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# Prevalence of Congenital Malformations among Neonates at Al-Ahrar Teaching Hospital

**Ahmed Hassan Mahmoud Hassan*[1], Aly Hassan Muhammad Fayyadh[2], Alaa Hassieb Elsadek[3]**
Departments of [1]Pediatrics, [2]Radiodiagnosis and [3]Obstetrics and Gynecology,
Al-Ahrar Teaching Hospital, Zagazig, Egypt
***Corresponding author:** Ahmed Hassan Mahmoud Hassan, **Mobile:** (+20)1225953895, **Email:** drahmhassan@gmail.com

## ABSTRACT
**Background:** Congenital disorders are common conditions. The incidence of malformations in the neonate variations both between countries and between regions within the same nation.
**Objective:** The aim of the current work was to determine the spot incidence of congenital malformations among neonates at Obstetric Department of El-Ahrar Zagazig Hospital.
**Patients and methods:** This prospective descriptive study included a total of 31 babies who were noted to have congenital malformation, attending with their parents at the Obstetric Department and the Neonatal Intensive Care Unit (NICU), El-Ahrar Zagazig Hospital. The total number of deliveries during the period of the study was 1254.
**Results:** Congenital anomalies incidence was 2.47%. The greatest incidence of congenital abnormalities (CAs) involved the musculoskeletal system, abdominal wall and skin (in 23%), the central nervous system (in 19%), the cardiovascular system (in 19%), the genitourinary system (in 13%), the gastrointestinal tract (in 10%), the orofacial (in 10%) and chromosomal aberrations (in 6.5%). Most cases of congenital anomalies were full term.
**Conclusion:** It could be concluded that the spot incidence of congenital anomalies among liveborn neonates in Zagazig locality accounts for 2.5% (31/1254 deliveries).
**Keywords:** Congenital Malformations, Neonates, Al-Ahrar Teaching Hospital.

## INTRODUCTION

Structural or functional abnormalities, such as metabolic problems, that are present at birth are what are referred to as birth defects. Both "birth defect" and "congenital disorder" are used interchangeably since they mean the same thing **(1).**

Birth defects, regardless of classification, are a substantial but underrecognized cause of mortality and impairment among newborns and children under the age of five. They are also a leading cause of abortion and stillbirth. They pose serious health risks, can cause permanent disability, and have far-reaching consequences for people's lives, families, healthcare systems, and communities **(2).**

The prevalence of congenital anomalies varies greatly from country to country and even from area to region within a same country. Infants have a 1-3% chance of being born with complete abnormalities across all body systems **(3).** About 3% of all live births are associated with a birth abnormality that can be identified, while between 15% and 20% of stillbirths are associated with a significant congenital deformity. Genealogical and environmental factors both play a role in the development of congenital anomalies. However, a large percentage of birth abnormalities have unknown causes and many are known to result from a combination of genetic and environmental variables (multifactorial inheritance) **(4).**

Disorders present at birth, known as congenital disorders, are quite frequent. CAs were responsible for around 265,000 deaths globally, or about 7% of all neonatal deaths. Some regions, including the WHO European Region, have as high as 25% of neonatal deaths attributable to CAs, even if overall mortality rates are lower in such areas **(5)**.

There are many potential prenatal causes for birth defects, including mutations in a single gene, chromosomal abnormalities, multifactorial inheritance, teratogens in the environment, and nutritional inadequacies in the fetus. Birth malformations are common in low and middle-income nations, and maternal illnesses like syphilis and rubella are a major contributor. Causes of birth abnormalities include iodine and folic acid deficiencies, maternal illnesses like diabetes mellitus (DM), and exposure to medical and recreational substances like alcohol and nicotine, as well as environmental toxins and high amounts of radiation **(2)**.

Existing health-care services, especially those concerned with maternal and child health, should include treatments and interventions for the prevention and care of birth abnormalities. Education, preconception care, population screening, genetic counselling, and access to diagnostic tests should all be part of a comprehensive, preventative approach to providing the best possible care to their patients. As part of a larger set of interventions for mother and child health, this plan must provide services for the detection and treatment of congenital anomalies. Services should include secondary and tertiary care, such as obstetrics, pediatrics, surgery, laboratory, radiology, and clinical genetics, if these are accessible in the country **(2).**

The aim of the current work was to determine the spot incidence of congenital malformations among neonates at Obstetric Department of El-Ahrar Zagazig Hospital.

## PATIENTS AND METHODS

This prospective descriptive study included a total of 31



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babies who were noted to have congenital malformation, attending with their parents at the Obstetric Department and the Neonatal Intensive Care Unit (NICU), El-Ahrar Zagazig Hospital.
The total number of deliveries during the period of the study was 1254. Out of this number, 31 Babies were noted to have congenital malformation.

***Babies and their mothers were subjected to the following:***

**I. History:**

1. Full maternal history as regards maternal age, consanguinity, serial no of baby in the family, history of an anomaly in other kids, family history of anomaly, history of previous abortions, modes of previous deliveries, special habits like smoking, alcohol intake, other addicting habits, if the father was being smoker, body weight and nutritional status before and during pregnancy.
2. Maternal history of chronic diseases as DM, SLE, PKU, renal diseases, cardiac diseases, thyroid diseases, epilepsy.
3. History of drugs intake or ionizing radiation during pregnancy.
4. History of acute illness during present pregnancy regarding TORCH infection, fever, bleeding, and threatened abortion.
5. History of pregnancy complications as gestational diabetes, preeclampsia, eclampsia.
6. History of obstetric complications as oligohydramnios, polyhydramnios, bleeding and multiple pregnancies.
7. Perinatal history with special emphasis on perinatal asphyxia, mode of delivery, estimated gestational age and fetal presentation.

**II. Clinical examination:**

A thorough physical examination was essential for the baby who had already been diagnosed with a major or mild congenital deformity to rule out the presence of any other defects [6].

1. Full clinical examination of the baby as regards gestational age (GA) determination (according to Ballard scoring system [7]), of birth weight, jaundice, cyanosis, and pallor.
2. Careful inspection of the baby starting with the head and face, following the sequence presented below:
    - Skull and face for flat or prominent nasal bridge, small mandible, flat or prominent mandible, hydrocephalus, anencephaly.
    - Eye for cataract, epicanthal folds, hypo- or hypertelorism, ptosis, upward slant of palpebral fissures.
    - Ears for low- set ear, large or small ear or deformed ear.
    - Mouth and lips for cleft lip/palate, high arched palate, large tongue.
    - Chest for depressed sternum, wide set nipples, pectus excavatum or pectus carinatum.
    - Abdominal/perineal for umbilical hernia, inguinal hernia, small testis, hypospadias.
    - Back for meningocele, kyphosis and / or scoliosis.
    - Neck for webbed neck, short neck.
    - Hands for clinodactyly, unusual palm crease pattern, syndactyly, polydactyly, or abnormal shape of the hand.
    - Feet for syndactyly of toes, hallux valgus.
    - Skin and hair for low hair line, alopecia of scalp... etc.
3. Auscultation of the heart, chest and abdomen.

4. Neurological examination of the baby.
5. Actual measurements compared with age related norms was used to measure body proportions, length of extremities and such facial features as distance between eyes, length of eye fissures, size of the ear and length of philtrum.
6. Examination for congenital hip dysplasia (CHD).

**III. Investigations:**

Baseline investigations such as blood group, Rh factor, complete blood picture, urine analysis and blood sugar were carried in all suspected babies. Any newborn with several congenital malformations that could be caused by a single chromosomal abnormality, or who has multiple abnormalities or neurological impairment of uncertain origin, would benefit from a cytogenetic examination [6]. So karyotyping was done for babies who were suspected to have any chromosomal abnormality.
X-ray examination should be obtained if a skeletal abnormality is suspected or if the differential diagnosis includes a genetic syndrome that has skeletal defects as part of phenotype [8]. Organ imaging by ultrasonography (U/S), magnetic resonance imaging (MRI) and computed tomography (CT) scan should be used to rule out structural abnormalities of major organs such as brain, heart and kidney [9].
Echocardiography was done to any cases that had murmur on auscultation or were persistently cyanosed. Abdominal U/S was done to any infant who was suspected to have any congenital anomaly in kidney, urinary system and/ or liver. CT scan and MRI were done to cases with abnormality in skull shape / size, abnormal size of fontanelles and abnormal neurological manifestations.

**Congenital abnormalities were diagnosed by a combination of the patient's history, physical examination, and diagnostic tests.**

The congenital anomalies were classified into 7 groups:

- Cardiovascular system (CVS) malformations.
- Central nervous system (CNS) anomalies.
- Urogenital anomalies.

- Gastrointestinal tract (GIT) anomalies.
- Orofacial and eye abnormalities.
- Chromosomal abnormalities.
- Musculoskeletal anomalies, skin and abdominal wall defect.

**Ethical consent:**

**An approval of the study was obtained from Zagazig University Academic and Ethical Committee. Written informed consent of all the parent participants was obtained, after being informed about the aims and process of the study as well as applicable objectives. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.**

**Statistical analysis:**

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 22 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Data were tested for normal distribution using the Shapiro Walk test. Qualitative data were represented as frequencies and relative percentages. P value < 0.05 was considered significant.

**RESULTS**

The total number of cases surveyed was 1254. The incidence of congenital abnormalities in this study was 2.5%, as only 31 infants were born with the condition. The frequency of different congenital anomalies is shown in **Tables (1).**

**Table (1):** Incidence of congenital anomalies (percent and perthousand).

| **Total no. of deliveries** | **Congenital anomalies** | | |
|---|---|---|---|
| | **n** | **%** | **Per 1000** |
| 1254 | 31 | 2.47 | 24.7 |

**Table (2):** Incidence of 31 congenital anomalies among various systems (per cent) and among 1254 deliveries (per thousand).

| **System anomalies** | **N** | **%** | **Among deliveries, n=1254 (%o)** |
|---|---|---|---|
| Musculoskeletal, abdominal wall and skin | 7 | 22.58 | 5.58 |
| Central nervous | 6 | 19.35 | 4.78 |
| Cardiovascular | 6 | 19.35 | 4.78 |
| Urogenital | 4 | 12.90 | 3.19 |
| Gastrointestinal | 3 | 9.6 | 2.39 |
| Orofacial and eye | 3 | 9.6 | 2.39 |
| Chromosomal | 2 | 6.45 | 1.59 |

**Analysis of data "characteristics of neonates with CAs"**

**Characteristics of neonates with CAs (Table 3)**

**(I) Sex:** Fifteen cases (48.4%) were males and 16 cases (51.6 %) were females.

**(II)Gestational age (weeks):** Eleven cases (35.4%) were delivered between 24-36 weeks, and 20 cases (64.5%) were delivered between 37-40 weeks.

**(III) Birth weight**: Two cases (6.5%) were with birth weight between 500-1500 grams, 13 cases (41.9%) were with birth weight between 1500-2500 grams, and 16 cases (51.6%) were with birth weight between 2500 ≥ 3500 grams.

**(IV) Outcome**: Twenty- nine cases (93.5%) of cases were singletons and 2 cases (6.5%) were one of twins.

**Table (3):** Characteristics of 31 neonates with congenital anomalies.

| **Characteristic (s)** | **n** | **%** |
|---|---|---|
| Gender | | |
| Male | 15 | 48.4 |
| Female | 16 | 51.6 |
| | | |
| Gest. Age (week) | | |
| 24- 36 | 11 | 35.5 |
| 37- 40 | 20 | 64.5 |
| | | |
| Body weight (gm) | | |
| < 1500 | 2 | 6.5 |
| 1500- 2500 | 13 | 41.9 |
| 2500 ≥ 3500 | 16 | 51.6 |
| | | |
| Outcome | | |
| Singleton | 29 | 93.5 |
| One of twin | 2 | 6.5 |

**Maternal Risk Factors (table 4)**

**1-Maternal age:** There were 2 cases (6.5%) among infants born to moms younger than 20., 23 cases (74.2%) were seen in neonates born to mothers of age between 20-38 years and 6 cases (19.4%) were seen in neonates born to mothers with age of more than 38 years.

**2-Consanguinity:** Seven cases (22.6%) were noted in babies with family history of positive consanguinity

**3- Mode of delivery:** Six cases (19.4%) were delivered by normal vaginal delivery (VD) and 25 cases (80.6%) were delivered by cesarean section (C/S).

**4-Whether there's a family history of CA or anomalies in other children:** Five cases (16.1%) had a history of an anomaly in other kid or family history of CA.

**5- History of abortion:** Seven cases (22.6%) had a history of previous abortion.

6- **Father smoking**: Thirteen cases (41.9%) had a smoking father.

**7- Drugs:** Two cases (6.5%) were with mothers who had taken a drug during pregnancy.

**8-Oligohydramnios / Polyhydramnios:** Two cases (6.4 %) were of mothers with oligohydramnios and another 2 cases were of mothers with polyhydramnios.

**9-Nutrition:** Six cases (19.3%) were with obese mothers, while 11 cases (35.5 %) were seen in malnourished mothers.

**Table (4):** Maternal risk factors in 31 neonates with congenital anomalies, presented as number (n) and percentage (%).

| Maternal risk factor (s) | N. | % |
|---|---|---|
| Maternal age (years) | | |
| < 20 | 2 | 6.5 |
| 20- 38 | 23 | 74.2 |
| > 38 | 6 | 19.4 |
| Positive consanguinity. | 7 | 22.6 |
| Mode of delivery | | |
| VD | 6 | 19.4 |
| CS | 25 | 80.6 |
| H/O another kid or CA in the family | 5 | 16.1 |
| H/O abortion | 7 | 22.6 |
| Oligohydramnios/ polyhydramnios. | 4 | 12.9 |
| Malnutrition | 11 | 35.5 |
| Obesity | 6 | 19.4 |
| Father smoking | 13 | 41.9 |
| Drug intake during pregnancy | 2 | 6.5 |

**Maternal diseases (Table 5)**

**1-Diabetes mellitus (D M)**: Four cases (12.9%) were of mothers with gestational D.M.

**2-Epilepsy:** One case (3.2%) was of a mother with epilepsy.

**3-Torch:** Two cases (6.5%) were of mothers who had torch infection during pregnancy.

**4-Fever:** Seven cases (22.6%) were of mothers who had fever during pregnancy.

**5-Pre-eclampsia and antepartum hemorrhage:** Seven cases (22.6%) with CAs were of mothers with pre- eclampsia and another 5 cases were of mothers who had antepartum hemorrhage.

**Table (5):** Maternal diseases in mothers of 31 neonates with congenital anomalies, presented as number (n) and percentage (%)

| Maternal disease | N. | % |
|---|---|---|
| Pre-eclampsia and antepartum hemorrhage | 7 | 22.6 |
| Fever | 7 | 22.6 |
| Diabetes mellitus (DM) | 4 | 12.9 |
| Torch | 2 | 6.5 |
| Epilepsy | 1 | 3.2 |

Table 6 shows percentage of different congenital anomalies among 31 neonates, presented as number (n) and percentage (%) in the study.

Table (6) shows the pattern of CAs among 31 study neonates the musculoskeletal system, abdominal wall and skin (in 23%), the central nervous system (in 19%), the cardiovascular system (in 19%), the genitourinary system (in 13%), the gastrointestinal tract (in 10%), the orofacial (in 10%) and chromosomal aberrations (in 6.5%). The encountered musculoskeletal, skin and abdominal wall anomalies included talipes, polydactyly, syndactyly, exomphalos major, gastroschisis and collodion skin. CNS anomalies included hydrocephalus (2 cases), meningiocele (2 cases), and both (one case), and encephalocele. CVS anomalies detected are VSD (2 cases), ASD, PDA, TGA and Fallot's tetralogy, each in one case. Gentitourinary anomalies included ambigious gentalia, hydrocele, hypospadius and undescended testis. GIT anomalies (duodenal atresia, imperforate anus and TOF) were detected in 3 cases. The Orofacial anomalies were detected in 3 cases (one clef lip and palate, one anophthalmia and one ectropion & microphthalmia). Two neonates were detected with chromosomal anomalies (one Down syndrome and one Edward syndrome).

**Table (6):** Percentage of different congenital anomalies among 31 neonates, presented as number (n) and percentage (%)

| Anomalies | n | % |
|---|---|---|
| Musculoskeletal, skin and abdominal wall | 7 | 22.6 |
| Talipes equinovarus | 2 | 6.5 |
| Polydactyly | 1 | 3.2 |
| Syndactyly | 1 | 3.2 |
| Exomphalos major | 1 | 3.2 |
| Gastroschisis | 1 | 3.2 |
| Collodion baby | 1 | 3.2 |
| Central nervous system | 6 | 19.4 |
| Hydrocephalus | 2 | 6.5 |
| Meningocele | 2 | 6.5 |
| Hydrocephalus & meningocele | 1 | 3.2 |
| Encephalocele | 1 | 3.2 |
| Cardiac anomalies | 6 | 19.4 |
| VSD | 2 | 6.5 |
| ASD | 1 | 3.2 |
| PDA | 1 | 3.2 |
| TGA | 1 | 3.2 |
| Fallot's tetralogy | 1 | 3.2 |
| Urogenital anomalies | 4 | 12.9 |
| Ambiguous gentalia | 1 | 3.2 |
| Hydrocele | 1 | 3.2 |
| Hypospadius | 1 | 3.2 |
| Undescended testis | 1 | 3.2 |
| Gastrointestinal anomalias | 3 | 10 |
| Duodenal atresia | 1 | 3.2 |
| Imperforate anus | 1 | 3.2 |
| TOF | 1 | 3.2 |
| Orofacial and Eye anomalies | 3 | 10 |
| Cleft lip and palate | 1 | 3.2 |
| Anophthalmia | 1 | 3.2 |
| Ectropion & micro-ophthalmia | 1 | 3.2 |
| Chromosomal anomalies | 2 | 6.5 |
| Down syndrome | 1 | 3.2 |

| | | |
|---|---|---|
| Edward syndrome | 1 | 3.2 |

## DISCUSSION

Defects at birth may be single anomalies or components of a syndrome. Around 495,000 people died as a direct result of significant congenital abnormalities. This represents roughly 3 million newborns each year. Multiple large population studies estimate that 2-3% of all babies are affected by a significant abnormality. About the same number of additional severe birth defects are discovered in later life. Nearly 60% of all congenital abnormalities are found within the first month, and 80% within the first three months of life [(10)].

Approximately 8 billion dollars are spent each year in the United States on medical and rehabilitative care for children with birth abnormalities [(10)].

There are currently no reliable estimates of how many babies suffer from a severe congenital disease due to either genetic or environmental factors. Inadequate death registration is a major problem in many countries, making it difficult to accurately assess the prevalence and mortality rates of congenital diseases. These numbers, however, show that efforts to reduce the mortality rate of children under the age of five by two thirds between 1990 and 2015 must be linked to those of addressing the incidence and mortality related with CAs [(2)].

In this study, the pattern of CAs among 31 studied neonates is shown in table (6).

According to ICD-10 classification of CAs, **Alshehri** [(11)], in Asir central Hospital (Kingdom of Saudi Arabia), reported that the systems involved in the major CAs investigated were (in descending order of frequency) as follows: digestive (28.6%), CNS (26.1%), CVS (16.5%), urogenital (7.1%), face and neck (4.1%), respiratory (4.2%), musculoskeletal (3.6%), chromosomal (3.3%) and other anomalies (4.5%). In Kuwait, isolated systems anomalies included CNS (25%), CVS (18.8%), skeletal system (14.6%), and gastrointestinal system (12.5%) [(12)].

Social and racial effects, well-known in genetic illnesses, may account for these discrepancies in prevalence. The results also differ depending on the expertise of the researchers and the characteristics of the population that was examined [(13)].

Study of the characteristics of liveborn neonates with CAs, revealed that: Fifteen (48.4%) cases were males and 16 (51.6%) cases were females, 2) the majority of neonates (65%), with CAs were full-term; 3) about 52% of cases with CAs are of birth wight ranging from 2500g to > 3500g; 4) the majority of neonates (94%) were singletons.

Regarding sex of neonates with CAs, in contrast to our results other studies reported that cases with CAs constituted significantly higher proportion of males that of females [(11, 14, 15)]. However, **Gupta *et al.*** [(16)] reported an apparent increase in the occurrence of congenital musculoskeletal abnormalities in female babies compared to male babies, however this difference was not statistically significant.

In the current study, maternal risk factors associated with neonatal CAs included maternal age, consanguinity, mode of delivery, history of an anomaly in other kids or in the family, history of abortion, maternal nutrition, maternal intake of drugs during pregnancy, oligohydramnios / polyhydramnios and/or father smoking. Results showed that the majority (74.2%) of mothers of neonates with CAs were of ages ranging from 20 to 28 years. Positive consanguinity was observed in only about 23% of neonates with CAs the majority (81%) of neonates with CAs were delivered by C/S. Only 16% of affected neonates had an anomaly in other kids or family history of CAs. History of abortion was reported in about 23% of cases Oligohydramnios or polyhydramnios was reported only in 4 cases (12.8%). Maternal obesity was reported in 6 cases (35.5%) of mothers, while undernutrition was reported in 35.5% of mothers. Father smoking was reported in about 42% of cases with CAs.

As reported by **Gupta *et al.*** [(16)], the incidence of musculoskeletal system CAs was nonsignificantly different among babies born to mothers of different age groups. Meanwhile, **Swain *et al.*** [(17)], stated that though there was higher incidence of malformation in babies born to mothers of more than 35 years the difference was not statistically significant.

In this study, positive parental consanguinity was observed in only 23% of our series of neonates with CAs. In contrast, other previous studies reported statistically significant. Parental consanguinity [(13)].

In our study, we found that 5 cases (16.1%) had a family history of congenital anomalies. **Anjum *et al.*** [(18)] found that among patients 17.8% had a family history of congenital anomalies

In our study we found that a large percentage (41.9%) of cases born to smoking fathers which agrees with **Larsen *et al.*** [(19)] who found that fathers smoking was more common among children with cleft lip or with cleft palate, hydrocephalus, VSD and urethral stenosis. Disorders of amniotic fluid was observed in only (12.8%) of cases with CAs. However, **QueiBer-Luft *et al.*** [(20)] reported that the calculated prevalence odds ratios confirm well known association between hydramnios and major CAs

Out of the maternal risk factors studied in our series; malnutrition, TORCH & fever, maternal obesity, pre-eclampsia and antepartum hemorrhage were observed in 35.5%, 29%, 19%, and 16%, respectively, of cases with CAs. **Cassell and Golden** [(21)] reported that certain birth abnormalities, including spina bifida and heart problems, are significantly related with maternal obesity.

## CONCLUSION

It could be concluded that the spot incidence of congenital anomalies among liveborn neonates in Zagazig locality accounts for 2.5% (31/1254

deliveries).

The majority of neonates suffering congenital anomalies are full term singletons, of normal birth weight, without considerable difference between males and females.

Maternal risk factors associated with high prevalence of congenital anomalies included, maternal age (20 to 28 years), positive consanguinity, mothers delivered by C/S, mothers with history of abortion, both maternal malnutrition and obesity, father smoking, fever/ TORCH infections pre-eclampsia and antepartum hemorrhage.

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**Author contribution:** Authors contributed equally in the study.

## REFERENCES

1. **Mai C, Isenburg J, Canfield M *et al.* (2019):** National population-based estimates for major birth defects, 2010-2014. Birth Defects Research, 111(18): 1420–1435.
2. **Kirby R (2017):** The prevalence of selected major birth defects in the United States. Seminars in Perinatology, 41(6): 338–344.
3. **Toobaie A, Yousef Y, Balvardi S *et al.* (2019):** Incidence and prevalence of congenital anomalies in low- and middle-income countries: A systematic review. Journal of Pediatric Surgery, 54(5): 1089–1093.
4. **ElAwady H, AlGameel A, Ragab T *et al.* (2021):** Congenital anomalies in neonates in Fayoum Governorate, Egypt. Eastern Mediterranean Health Journal, 27(8): 790–797**.**
5. **Boyle B, Addor M, Arriola L *et al.* (2018):** Estimating Global Burden of Disease due to congenital anomaly: an analysis of European data. Archives of disease in childhood. Fetal and Neonatal Edition, 103(1): 22–28.
6. **World Health Organization (2022):** Birth defects. https://www.who.int/news-room/fact-sheets/detail/birth-defects
7. **Ballard J, Khoury J, Wedig K *et al.* (1991):** New Ballard score, expanded to include extremely premature infant. J Pediatr., 119: 417-23.
8. **McCandles S (2004):** A primer on expanded newborn screening by tandem mass spectrometry. Prim Care Clin Office Pract., 31:583-88.
9. **Aase J (1999):** Diagnostic dysmorphology for the pediatric practitioner. Ped Clin North Am., 46:135-39.
10. **Kirby R, Mai C, Wingate M *et al.* (2019):** Prevalence of selected birth defects by maternal nativity status, United States, 1999-2007. Birth Defects Research, 111(11): 630–639.
11. **Alshehri M (2005):** Pattern of major congenital anomalies in south western Saudi Arabia. Bahrain Med Bull., 27 (1): 302-307.
12. **Madi S, Al-Naggar R, Al-Awadi S *et al.* (2005):** Profile of major congenital malformations in neonates in Al-Jahra region of Kuwait. East Mediter Health J., 11 (4): 700-706.
13. **Jehangir W, Ali F, Jahangir T *et al.* (2009):** Prevalence of gross congenital malformations at birth in neonates in a tertiary care hospital. APMC., 3: 47-50.
14. **Ahmadzadeh A, Safikhani Z, Abdulahi M (2008):** Congenital malformation among livebirths at Atvand Hospital, Ahwaz, Iran. Pak Med., 24 (1): 33-37.
15. **Singh A, Gupta R (2009):** Pattern of congenital anomalies in newborn: A hospital based prospective study. JK Science, 11 (1): 34-36.
16. **Gupta R, Gupta C, Singh D (2003):** Incidence of congenital malformations of the musculo-skeletal system in new liveborns in Jammu. JK Science, 5 (4): 157-160.
17. **Swain S, Agrawal A, Bhatia B (1994):** Congenital malformations at birth. Indian Pediatrics, 31: 1187-1191.
18. **Anjum R, Saher S, Soomro N (2006):** Frequency of congenital anomalies and associated maternal risk factors. Pak J Sur., 22(3): 18-23.
19. **Larsen L, Clausen H, Jansson L (2002):** Sterologic examination of placentas from mothers who smoke during pregnancy. Am J Obstet Gynecol., 99:186-89.
20. **QueiBer-Luft A, Stolz G, Wiesel A *et al.* (2002):** Malformations in newborn results based on 30940 infants and fetuses from the mainz congenital birth defect monitoring system (1990-1998): Arch Gynecol Obstet., 266: 163-167.
21. **Cassell C, Golden L (2010):** Epidemiology as a guardian of children's health: translating birth defects research into policy. AEP., 20 (7): 493-498.