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Frequency of Congenital Anomalies in Newborns

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ABSTRACT

Congenital abnormalities (CA) are anatomical or performance-based anomalies that express themselves during the in-utero growth and may be diagnosed during pre-birth, during delivery, and post-birth. **Objective:** To review the incidence of birth defects in infants. **Methods:** The descriptive cross-sectional study was conducted in the Department of Obstetrics and Gynecology, Civil Hospital, Karachi, during a period of two years, i.e., March 2017 to March 2019. This study had 213 pregnant women. After birth, there was the identification of congenital anomalies in the newborns by visual examination, and other factors were established by the history of the patient or medical records. All the data were recorded on a pre-determined proforma template. **Results:** The average age of the participants was 27.381 ± 4.08. The most common congenital anomalies were anencephaly (19.7%), hydrocephalus (15.5%), absence of ear/finger/toe/scrotum/arm/leg/limbs (9.4%), cleft lip and cleft palate (8.9%), meningomyelocele (7%), and talipes (8%). The causal variables were maternal age 30 years and above (20.2%), paternal age 35 years and above (19.7%), maternal diabetes mellitus (20.2%), consanguinity marriage (20.2%), maternal infection during pregnancy (8.9%), and maternal folic acid supplementation (61.5%). These are said to be descriptive and not causal. **Conclusions:** This study highlights the rate of congenital anomalies and the types of congenital anomalies. Its results touch on the importance of routine antenatal care and prenatal screening to intervene and manage affected pregnancies at an earlier stage.

INTRODUCTION

Congenital abnormalities (CA) are anatomical or performance-based abnormalities (e.g., endocrine or sensory functional conditions like congenital deafness or visual impairment) that appear during in utero growth and could be diagnosed prenatally, at birth, or later on [1]. The WHO indicates that congenital defects occur in approximately 6 percent of live births in the world. They cause 17-42 percent of deaths in infants, and there is variability in the deaths in various regions and different countries [2]. A study by Shahid *et al.* in Pakistan has shown that congenital abnormalities were a major cause of high perinatal mortality rate, and the Pakistan Health and Demographic Survey 2017-18 states that the perinatal mortality rate in Pakistan has been consistently high over the last decade at 75 per 1,000 births [3]. CA is a result of the abnormal development process that is inherent in which the development of a tissue or organ is arrested or slowed down prematurely [4]. Congenital anomalies have been the major cause of spontaneous miscarriage, stillbirth, perinatal mortality, and long-term disability that cause significant challenges to affected persons, their families, and to healthcare systems [5]. The anomalies can be associated with one organ or a combination of organ systems and have various possible causes. Nevertheless, the cause that lies behind the whole situation is not known in about half of all cases. Among those with an identifiable cause, about 20–25% are believed to result from a combination of genetic and environmental factors. Recent

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studies have expanded our understanding of monogenic disorders frequently associated with congenital anomalies, while emerging methods have also uncovered non-Mendelian genetic factors, including interactions between genes and environmental exposures [6]. The prevalence of congenital anomalies is strongly influenced by genetic, environmental, and socioeconomic factors. According to the WHO, the majority of severe congenital disorders occur in low- and middle-income countries [7]. Gastrointestinal tract and abdominal wall anomalies are among the most frequently observed congenital anomalies, ranking as the fourth most common structural anomalies after those affecting the heart, nervous system, and urogenital tract [8]. In a systematic review and meta-analysis study by Staniczek et al. adolescents and young women living in socioeconomically poor neighborhoods were reported to be more susceptible to giving birth to children with congenital anomalies. This increased danger is due to the lack of access to vaccination services, insufficient folic acid consumption, and little preconception and antenatal care. Also, young women who are exposed to maternal infections are especially at risk of giving birth to children with congenital abnormalities [9]. Geda *et al.* performed a meta-regression analysis and identified that maternal illness, unidentified drug use, low birth weight, khat chewing, exposure to chemicals, and never use of folic acid were statistically significant factors that could lead to the risk of congenital anomalies in low-resource settings [10]. High-quality antenatal care, skilled attendance at birth, and appropriate management of small and sick newborns play a vital role in reducing the incidence of congenital anomalies and neonatal mortality. Integrating the prevention and management of congenital anomalies into existing maternal, reproductive, and child health services is essential for improving outcomes [11].

This study aimed to determine the most common congenital anomaly in newborns and identify the causative factors in our population, so that preventable measures taken to prevent the most frequent congenital anomaly and prenatal diagnosis can be made to take any decision for intervention. A congenital anomaly was defined as the presence of any of the following conditions, which were identified by visual examination: hydrocephalus, characterized by an enlarged head with prominence of the forehead; anencephaly, defined by a small head with no prominence of the forehead; cleft lip, which is the partial fusion of the upper lip; cleft palate, the partial fusion of the upper jaw; talipes, where the foot is twisted from its normal shape and position; spina bifida, which is a malformation of the vertebral column through which meninges may or may not protrude; and omphalocele, the protrusion of the intestine through a defect in the abdominal wall that is covered by a membrane. The research aimed to identify the frequency of congenital anomalies in newborns and the causes behind these anomalies.

METHODS

This descriptive cross-sectional study was undertaken at Unit 2 of the Department of Obstetrics and Gynecology, Civil Hospital Karachi, during the span of two years, from March 2017 to March 2019, following approval of the research proposal by CPSP (CPSP Letter number CPSP/REU/OBG-2015-183-7029). The sample size was determined using the Open Epi sample size calculator tool with a prevalence of 5.26% [5], a margin of error of 3%, and a 95% confidence interval, resulting in an estimated sample size of 213. Formula: $n=Z2 \times p \times (1-p) / d^2$. Where n is the required sample size, Z=1.96for a 95% confidence interval, p=0.0526 (prevalence of congenital anomalies [5]), and d=0.03 (absolute precision). Substituting these values: n = (1.96) 2 x 0.0526 x (1 – 0.0526) / (0.03)2. n=213 (Thus, the minimum required sample size was 213 participants). Participants were selected by consecutive sampling with a non-probability sampling technique. Maternity age was limited to 19-45 years, both primigravida and multipara women, and gestational age of over 20 weeks. Those who were pregnant with twins or below 20 gestational weeks were excluded. In order to start data collection, the College of Physicians and Surgeons of Pakistan were consulted. All women who followed the inclusion criteria provided informed consent. These women were already in the delivery room in the Department of OBGYN, Unit 2 of Civil Hospital Karachi. Congenital anomalies of the newborns were detected by observing the babies after delivery. The medical history and records were used to get the maternal and pregnancy-related factors. Data such as maternal demographic information, obstetric history, health status, and other clinical findings were collected. A review of the prenatal ultrasound scans, where available, was also done to determine and categorize congenital abnormalities before birth. Maternal infection during pregnancy was documented in relation to clinical history, medical records, and any laboratory testing that was performed. Commonly suspected congenital pathogens (parvovirus B19, varicella, herpes simplex virus, syphilis, and Toxoplasma) were also included in the infections. Not every infection could be serologically confirmed because of the restrictions of routine testing in the hospital. History and prescription records were used to document the folic acid supplementation. Descriptive statistics were utilized to investigate the relationships between maternal infections, folic acid supplementation, and congenital abnormalities, but due to the low number of confirmed infections, they could not perform a robust correlation analysis. All the data were entered into a pre-

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coded proforma and processed to identify the nature and the frequency of congenital anomalies as well as to investigate the relationship with maternal or pregnancy factors. The assessments were all carried out under the guidance of a consultant who has a background of more than five years. To analyze the data, SPSS version 22.0 was employed. Quantitative variables, such as the age of the mother, paternal age, pregnancies, and gestational age, were calculated in terms of the mean and the standard deviation. Qualitative variables like the factors that contribute to the occurrence of congenital anomalies (maternal age, paternal age, consanguinity, folic acid intake, infections, and diabetes) and the nature of congenital anomalies were determined in terms of frequency and percentage. The variables such as gestational age and parity were stratified to determine the effect of these variables on the outcome.

RESULTS

A total of 213 expectant mothers were included in the study, with a mean maternal age of 27.38 ± 4.08 years, a mean paternal age was 31.99 ± 5.57 years, a mean parity was 3.22 ± 1.89, and a mean gestational age was 32.17 ± 4.85 weeks, as summarized in table 1.

Table 1: Descriptive Statistics of Characteristics of Patients

Variables	Mean ± SD	95% Confidence Interval
Maternal Age (Years)	27.38 ± 4.08	26.83-27.94
Paternal Age (Years)	31.99 ± 5.57	28.54-35.44
Parity	3.22 ± 1.89	2.95-3.49
Gestational Age (Weeks)	32.17 ± 4.85	31.52-32.83

Among these 213 newborns, 161 (75.6%) were born to multigravida women and 52 (24.4%) to primigravida women. Single congenital anomalies were observed in 175 (82.2%) newborns, while multiple anomalies occurred in 38 (17.8%). The frequency of congenital anomalies in newborns is presented in table 2.

Table 2: Frequency of Congenital Anomalies in Newborns

Congenital Anomaly	n (%)
Anencephaly	42 (19.7%)
Hydrocephalus	33 (15.5%)
Cleft Lip	10 (4.7%)
Talipes	17 (8.0%)
Omphalocele	7 (3.3%)
Gastroschisis	4 (1.9%)
Meningomyelocele	15 (7.0%)
Cleft Palate	4 (1.9%)
Encephalocele	2 (0.9%)
Meningocele	6 (2.8%)
Hydrops Fatalis	7 (3.3%)
Absence of Ear/Finger/Toe/scrotum/Arm/Leg/Limbs	20 (9.4%)
Cleft Lip + Cleft Palate	19 (8.9%)
Hydrocephalus +Cleft lip + Cleft palate	3 (1.4%)
Hydrocephalus + Talipes	7 (3.3%)
Hydrocephalus + Encephalocele	4 (1.9%)
Meningocele + Talipes	3 (1.4%)
Hydrocephalus + Polydactyl	2 (0.9%)
Other	8 (3.8%)

As this study only included affected newborns and did not include a comparison group of unaffected newborns, these data are descriptive only, and no causal associations can be inferred. Maternal and pregnancy-related factors among newborns with congenital anomalies included maternal age >30 years (20.2%), paternal age ≥35 years (19.7%), diabetes (20.2%), consanguineous marriage (20.2%), infections during pregnancy (8.9%), and folic acid supplementation (61.5%), as summarized in table 3.

Table 3: Frequency of Maternal and Pregnancy-Related Factors Among Newborns with Congenital Anomalies

Factors	Frequency (%)
Maternal Age (Years)	
≤ 30 Years	170 (79.8%)
>30 Years	43 (20.2%)
Paternal Age (Years)	
<35 Years	171 (80.3%)
≥35 Years	42 (19.7%)
Diabetic Mellitus	
Yes	43 (20.2%)
No	170 (79.8%)
Consanguineous Marriage	
Yes	43 (20.2%)
No	170 (79.8%)
Infection During Pregnancy	
Yes	19 (8.9%)
No	194 (91.1%)
Folic Acid Supplementation	
Yes	131 (61.5%)
No	82 (38.5%)

This table presents the frequency and percentage of various maternal and pregnancy-related factors observed in newborns with congenital anomalies. The factors are reported as associations and are not established as causes.

On analysis of the 213 newborns, certain congenital anomalies were observed to vary with gestational age and maternal parity. Anencephaly (22.6% vs 11.1%, p=0.006), talipes (5.7% vs 14.8%, p=0.032), meningomyelocele (9.4% vs 0%, p=0.019), and absence of limbs (6.3% vs 18.5%, p=0.008) differed significantly between neonates delivered at <35 weeks and those ≥35 weeks. Encephalocele was significantly more frequent among primigravida than among multigravida (3.8% vs 0%, p=0.012), whereas most other anomalies showed no significant differences by parity. Regarding maternal and pregnancy-related factors, none of the factors were significantly associated with

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gestational age. However, maternal age >30 years (p=0.003), paternal age ≥35 years (p=0.0005), and maternal diabetes (p=0.029) were significantly associated with the occurrence of congenital anomalies when stratified by parity. Other factors, including consanguinity, infection during pregnancy, and folic acid supplementation, did not show significant associations, as shown in table 4.

Table 4: Congenital Anomalies and Associated Factors

Variables	Group 1	Group 2	p-value	Significant	Comparison Basis
Anencephaly	<35 Weeks: 22.6%	≥35 Weeks: 11.1%	0.006	Yes	Gestational Age
Talipes	<35 Weeks: 5.7%	≥35 Weeks: 14.8%	0.032	Yes	
Meningomyelocele	<35 Weeks: 9.4%	≥35 Weeks: 0%	0.019	Yes	
Absence of Limbs	<35 Weeks: 6.3%	≥35 Weeks: 18.5%	0.008	Yes	
Encephalocele	Primigravida: 3.8%	Multigravida: 0%	0.012	Yes	Maternal Parity
Other Anomalies by Parity	No Significant Difference	No Significant Difference	>0.05	No	Maternal Parity
Maternal Factors (GA Association)	No Factor Significant	–	–	No	Gestational Age
Maternal Age >30 Years	Associated	–	0.003	Yes	Parity-Stratified
Paternal Age ≥35 Years	Associated	–	0.0005	Yes	
Maternal Diabetes	Associated	–	0.029	Yes	
Consanguinity	Not Associated	–	>0.05	No	
Infection During Pregnancy	Not Associated	–	>0.05	No	
Folic Acid Supplementation	Not Associated	–	>0.05	No	

DISCUSSION

Congenital anomalies are characterized by structural or functional defects present at birth, which frequently lead to significant morbidity and mortality [12]. Congenital anomalies occur in about 3% to 4% of births and are a major cause of perinatal and infant morbidity and mortality [13]. In many high-income settings, routine antenatal care includes two ultrasound scans: one performed at 11–14 weeks of gestation to confirm fetal viability, determine gestational age, and detect multiple pregnancies, and another at 18–20 weeks to screen for major congenital anomalies [14]. Regarding morbidity, congenital malformations represent 12% of all pediatric admissions to hospitals. Patients with congenital malformations tend to have extended hospitalizations and increased medical costs as compared to other patients [15]. In addition to other associated risks, major congenital fetal abnormalities increase the likelihood of malpresentation, particularly breech presentation, and are a risk factor for delivery by cesarean section [16]. Congenital anomalies (CAs) are estimated to affect 3-6% of newborns globally and are linked to hundreds of thousands of deaths. Additionally, socioeconomic disadvantage, health disparities, and misinformation can hinder prevention efforts. A substantial proportion of CAs are caused by genetic factors, including chromosomal abnormalities or single-gene disorders [17]. The most frequently observed congenital anomalies include heart defects, neural tube defects, Down syndrome, cleft lip and palate, clubfoot, hydrocephalus, anencephaly, and others [18]. In a study conducted by Ahn *et al.* and Loane *et al.* it was seen that women in the older maternal age group were more likely to have children with congenital anomalies compared to those aged 20–34 years. However, there was no significant increase in the likelihood of congenital anomalies in women under 20, except for abdominal defects, when compared to those in the 20–34-year age group [18, 19]. This investigation aimed to find out the frequency of congenital anomalies in newborns and the factors contributing to them. A total of 231 pregnant women, aged 19-45 years, were included in the study. Both younger and older maternal ages can elevate the likelihood of birth defects, which presents a significant public health concern [9, 5]. The mean age of the women in our research population was 27.38 ± 4.08 years. The literature that has been available has discussed the implications of maternal age on pregnancy and how it is related to the occurrence of congenital anomalies among newborns. The average age of women at birth has been observed to increase by a noteworthy margin in the last few decades. More couples are getting their first children when the maternal age is 30 or more to 35 years. Some of the studies have attributed delayed childbearing to several pregnancy and fetal complications, which provide guidelines on how to manage these high-risk pregnancies. The strongest among congenital anomalies is the relationship between chromosomal abnormalities (CA) and advanced maternal age (AMA), which has already developed a strong relationship that has influenced the current pattern of screening by professionals worldwide, and it is constantly being improved [20]. In one study by Pethő *et al.* it was found that some non-chromosomal anomalies (NCAs) are closely related to the maternal age and a definite case of

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high or low maternal age that increases the risk of developing an NCA, but the specific age ranges differ depending on the anomaly. On the basis of these findings, the introduction of better screening procedures is suggested. The guidelines are not currently combined with maternal age-related recommendations to fetal echocardiography or fetal neurosonography, which may prove to be useful in the detection of the corresponding NCAs. Also, it should not be limited to the old mothers alone, but the very young mothers age group should be considered as well. [20]. It has been reported in the past that the incidence of malformations is significantly high among multiparous women [18]. Our findings also confirm this position, which shows that there is a positive relationship between birth order and the occurrence of birth anomalies. Notably, 75.5% of the women in our study were multiparous. The trends and frequency of congenital disorders can change over the course of time or across different geographic locations, influenced by a sophisticated interplay of hereditary, ecological, socio-cultural, racial, and ethnic factors, both known and unknown [19]. In the current study, there were 82.16% single anomalies and 17.84% multiple anomalies. The commonest congenital anomalies were anencephaly 19.7%, Hydrocephalus 15.5%, Absence of Ear/Finger/Toe/scrotum/Arm/Leg/Limbs 9.4% Cleft Lip plus Cleft Palate 8.9%, meningomyelocele 7%, and talipes 8%. Our study revealed that the central nervous system (CNS) was the most frequently affected, followed by the ear, fingers, toes, scrotum, arms, legs, and musculoskeletal system, in that order of frequency. This aligns with a study conducted in Saudi Arabia, which also found the central nervous system (CNS) to be the most frequently affected, with the musculoskeletal and renal systems following in prevalence [9]. Likewise, a study conducted in Iran identified disorders of the CNS, musculoskeletal system, gastrointestinal system, urogenital system, and chromosomal abnormalities, listed in order of decreasing frequency [20]. A study conducted in India found that the central nervous system (CNS) ranked first, followed by the musculoskeletal system and then the cardiovascular system (CVS) [20]. Similarly, another study found CNS anomalies to be the most common [21]. In a study conducted by Asemi et al. it was found that anomalies of the nervous system (24.1%) and cardiovascular system (21.1%) were the most frequent. Spina bifida was the most common central nervous system anomaly, while unspecified heart malformations (17.1%), other cardiovascular malformations (18.7%), and patent ductus arteriosus (11.7%) were the most prevalent cardiovascular anomalies [22]. In our study, the responsible factors were Maternal age>30 (20.2%), paternal age ≥35 (19.7%), diabetic mellitus (20.2%), consanguineous marriage (20.2%), infection during pregnancy (8.9%), and folic acid supplementation (61.5%). Consanguineous marriages are reported to significantly contribute to the occurrence of congenital malformations [23]. In the current study, the prevalence of congenital anomalies was higher among newborns born to consanguineous marriages, which aligns with findings from studies conducted in Qatar, Morocco, and India [24-26]. Our study found that mothers exceeding the age of 30 had a higher likelihood of giving birth to newborns with congenital malformations. This is in agreement with a study report by Fernandes *et al.* who reported that advanced maternal age (above 40 years old) and multiple pregnancies were major risk factors associated with a high probability of live births with the occurrence of congenital anomalies [27]. Maternal diabetes has long been considered an important factor in neural tube defects (NTDs), but this association is hardly investigated in multivariate analyses. It was determined in a study that complications of pregnancy by type 2 diabetes were associated with a significant incidence of congenital anomalies, and the incidence was increased in mothers with maternal HbA1c levels above normal [28]. Thus, in women with existing diabetes, a high dose folate therapy of up to 5 mg/day is prescribed, and it is necessary to be included in a personalized preconception care plan [29]. Although there is a high likelihood of recurrent malformations occurring congenitally, the preventive measures are not prevalent among developing countries such as India. This implies that there is a requirement for good preventive measures against congenital abnormalities in this area. Raising the awareness of the importance of maternal care in the course of pregnancy, initiating educational programs on the topic of congenital malformations, and emphasizing the dangers of consanguinity marriages are among the key steps to reduce the incidence of congenital malformations and the associated health issues.

CONCLUSIONS

This group of 213 newborns with congenital anomalies was of 82 percent single anomalies, the most common ones being anencephaly (19.7) and hydrocephalus (15.5). Descriptive characteristics of the maternal and pregnancy were presented, though it is not possible to point out causal or statistical dependencies because the study was descriptive. The common characteristics in the affected pregnancies were maternal age ≤30 years (79.8%), diabetes (20.2%), consanguinity (20.2%), and absence of folic acid supplementation (38.5%), but these do not imply causal relationships. There is a need to provide enhanced surveillance and early detection of congenital anomalies to enhance antenatal counselling and neonatal care planning.

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Authors Contribution

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Conflicts of Interest

All the authors declare no conflict of interest.

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REFERENCES

[1] Li S. Stroke Recovery Is a Journey: Prediction and Potentials of Motor Recovery After A Stroke from A Practical Perspective. Life. 2023 Oct; 13(10): 2061. doi: 10.3390/life13102061.

[2] Lugli L, Rossi C, Berardi A, Pugliese M, Ceccarelli PL, Sileo FG *et al.* Prenatal Multidisciplinary Counseling for Fetal Congenital Anomalies: A Narrative Review. International Journal of Gynecology and Obstetrics. 2025 May; 169(2): 498-510. doi: 10.1002/ijgo.16068.

[3] Shahid N, Kazmi T, Farhat S, Naqvi SZ, Ahmed H. A Decade of Perinatal Mortality in Pakistan: Systematic Review of Patterns and Challenges (2013–2022). Journal of Taibah University Medical Sciences. 2025 Apr; 20(2): 139-50. doi: 10.1016/j.jtumed.2025.02.008.

[4] Verma RP. Evaluation and Risk Assessment of Congenital Anomalies in Neonates. Children. 2021 Sep; 8(10): 862. doi: 10.3390/children8100862.

[5] Timilsina D and Gupta S. Prevalence of Congenital Anomalies Among Pregnant Women at a Tertiary Care Center: A Cross-Sectional Study. Cureus. 2025 Feb; 17(2). doi: 10.7759/cureus.79444.

[6] Wojcik MH and Agrawal PB. Deciphering Congenital Anomalies for the Next Generation. Molecular Case Studies. 2020 Oct; 6(5): a005504. doi: 10.1101/mcs.a005504.

[7] World Health Organization. Congenital Disorders. 2023. https://www.who.int/news-room/fact-sheets/detail/birth-defects.

[8] Xie X, Pei J, Zhang L, Wu Y. Global Birth Prevalence of Major Congenital Anomalies: A Systematic Review and Meta-Analysis. BioMed Central Public Health. 2025 Feb; 25(1): 449. doi: 10.1186/s12889-025-21642-6.

[9] Staniczek J, Manasar-Dyrbuś M, Rybak-Krzyszkowska M, Kondracka A, Orszulak D, Niziński K et al. Systematic Review and Meta-Analysis of the Association Between Young Maternal Age and Fetal Abnormalities. Scientific Reports. 2024 Sep; 14(1): 22562. doi: 10.1038/s41598-024-74015-1.

[10] Geda YF, Lamiso YY, Berhe TM, Mohammed SJ, Chibsa SE, Adeba TS *et al.* Structural Congenital Anomalies in Resource-Limited Setting, 2023: A Systematic Review and Meta-Analysis. PLOS One. 2023 Oct; 18(10): e0291875. doi: 10.1371/journal.pone.0291875.

[11] Didisa MK, Baye Y, Tamiru E, Mengesha G, Solbana LK, Yadeta TA. Trends in Congenital Anomalies and Associated Factors among Newborns in Eastern Ethiopia: An 8-Year Open Cohort Analysis of the Kersa Health and Demographic Surveillance System. British Medical Journal Open. 2025 Feb; 15(2): e089984. doi: 10.1136/bmjopen-2024-089984.

[12] Heaney S, Tomlinson M, Aventin Á. Termination of Pregnancy for Fetal Anomaly: A Systematic Review of the Healthcare Experiences and Needs of Parents. BioMed Central Pregnancy and Childbirth. 2022 May; 22(1): 441. doi: 10.1186/s12884-022-04770-4.

[13] Monier I, Lelong N, Benachi A, Jouannic JM, Khoshnood B, Zeitlin J. Postnatal Diagnosis of Congenital Anomalies Despite Active Systematic Prenatal Screening Policies: A Population-Based Registry Study. American Journal of Obstetrics and Gynecology Maternal-Fetal Medicine. 2023 Nov; 5(11): 101170. doi: 10.1016/j.ajogmf.2023.101170.

[14] Campbell HE, Karim JN, Papageorghiou AT, Wilson EC, Rivero-Arias O, ACCEPTS Study *et al.* Evaluating the Cost-Effectiveness of Antenatal Screening for Major Structural Anomalies During the First Trimester of Pregnancy: A Decision Model. BJOG: An International Journal of Obstetrics and Gynaecology. 2025 Apr; 132(5): 638-47. doi: 10.1111/1471-0528.18053.

[15] Korejo R, Bhutta S, Noorani KJ, Bhutta ZA. An Audit and Trends of Perinatal Mortality at the Jinnah Postgraduate Medical Centre, Karachi. The Journal of the Pakistan Medical Association. 2007 Apr; 57(4): 168-72.

[16] Adam H, Ghenimi N, Minsart AF, Narchi H, Al Awar S, Al Hajeri OM *et al.* The Impact of Major Congenital Anomalies on Obstetric Outcomes in the United Arab Emirates: the Mutaba'ah Study. Scientific reports. 2025 Jan; 15(1): 2708. doi: 10.1038/s41598-025-87263-6.

[17] Shaheen F, Humayoon QS, Malik S, Mumtaz S. Clinical and Genetic Attributes of Congenital Anomalies Ascertained at a Tertiary Care Hospital in Rawalpindi, Pakistan. Pakistan Journal of Medical Sciences. 2023 Nov; 39(6): 1673. doi: 10.12669/pjms.39.6.7408.

[18] Ahn D, Kim J, Kang J, Kim YH, Kim K. Congenital Anomalies and Maternal Age: A Systematic Review

DOI: https://doi.org/10.54393/pjhs.v6i12.2965

and Meta-Analysis of Observational Studies. Acta Obstetricia et Gynecologica Scandinavica. 2022 May; 101(5): 484-98. doi: 10.1111/aogs.14339.

[19] Loane M, Dolk H, Morris JK, a EUROCAT Working Group. Maternal Age-Specific Risk of Non-Chromosomal Anomalies. An International Journal of Obstetrics and Gynaecology. 2009 Jul; 116(8): 1111-9. doi: 10.1111/j.1471-0528.2009.02227.x.

[20] Pethő B, Váncsa S, Váradi A, Agócs G, Mátrai Á, Zászkaliczky-Iker F *et al.* Very Young and Advanced Maternal Age Strongly Elevates the Occurrence of Nonchromosomal Congenital Anomalies: A Systematic Review and Meta-Analysis of Population-Based Studies. American Journal of Obstetrics and Gynecology. 2024 Nov; 231(5): 490-500. doi: 10.1016/j.ajog.2024.05.010.

[21] Pethő B, Mátrai Á, Agócs G, Veres DS, Harnos A, Váncsa S *et al.* Maternal Age Is Highly Associated with Non-Chromosomal Congenital Anomalies: Analysis of A Population-Based Case-Control Database. An International Journal of Obstetrics and Gynaecology. 2023 Sep; 130(10): 1217-25. doi: 10.1111/1471-0528.17461.

[22] 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. International Journal of Reproductive BioMedicine. 2023 Sep; 21(8): 647. doi: 10.18502/ijrm.v21i8.14020.

[23] Kalam MA, Sharma SK, Ghosh S, Roy S. Linkages Between Consanguinity, Pregnancy Outcomes and Offspring Mortality in Twenty-First Century India. Scientific Reports. 2024 Sep; 14(1): 22522. doi: 10.1038/s41598-024-69151-7.

[24] Manyama M, Al Sayegh D, Al-Sulaiti K, Almasri M, Sharma O, El Jerbi A *et al.* Congenital Heart Defects and Consanguinity: An Analysis of the Sidra Cardiac Registry Data in Qatar. International Journal of Cardiology: Congenital Heart Disease. 2024 Sep; 17: 100529. doi: 10.1016/j.ijcchd.2024.100529.

[25] Dahbi N, El khair A, Cheffi K, Habibeddine L, Talbi J, Hilali A *et al.* Consanguinity, Complex Diseases, and Congenital Disabilities in the Souss Population (Southern Morocco): A Cross-Sectional Survey. Egyptian Journal of Medical Human Genetics. 2024 Mar; 25(1): 27. doi: 10.1186/s43042-024-00490-w.

[26] Rajeswari MR, Ramamoorthy A, Rajakumar A, Narayan VK. Consanguineous Marriage as a Key Indicator of Isolated Congenital Dental Anomaly among South Indian Population–A Cross-Sectional Study. Journal of Oral and Maxillofacial Pathology. 2023 Jan; 27(1): 60-5. doi: 10.4103/jomfp.jomfp_265_21.

[27] Fernandes QH, Paixão ES, da Conceição Nascimento Costa M, Teixeira MG, Barreto ML, Acosta AX. Maternal and Gestational Factors Associated with Congenital Anomalies among Live Births: A Nationwide Population-Based Study in Brazil from 2012 to 2020. BioMed Central Pregnancy and Childbirth. 2025 Jul; 25(1): 678. doi: 10.1186/s12884-025-07675-0.

[28] Oppermann ML, Campos MA, Guerra GL, Hirakata VN, Castanho VC, Muck FA *et al.* Prevalence of Congenital Anomalies in Pregnancies Complicated by Type 2 Diabetes: Systematic Review and Meta-Analysis. International Journal of Gynecology and Obstetrics. 2025 Jul. doi: 10.1002/ijgo.70369.

[29] Perera N, Rudland VL, Simmons D, Price SA. Folate Supplementation in Women with Pre-Existing Diabetes. Nutrients. 2023 Apr; 15(8): 1879. doi: 10.3390/nu15081879.