Section: Obstetrics and Gynaecology

Original Research Article

A CROSS-SECTIONAL STUDY ON THE PATTERN OF CONGENITAL ANOMALIES AT BIRTH AND THEIR ASSOCIATION WITH MATERNAL CHARACTERISTICS IN A TERTIARY CARE TEACHING HOSPITAL

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ABSTRACT

Background: Congenital anomalies remain a significant cause of neonatal morbidity and mortality worldwide. This study aims to investigate the incidence of congenital anomalies and its association with maternal factors such as age, education, occupation, comorbidities, and lifestyle behaviors. **Materials and Methods:** A cross-sectional analysis was conducted at Niloufer Hospital, comprising data from 18,793 deliveries between June 2022 and May 2024. The study included demographic details of mothers, birth weight, mode of delivery, gestational age, maternal comorbidities, and smoking habits. The incidence rate of congenital anomalies was calculated, and various maternal factors were analyzed for their association with these anomalies. **Result:** Of the 18,793 deliveries, 240 newborns had congenital anomalies, resulting in an incidence rate of 12.77 per 1,000 deliveries. Maternal age showed a significant correlation with the incidence of anomalies, with the highest rate observed in mothers aged >35 years (49.24 per 1,000 deliveries). Educational level and occupation were also factors, with 26.25% of mothers having no formal education and the majority being housewives (87.08%). Other factors, including smoking, comorbidities such as diabetes and hypertension, and gestational age, further influenced the incidence of congenital anomalies. **Conclusion:** This study highlights the significant role of maternal factors, particularly age, education, and health conditions, in the occurrence of congenital anomalies. Interventions targeting these factors could help reduce the burden of congenital anomalies in the population.

INTRODUCTION

Congenital anomalies, also referred to as birth defects, are structural or functional abnormalities that occur during fetal development.[1] These anomalies contribute significantly to neonatal morbidity and mortality worldwide, affecting the physical, mental, and developmental health of newborns.[2] According to the World Health Organization (WHO), congenital anomalies are responsible for approximately 20% of neonatal deaths annually.[3] The prevalence of these anomalies varies widely across regions, influenced by genetic, environmental, and socio-economic factors. Identifying and understanding the factors associated with congenital anomalies is essential for improving maternal and neonatal health outcomes.[4] Maternal factors, including age, education, occupation, comorbidities, and lifestyle choices such as smoking, have been identified as significant determinants of birth outcomes. Maternal age, in particular, is a well-established risk factor for the occurrence of congenital anomalies, with advanced maternal age being associated with an increased risk of chromosomal abnormalities and other defects.[5] Education and occupation have been shown to correlate with socioeconomic status, access to healthcare, and health literacy, which may, in turn, affect the likelihood of congenital anomalies.[6] Additionally, maternal comorbidities such as

diabetes, hypertension, and thyroid disorders have been linked to an increased risk of adverse birth outcomes, including congenital anomalies.

Despite the increasing volume of research on congenital anomalies, there is still a need for more region-specific studies that investigate the relationship between these anomalies and maternal factors.This study aims to provide insights into the incidence of congenital anomalies and their relationship with maternal age, education, occupation, comorbidities, and smoking status in a cohort of deliveries at Niloufer Hospital, providing evidence that may inform public health interventions and policies aimed at reducing the burden of congenital anomalies.

MATERIALS AND METHODS

Study Design and Setting

This cross-sectional study was conducted at Niloufer Hospital, a tertiary care facility, between June 2022 and May 2024. The study aimed to evaluate the incidence of congenital anomalies and its association with various maternal factors such as age, education, occupation, comorbidities, and smoking status.

Study Population

The study included 18,793 deliveries that occurred during the specified period. The inclusion criteria were all live births during the study period, with both singleton and multiple pregnancies considered. Neonatal outcomes, including the presence of congenital anomalies, were recorded.

Data Collection

Data were collected through maternal and neonatal records, which were reviewed retrospectively. Information gathered from the records included maternal age, educational level, occupation, smoking status, comorbidities (such as diabetes, hypertension, and thyroid disorders), and the gestational age at delivery. For each case of congenital anomaly, detailed information about the type and severity of the anomaly was recorded.

Variables and Measurements

Congenital Anomalies: The presence of any structural or functional abnormality identified at birth. The anomalies were classified into categories based on the affected organ system (e.g., cardiovascular, musculoskeletal, nervous system).

Maternal Factors: Maternal age was categorized into four groups: ≤25, 26-30, 31-35, and >35 years. Educational level was categorized as higher education, intermediate, up to 10th grade, 5th to 8th grade, and no formal education. Occupation was recorded as either housewife or labor. Maternal smoking status was recorded as either smoker or non-smoker. Maternal comorbidities, including diabetes mellitus, hypertension, and thyroid disorders, were recorded as present or absent.

Gestational Age: Recorded as preterm (≤37 weeks), term (38-42 weeks), and post-term (>42 weeks).

Birth Weight and Mode of Delivery: Birth weight was categorized into three groups: <1.5-2.0 kg, 2.0-2.5 kg, and >3.5 kg. Mode of delivery was categorized as cesarean section or normal vaginal delivery.

Statistical Analysis

Descriptive statistics were used to summarize the characteristics of the study population, including frequencies and percentages for categorical variables and means with standard deviations for continuous variables. The incidence of congenital anomalies was calculated per 1,000 deliveries. Chi-square tests were used to examine the association between maternal factors (age, education, occupation, smoking, comorbidities) and the occurrence of congenital anomalies. A p-value of <0.05 was considered statistically significant. Data were analyzed using statistical software such as SPSS (Version 25) and Microsoft Excel.

Ethical considerations: included obtaining informed consent from all participants, ensuring confidentiality of maternal and neonatal data, and adhering to ethical guidelines established by the hospital. The study was approved by the Institutional Ethics Committee (IEC) of Niloufer Hospital, ensuring compliance with ethical standards and the protection of participants' rights.

RESULTS

The study analyzed data from a total of 18,793 deliveries conducted at Niloufer Hospital between June 2022 and May 2024. Among these deliveries, 240 newborns were identified with congenital anomalies, resulting in an incidence rate of 12.77 per 1,000 deliveries (Table 1).

Maternal Age and Congenital Anomalies The maternal age distribution revealed that 60.5% of mothers were aged ≤25 years, with an incidence rate of 1.2 per 1,000 deliveries. Among mothers aged 26-30 years, 24.1% had an incidence rate of 19.5 per 1,000 deliveries. The age group 31-35 years comprised 13.4% of the study population, with the incidence rate rising to 24.4 per 1,000 deliveries. The highest incidence rate of 49.24 per 1,000 deliveries was observed in mothers aged >35 years, who accounted for 2.8% of the total sample (Table 2).

Maternal Educational Level and Congenital Anomalies Regarding maternal education, 12.92% of mothers had higher education, with a smaller proportion (40%) having intermediate education. A significant percentage of mothers (26.25%) had no formal education. Among the remaining participants, 10.42% had education up to the 10th grade, and another 10.42% had education up to the 8th grade (Table 3).

Occupation and Gestational Age In terms of maternal occupation, 87.08% of mothers were housewives, while 12.92% worked in labor-intensive jobs. The gestational age distribution showed that

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5.83% of deliveries were post-term, 54.17% were preterm, and 40% were term (Table 4).

Birth Weight and Mode of Delivery The birth weight distribution indicated that 52.92% of babies had a birth weight between 1.5 kg and 2.0 kg, followed by 39.16% with a birth weight between 2.0 kg and 2.5 kg. A smaller percentage (14.16%) had a birth weight greater than 3.5 kg. As for the mode of delivery, 52.92% of deliveries were by cesarean section, while 47.08% were vaginal deliveries (Table 5).

Parity, Sex of Newborns, and Smoking Status Regarding gravidity, 47.08% of mothers were primigravida, while 52.92% were multigravida. In terms of newborn sex, 52.92% of the newborns were male, and 47.08% were female. As for smoking status, 80% of mothers reported no smoking during pregnancy, while 20% admitted to smoking (Table 6).

Maternal Comorbidities, Consanguinity, and Drug Usage Maternal comorbidities were also recorded. Diabetes mellitus was present in 23.75% of mothers, hypertension in 10.42%, and thyroid disorders in 12.92%. The remaining 52.92% of mothers had no reported comorbidities. In terms of consanguinity, 23.75% of mothers had a consanguineous marriage. Regarding drug usage, 5.83% of mothers reported using medication during pregnancy, while the majority (94.17%) did not (Table 7).

System-Wise Distribution of Congenital Anomalies

A system-wise classification of the congenital anomalies observed among the 240 affected newborns revealed that the central nervous system (CNS) was the most commonly involved, accounting for 41.67% of the cases. Cardiovascular system (CVS) anomalies were the second most frequent, present in 27.50% of the cases. Gastrointestinal tract (GIT) and genitourinary system (GUS) anomalies constituted 10.83% and 7.08% respectively. Musculoskeletal anomalies were noted in 12.92% of the affected newborns. These findings underscore the predominance of CNS and CVS anomalies in the study cohort (Table 8).

Table 1: Incidence of Congenital Anomalies

Total Deliveries	Newborns with Congenital Anomalies	Incidence Rate (per 1,000 Deliveries)
18,793	240	12.77

Table 2: Maternal Age Distribution and Congenital Anomalies

Maternal Age Group	Number of Mothers	Percentage (%)	Incidence Rate (per 1,000 Deliveries)
≤25	11,373	60.5	1.2
26-30	4,541	24.1	19.5
31-35	2,523	13.4	24.4
>35	528	2.8	49.24

Table 3: Maternal Educational Level and Congenital Anomalies

Educational Level	Number of Mothers	Percentage (%)
Higher Education	31	12.92
Intermediate	96	40.00
Up to 10th Grade	25	10.42
5th to 8th Grade	25	10.42
No Formal Education	63	26.25

Table 4: Occupation and Gestational Age Distribution

Occupation	Number of Mothers	Percentage (%)
Housewife	209	87.08
Labor	31	12.92
Gestational Age	**Number of Cases**	**Percentage (%)**
Post-term	14	5.83
Preterm	130	54.17
Term	96	40.00

Table 5: Birth Weight Distribution and Mode of Delivery

Birth Weight (kg)	Number of Cases	Percentage (%)
<1.5 - 2.0	122	52.92
2.0 - 2.5	84	39.16
>3.5	34	14.16
Mode of Delivery	**Number of Cases**	**Percentage (%)**
Cesarean Section	127	52.92
Normal Vaginal Delivery	113	47.08

Table 6: Parity, Sex of Newborns, and Smoking Status

Gravidity	Number of Cases	Percentage (%)
Primigravida	113	47.08
Multigravida	127	52.92

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Sex	Number of Cases	Percentage (%)
Male	127	52.92
Female	113	47.08
Smoking Status	**Number of Mothers**	**Percentage (%)**
No	192	80.00
Yes	48	20.00

Table 7: Maternal Comorbidities, Consanguinity, and Drug Usage

Comorbidity	Number of Mothers	Percentage (%)
Diabetes Mellitus	57	23.75
Hypertension	25	10.42
Thyroid Disorders	31	12.92
No Comorbidities	127	52.92
Consanguinity	**Number of Mothers**	**Percentage (%)**
No	183	76.25
Yes	57	23.75
Drug Usage	**Number of Mothers**	**Percentage (%)**
No	226	94.17
Yes	14	5.83

Table 8: Distribution of System Involved (N = 240)

Category	N	%
Central Nervous System (CNS)	100	41.67%
Cardiovascular System (CVS)	66	27.50%
Gastrointestinal Tract (GIT)	26	10.83%
Genitourinary System (GUS)	17	7.08%
Musculoskeletal System	31	12.92%
Total	240	100.00%

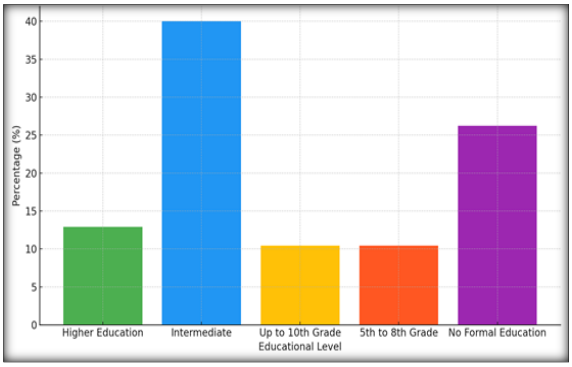

Figure 1: Maternal Educational Level and Congenital Anomalies

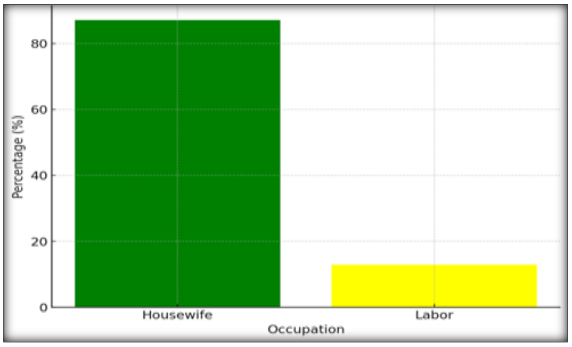

Figure 2: Occupation Distribution of Mothers

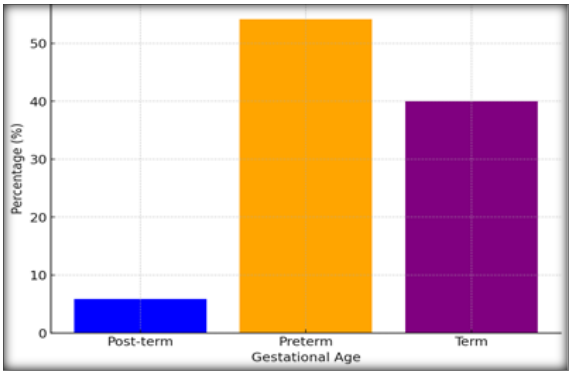

Figure 3: Gestational Age Distribution of Mothers

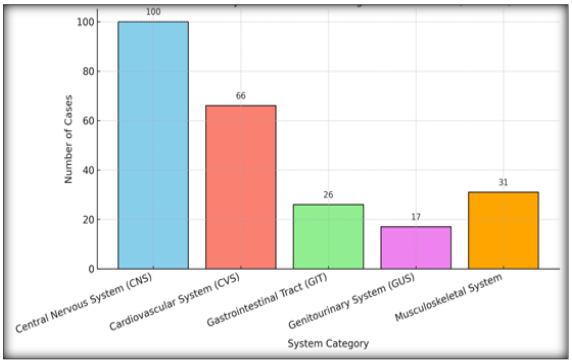

Figure 4: Distribution of System Involved in Congenital Anomalies

DISCUSSION

The findings of this study underscore the significance of maternal characteristics in influencing the incidence of congenital anomalies among newborns. The observed incidence rate of 12.77 per 1,000 deliveries at Niloufer Hospital aligns with previous

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studies conducted in developing countries, where similar rates have been reported due to varying maternal health conditions, environmental factors, and healthcare access (Taksande et al., 2010; Sarkar et al., 2013).[7,8]

Maternal Age: A strong correlation between increasing maternal age and the occurrence of congenital anomalies was observed. Mothers above 35 years of age had the highest incidence (49.24 per 1,000 deliveries), which is consistent with global findings associating advanced maternal age with chromosomal abnormalities, particularly neural tube defects and Down syndrome (Cleary-Goldman et al., 2005). This highlights the importance of preconception counseling and timely antenatal screening for this demographic, as advanced age is a significant risk factor for birth defects.[9]

Educational Level and Occupation: Lower maternal education was significantly associated with a higher frequency of anomalies. Approximately 26.25% of mothers with affected newborns had no formal education, suggesting a potential link between poor health literacy and inadequate antenatal care. Furthermore, the predominance of housewives (87.08%) suggests limited socioeconomic mobility, which may restrict access to quality prenatal services. These findings are in line with studies that emphasize maternal education as a critical determinant of healthcare utilization and pregnancy outcomes.[10,11]

Maternal Comorbidities and Lifestyle: Maternal comorbidities such as diabetes and hypertension were observed among mothers of affected newborns. These conditions are known to disrupt embryonic development and increase the risk of malformations (Correa et al., 2008). Additionally, lifestyle factors like smoking further elevate teratogenic risk, although its prevalence in the present cohort was low. Nevertheless, even minimal exposure to smoking warrants concern due to its association with congenital heart defects and orofacial clefts.[12,13]

Gestational Age and Birth Weight: Premature birth and low birth weight were more common among newborns with anomalies. This could reflect the direct impact of congenital anomalies on intrauterine growth or indicate adverse maternal health status. The findings support previous research that links preterm delivery and fetal growth restriction with underlying structural anomalies.[7]

Limitations: This study is limited by its retrospective design and reliance on hospital-based data, which may underrepresent anomalies diagnosed postnatally or after discharge. Additionally, certain maternal lifestyle and environmental exposures could not be quantified.

Implications: The study reinforces the need for targeted antenatal surveillance, particularly in high-risk groups such as older mothers and those with preexisting health conditions. Health education programs focusing on family planning, nutrition, and regular antenatal visits can help reduce the burden of congenital anomalies. Policy-level interventions aimed at improving maternal education and access to comprehensive prenatal care are crucial in addressing the root causes of preventable birth defects.

CONCLUSION

This study highlights the significant role of maternal factors, such as age, education, comorbidities, and lifestyle behaviors, in the occurrence of congenital anomalies at birth. The incidence of congenital anomalies was notably higher among older mothers, particularly those aged over 35 years, and those with lower educational levels and preexisting health conditions like diabetes and hypertension. The findings emphasize the need for targeted interventions, including early antenatal screening, health education, and improved access to maternal healthcare, particularly for high-risk groups. Addressing these factors could help reduce the incidence of congenital anomalies, ultimately improving neonatal health outcomes and reducing neonatal morbidity and mortality.

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