants with congenital anomalies than female infants. This tendency is consistent with findings from structural birth defect epidemiology studies (Ali Hussein, 2017) (Tennant et al., 2011) (Sokal et al., 2014) Male reproductive organs are extremely sensitive to hormonal imbalances since they develop early in pregnancy, which may result in greater urinary and reproductive tract problems, according to researchers (Lary & Paulozzi, 2001). Gender disparities in other disorders, like cleft lip and palate, may also be explained by the way sex hormones interact with growing body systems (Nagase et al., 2010). The mortality rate of 25.1% reflects a high burden of severe congenital anomalies and aligns with global reports identifying congenital anomalies as a leading cause of neonatal mortality (Ambey & Bhadauria, 2025) (Chimah et al., 2022). This high case-fatality rate underscores the clinical severity of congenital anomalies and the level expertise at the different facilities. While the majority of infants (68.6%) presented with Normal Birth Weight, a significant proportion (29.2%) fell within the Low-Birth-Weight spectrum, including Very Low and Extremely Low Birth Weight categories. This finding disagrees with other studies which shows higher percentages in LBW (A. Bhalerao & Garg, 2016) (Shawky & Sadik, 2011) (Didisa et al., 2025) This finding made the cause of congenital anomalies related to genetic base rather than maternal one. A major finding is the high consanguinity rate (43%), suggesting a strong genetic contribution, and this finding similar to already been observed from recent studies with similarly high incidence of consanguineous marriages. (Sallout et al., 2015) (Hamdan et al., 2015) (Shawky & Sadik, 2011) (Alghamdi et al., 2013) as preference for marrying relatives in Arab communities is largely affected by socio-cultural causes as preserving family structure

and facilitating marriage arrangements and economic benefits, which may strongly point to an autosomal recessive genetic etiology for the observed congenital anomalies (Ameen et al., 2018).

While the majority (85.0%) of mothers are in the prime reproductive window (20–35 years), the cohort displays a "young mother" skew, which is in keeping with the findings of other studies (Taboo, 2012) (Abebe et al., 2021) which shows that younger mothers have a higher risk, which were attributed to nuclear waste so Particular attention should be devoted to more frequent discrepancies in maternal age groups. However Advanced maternal age more than 35 years was reported to be significantly associated with CA by other authors(Onankpa & Adamu, 2014) (Chimah et al., 2022) . The current study found that birth weight, pregnancy status, and history of previous abortion have non-significant correlations with CAs, which were approximately similar to results found by other studies (Sallout et al., 2015; Shawky & Sadik, 2011; Taboo, 2012) Furthermore, the current study demonstrated a nonsignificant correlation between maternal drugs used in the 1st trimester and CAs. However, since only 7 mothers complaining fever and only 5 mothers in the current study had received medications during the 1st trimester, we cannot rely on it to say that those drugs are safe during pregnancy. This "silence" in the clinical history is significant. It might reflect that the anomalies are likely intrinsic (genetic/malformation) rather than disruptive (teratogenic/environmental). Most of mothers lived in urban area 341(56.4%) were significantly associated with CAs, which is supported by (Abebe et al., 2021; Ameen et al., 2018; Mekonnen & Worku, 2021) . Because of the high concentration of air pollutants that urban residents are exposed to, there is a greatly increased risk of having babies with CAs. (Cheng et al., 2023) air pollutant cause diminishing the oxygen supply to the body s tissues. These factors increase the likelihood of CAs by reducing the amount of oxygen and nutrients that are delivered to the fetus (Ameen et al., 2018). Results also shown a significant epidemiological deviation, Gastrointestinal (GI) anomalies were the dominant pathology 200 cases (33.1%) which is similar with other study findings. (Ambey & Bhadauria, 2025; Ekwere et al., 2011; Obu et al., 2012; Shawky & Sadik, 2011) . while The musculoskeletal system was the most common system affected by CAs in similar studies (K. Bhalerao, 2019; Hussein et al., 2025; Sarkar et al., 2013) In contrast to Central nervous system abnormalities found in similar studies (Ameen et al., 2018; Taye et al., 2018) , Cardiovascular System in other studies, (Al-Dewik et al., 2023; Ali Hussein, 2017; Chimah et al., 2022). These differences could be attributed to various genetic and environmental factors in different countries & varied methodology, for instance, for example someone use investigative procedures such as karyotyping and aversion for autopsy in the study area. The combined burden of gastrointestinal and cardiac anomalies (57.6%) highlights the need for specialized neonatal surgical and intensive care services. A standout feature of the temporal analysis was the significant spike in recorded cases during 2021(28.1%,). The findings of this six-year observational study reveal a complex and persistent epidemiological profile of congenital anomalies from 2018 to 2023 with a spike in recorded cases during 2021 (28.1%), While the overall linear trend remained stable over the six-year span, this peak coincides with the post global COVID-19 pandemic, The peak observed in 2021 may be related to disruptions in healthcare systems during the COVID-19 pandemic (Mebratie et al., 2022) (Zhang et al., 2020) (Didisa et al., 2025) suggesting that shifts in hospital referral patterns, potential changes in maternal health-seeking behavior, or environmental stressors during this period may have influenced registry data. These findings going with other studies (Chimah et al., 2022) (Onankpa & Adamu, 2014) . Furthermore, the stability of the caseload from 2021 to 2023 indicates that the underlying drivers of congenital defects most notably the high

rates of consanguinity and maternal chronic diseases identified in our cohort remain entrenched challenges for the regional healthcare system. In comparison with my study at 2011-2015 ,this study at 2018-2023 The total cases significantly more than that of previous study( 605 versus 327),at the recent study the highest percentage were anomalies of the gastrointestinal tract followed by CVS while the previous study reveals highest number of cardiovascular system followed by the gastrointestinal system , and similarly Higher percentages for male sex, urban residency,18-35 years old maternal group& positive consanguinity (Ali Hussein, 2017). suggesting the fixity of some explored risk factor which needs further wide survey.

## Limitations

This study is limited by its retrospective design and reliance on hospital-based data, Additionally, certain maternal lifestyle and environmental exposures could not be quantified.

## Conclusion

Positive consanguinity is significant associated risk factor, several independent risk factors for CAs were identified in this study, including low birth weight, maternal age, maternal exposure to drugs, fever, previous sibling anomalies & previous abortion. GIT CA were the most common CA, the highest Annual Distribution of congenital anomalies in 2021, The organ system stratification definitively categorizes the cohort as a high-acuity surgical population, where the combined burden of Digestive (n=200) and Cardiovascular (n=148) anomalies accounts for 57.6% of all cases

## Recommendation

The findings of this study carry significant implications for the regional healthcare infrastructure and prenatal public health strategies**,** the high prevalence of Gastrointestinal (33.1) and Cardiovascular (24.5%) anomalies, classified as "Critical Surgical" and "High Survival Risk," necessitates a prioritization of neonatal surgical resources. Hospitals should consider expanding Neonatal Intensive Care Unit (NICU) capacity and ensuring access to specialized pediatric surgical teams, From a preventative standpoint, the 43% consanguinity rate identified in Table 1 suggests that pre-conception genetic counseling should be integrated into primary healthcare services, Educating couples about the risks associated with consanguineous unions particularly regarding autosomal recessive disorders could serve as a long-term strategy to reduce the incidence of complex anomalies. Finally, the stable trend observed from 2018 to 2023 suggests that existing strategies are insufficient; therefore, establishing a centralized national registry for congenital anomalies is a vital next step to move from reactive treatment to proactive prevention.

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