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Original Research

Magnitude and Associated Factors of Congenital Anomalies Among Newborns Delivered at Public Hospitals in Dire Dawa, Eastern, Ethiopia, 2022

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Abstract

Background: A congenital anomaly is defined as a structural or functional defect that can be detected during pregnancy, at birth, or later in life. Although neonatal mortality in Ethiopia remains high and neonatal morbidity is a significant health concern, research on congenital anomalies among newborns in the country is limited. This study aims to assess the magnitude and associated factors of congenital anomalies among newborns delivered at public hospitals in Dire Dawa, Ethiopia, in 2022.
Methods: A facility-based retrospective cross-sectional study was conducted at public hospitals in Dire Dawa, eastern Ethiopia. Using a census method, data were collected from all neonatal birth records and delivery summaries of newborns delivered between January 2022 and June 2022.
Results: Among 2126 newborns, 53 (2.5%) (95% CI: 1.8%, 3.2%) were born with various types of congenital anomalies. Common congenital anomalies were Anencephaly and spinal Bifidia. Neonates born to mothers aged ≤20 years were nearly 80% less likely to develop congenital anomalies than neonates born to mothers aged ≥35 years (AOR = 0.199, 95% CI: 0.06, 0.63; p-value: 0.006). Maternal use of iron and folate supplementation during pregnancy is a protective factor for the occurrence of congenital anomalies among newborn (AOR = 0.321, 95% CI: 0.12, 0.86; p-value: 0.024).
Conclusion: The prevalence of congenital anomalies among newborns was low. Maternal age, iron/folate supplementation, gestational age, and birth weight were significantly associated with congenital anomalies. Therefore, attention should be given to identifying risk factors and implementing preventive strategies, including expanding corrective surgical centers and planning food fortification with iron and folate.

Keywords: Congenital Anomalies, Dire Dawa, Ethiopia, Functional Defect, Newborns

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1. Introduction

Congenital anomalies are defined as structural or functional defects that may be detected during pregnancy or visible at birth or later in life. Stillbirth, spontaneous abortion, infant mortality and morbidity, disability, and frequent hospital admissions are all caused by congenital anomalies [1]. The cause of mortality and disability among infants and children under five years of age is not recognized as congenital anomalies, which can cause spontaneous abortions and stillbirths. They can, however, be life-threatening, result in long-term disability, and negatively affect individuals, families, healthcare systems, and societies. The risk of congenital anomalies is high during the embryonic period (3rd to 8th week of gestational age), which is the critical period for the development of the fetus [1, 2].

In the world, congenital anomalies cause an estimated 295 000 newborns to die within 28 days of birth every year. Congenital malformations have a greater contribution to long-term disability, which impacts individuals, families, health-care systems, and communities [3]. Congenital anomalies occur in Africa at a rate of 5.2 to 74.5 per 10,000 births. Amazingly, approximately 94% of severe congenital anomalies occur in low- and middle-income countries, of which approximately 190,000 babies are delivered each year with neural tube defects [4, 5].

More than 6% of infant deaths globally are caused by congenital malformations, and more than 70% of infants with CAs die within the first month of life. The majority of infants who survive are mentally, physically and socially disabled [6]. While genetic (non-modified) factors account for more than 50% of CAs, a significant number of congenital malformations can be caused by modifiable environmental factors [5]. Approximately 94% of congenital anomalies and 95% of deaths due to congenital anomalies are found in low- and middle-income countries.

Congenital anomalies account for 17%-42% of infant mortality, according to the World Health Organization. Some studies in different parts of the world have shown that congenital anomalies are an increasing public health concern in which serious attention should be given. In Brazil, congenital anomalies accounted for the second leading cause of death in children under 5 years old in 2017. Every year, 25,000 live births are recorded with some kind of congenital anomaly in Brazil [7].

In Ethiopia, the overall prevalence of congenital anomalies was less than approximately 2%, of which 40.3% were attributable to neural tube defects, which was lower than that in other African studies [8].

An estimated 7.9 million babies are born every year with birth defects. Of these babies, more than 3 million die, and 3.2 million have permanent disability [9]. In both developed and developing countries, although CAs are the most serious cause of infant mortality and disability, approximately 94% of CAs, 95% of deaths and 15-30% of hospital admissions of infants and children due to CAs are in low- and middle-income countries [10].

The impact of congenital anomalies is more severe in low- and middle-income countries, which may be due to a lack of health facilities, infections, malnutrition, and maternal exposure to different toxic substances [11]. In low- and middle-income countries, congenital anomalies are not the priority health problems due to their low prevalence rate and low proportionate to infant mortality relative to other causes of perinatal deaths, such as infections and malnutrition, and the intervention cost is very high [12].

The use of maternal and child health services may be a factor in the early detection of these birth defects. According to the Ethiopian mini demographic health survey (EMDHS) -2019 report, the prevalence of the utilization of institutional delivery increased from 26% in 2016 to 48% in 2019 [13].

According to EMDHS 2019, the infant mortality rate was 43 per 1000 live births, the under-five mortality rate was 55 per 1000 live births, and the neonatal mortality rate was 29 per 1000 live births. Those deaths may be due to congenital anomalies [14]. Most of the children born with major CA are prone to die, or even if they survive, they may confront long-term morbidity and disability.

Campaigns by aid organizations are used to correct the majority of patients with orofacial clefts. Although the neonatal and under five mortality rates have declined, birth defects or congenital anomalies have become a larger proportion of the causes of neonatal and under five deaths [15]. Providing health education to communities, particularly females of reproductive age, requires evidence-based information on risk factors for congenital anomalies.

2. Methods and Materials

2.1. Study Area and Study Period

The study was conducted in the health facilities of Dire Dawa city that provide abortion care services. The city is situated 515 km away from Addis Ababa with a projected population size of 466,000 in 2020, of which females account for 51.6% and 67.92% of the population are

considered urban inhabitants. There are 9 urban and 38 rural kebeles. The total fertility rate of Dire Dawa was 3.4 in 2014. The administration has two public hospitals, fifteen health centers, thirty-four health posts, sixteen private clinics, four private hospitals and two nongovernmental organizations. To obtain the sample size, we used the 3-month previous pattern of abortion services in each study area. The study was conducted from January 2022 – June 2022.

2.2. Study Design

A facility-based retrospective cross-sectional study was conducted from January – June 2022.

2.3. Source of Population

The source population was all birth records of newborns and delivery summaries who were delivered at public hospitals, and all birth records and delivery summaries of neonates who were delivered from January 2022 – June 2022 at public hospitals of Dire Dawa were the study population.

2.4. Study Population

All birth records and delivery summaries in selected public hospitals within the study period were included in the study, and those with incomplete delivery summaries and birth records were excluded from the study.

2.5. Eligibility Criteria

Inclusion Criteria: All birth records and delivery summaries of newborns delivered at public hospitals in Dire Dawa from January 2022 to June 2022.

Exclusion Criteria: Birth records and delivery summaries that were incomplete or missing essential information were excluded from the study.

2.6. Sampling Procedure

A census method was applied for this study. All birth records and delivery summaries from January 2022 to June 2022 at Public Hospital in Dire Dawa were reviewed.

2.7. Data Collection Tool and Procedure

Data collection was performed by using a checklist from the register documents of public hospitals in Dire Dawa during the data collection period. The questionnaire (checklist) was prepared in English; it has included questions that accommodate all the required data. Two

BSc. Midwives were assigned for the purpose of data collection, and one public health professional was assigned as supervisor. After obtaining informed consent from the responsible body, background information and possible factors were collected in the form of a checklist. The checklist comprised sociodemographic characteristics and maternal and neonatal variables that may contribute to the occurrence of congenital anomalies.

2.8. Study Variables

2.8.1. Dependent Variable

- Congenital Anomaly

2.8.2. Independent Variables

- Sociodemographic characteristics: maternal age, residency, parity
- Maternal factors: ANC visit, iron/folate use, infection, chronic medical illness, etc.
- Neonatal factors: Sex of neonate, gestational age and birth weight.

2.9. Data Quality Control

Data collectors were recruited from health professionals. Both data collectors and supervisors were trained before the actual data collection process to ensure the quality of data for one day by the principal investigator. The prepared tool was pretested on 5% of the sample at Hiwot Fana specialized hospital, Harar, before starting the actual data collection. Then, amendments were made accordingly. Additionally, daily counter checking of completed questionnaires was performed by the supervisor and principal investigator to ensure data completeness. A variable was coded to make the data more consistent, and the data were cleaned to reduce obvious data entry errors.

2.10. Statistical Analysis

Each collected data point was checked for completeness and consistency before data entry. The checked data were coded and entered into the computer with Epi-data version 3.1 and exported to SPSS version 26 for analysis. Descriptive statistics such as frequencies and percentages were used to describe respondents' results as appropriate. The data were presented using tables and bar graphs as appropriate. Bivariate analyses were performed for each variable and the respective crude odds ratio (COR). Independent variables with marginal associations ($P < 0.2$) in the bivariate analysis were entered in a multivariable logistic regression analysis to detect independent variables. The significant association of independent variables with the dependent

variable was assessed by using a 95% confidence interval. The Hosmer and Lemeshow test were used for the model fitness test. The adjusted odds ratio (AOR) with 95% confidence intervals was computed to identify the strength of association, and statistical significance was declared at a p value <0.05.

2.11. Operational Definitions

- **Congenital Anomaly:** Any structural congenital anomaly presenting at birth and recorded on charts [16, 17].
- **NTD:** Open and closed central nervous system disorders that include spinal bifidia and anencephaly present at birth and recorded on charts [16, 18].
- **Orofacial Clefs:** Those infants who have either cleft lips or cleft palate or both and recorded on charts [16].

3. Results

3.1. Socio Demographic Characteristics

A total of 2,187 birth records and delivery summaries were reviewed. The mean age of mothers was 26.84 years (SD = 5.5). Among the mothers who delivered during the study period, 1220 (55.8%) were multiparas. Of the participants, 1,605 (75.5%) were urban residents, and 1,810 (85.1%) of neonates were born with a normal birth weight (2.5–4 kg). Approximately 1119 (51.2%) of infants were female, and regarding gestational age at delivery, 1997 (91.3%) were born at term. Among all deliveries during the study period, 94 (4.3%) of mothers had chronic medical illnesses, and 55 (2.5%) had infections during pregnancy (Table 1).

Table 1: Frequency distribution of socio-demographic characteristics of the mothers and neonatal factors in Dilchora and Sabian general hospitals, Dire Dawa, Ethiopia, 2022

Variable	Frequency (*n*= 2126)	Percent
Age of Mother		
≤20	291	13.7%
21-34	1597	75.1%
≥35	238	11.2%
Residency of mother		
Urban	1605	75.5%
Rural	521	24.5%
Sex of the infant		
Male	1037	48.8%
Female	1089	51.2%
Gestational age		
Preterm	117	5.5%
Term	1941	91.3%
Post term	68	3.2%

3.2. Magnitude of Congenital Anomaly

Out of a total of 2,126 births reviewed during the study period, 53 newborns were diagnosed with congenital anomalies, resulting in an overall prevalence of 2.5% (95% CI: 1.8, 3.2). This indicates that congenital anomalies affected a small but notable proportion of newborns delivered at public hospitals in Dire Dawa. Among the neonates with congenital anomalies, 60.4% were male, suggesting a slightly higher occurrence in male infants compared to females. The study identified several types of congenital anomalies, with the most frequently observed being anencephaly, affecting 14 neonates (26.4% of all anomalies), followed by spina bifida in 13 neonates (24.5%), and hydrocephalus, which accounted for 18.8% of the cases. These findings highlight the burden of severe congenital anomalies among newborns in the study area, emphasizing the need for targeted preventive measures and early detection strategies (Table 2, Figure 1).

Table 2: The Frequency Distribution of Congenital Anomalies of Newborns by Sex Who Delivered from January 2022 to June 2022 at Public Hospitals in Dire Dawa, Ethiopia.

Congenital anomaly	Male	Percent	Female	Percent
Anencephaly	7	13.2%	7	13.2%
Spinal Bifida	8	15.1%	5	9.4%
Hydrocephalus	7	13.2%	3	5.66%
Orofacial clefts	3	5.66%	3	5.66%
Musculoskeletal Abnormality	2	3.77%	2	3.77%
Others	3	5.66%	2	3.77%

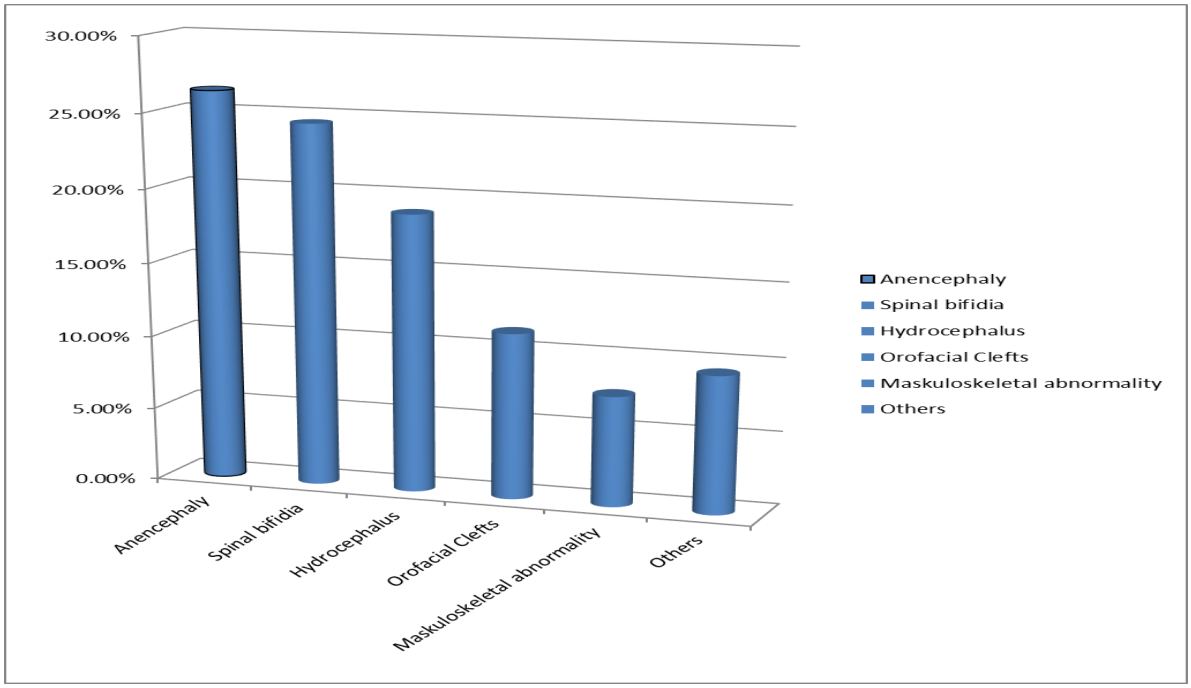

Figure 1: Shows the percentage distribution of congenital anomalies in newborns delivered at public hospitals, Dire Dawa, Ethiopia, 2022.

3.3. Factors Associated with Congenital Anomaly

Among the variables entered into the bivariate logistic analysis, maternal age above 35, ANC follow-up, maternal history of stillbirth or abortion, iron or folate supplementation, presence of chronic medical illness, prematurity, male sex of the neonate, and low birth weight showed a crude association with congenital anomalies and were entered into the multivariate analysis. Variables with a p-value less than 0.2 were considered for multiple logistic regression analysis.

In the multiple logistic regression analysis, four variables remained independent predictors of congenital anomalies: maternal age, iron/folate supplementation, gestational age, and birth weight. Neonates born to mothers aged ≥35 years were nearly 80% more likely to have congenital anomalies compared to those born to mothers aged ≤20 years (AOR = 0.199, 95% CI: 6.3, 62.9; p = 0.006).

Mothers who used iron/folate supplementation during pregnancy were nearly 70% less likely to have neonates with congenital anomalies than those who did not (AOR = 0.321, 95% CI: 12.0, 85.9; p = 0.024). Preterm neonates were 3.02 times more likely to be born with congenital anomalies than term neonates (AOR = 3.02, 95% CI: 27.1, 71.7; p = 0.012), and neonates with birth weights ≤2.5 kg were 2.7 times more likely to have congenital anomalies compared to those with birth weights ≥2.5 kg (AOR = 2.698, 95% CI: 26.5, 57.9; p = 0.01) (Table 3).

Table 3: Bivariate and multivariate logistic regression analyses of factors associated with congenital anomalies among newborns delivered at public hospitals in Dire Dawa, Ethiopia, 2022.

Variable	Category	Congenital Anomaly		COR(95%CI)	AOR(95%CI)	P value
		Yes	No			
Maternal age	≤20	5	286	0.2 (0.09, 0.7	0.20 (0.06, 0.63)	0.006
	21-34	32	1564	0.85 (0.3, 2.2)	0.50 (0.18, 1.36)	0.173
	≥35	16	222	1	1	
ANC visit	Yes	40	1977	0.2 (0.08, 0.3)	0.56 (0.20, 1.70)	0.295
	No	13	96	1	1	
History of still birth or	Yes	11	151	3.3 (1.7, 6.6)	1.41 (0.62, 3.17)	0.411
Abortion	No	42	1920	1	1	
Iron/Foliate	Yes	34	1915	0.1 (0.08, 0.3)	0.32 (0.12, 0.86)	0.024
supplementation	No	19	157	1	1	
Chronic Medical illness	Yes	5	89	2.3 (0.9, 6.0)	1.55 (0.54, 4.46)	0.415
	No	48	1984	1	1	
Gestational age	Preterm	13	104	0.1 (0.02, 0.9)	3.02 (1.30, 7.18)	0.012
	Term	39	1902	0.7 (0.1, 5.4)	4.07 (0.47, 35.4)	0.204
	Post term	1	68	1	1	
Neonatal sex	Male	32	1005	1.6 (0.9, 2.8)	1.58 (0.88, 2.85)	0.125
	Female	21	1068	1		
Birth Weight	<2.5 kg	18	225	4.2 (2.4, 7.6)	2.70 (1.27, 5.76)	0.01
	≥2.5 kg	35	1848	1		

Note: *P value <0.05 was considered significant, AOR: adjusted odds ratio, CI: confidence interval, 1, reference category. Hosmer and Lemeshow test 0.58.*

4. Discussion

This study aimed to assess the magnitude of congenital anomalies and associated factors among newborns delivered at public hospitals in Dire Dawa, Eastern Ethiopia. Out of 2,126 births reviewed during the study period, 53 newborns were diagnosed with congenital anomalies, resulting in a prevalence of 2.5% (CI: 1.8, 3.2). This finding indicates that while congenital anomalies affect a relatively small proportion of newborns, they remain a significant public health concern due to the potential for morbidity, long-term disability, and mortality associated with these conditions. Understanding the prevalence and associated factors is essential for developing preventive strategies and allocating healthcare resources effectively.

The prevalence of congenital anomalies observed in this study is comparable to findings from Nigeria, where a prevalence of 2.8% was reported among neonates admitted to neonatal intensive care units [19]. Similarly, studies conducted in the Philippines (2.74%) [20] and northern Ethiopia (1.96%) [3] reported prevalence estimates close to the current study. These similarities suggest that congenital anomalies among live births in diverse low- and middle-income countries may fall within a comparable range when larger populations, including both term and preterm infants, are assessed.

However, the prevalence in this study is lower than findings reported in other regions, such as Jimma, Ethiopia (5.95%) [13], Tanzania (29%) [21], Nigeria (6.3%) [20], and Korea (5.48%) [22]. The differences may be explained by variations in study populations, sample sizes, and methodologies. For instance, the Tanzanian study included 445 infants aged less than two months who were admitted to hospitals, a population likely to have more severe conditions. In contrast, the present study reviewed 2,126 delivery summaries and birth records, encompassing both healthy and high-risk deliveries. Similarly, the Jimma study focused on NICU-admitted infants and included congenital anomalies that were diagnosed shortly after birth, such as congenital heart defects [13]. These differences highlight the impact of study design and population selection on the reported prevalence of congenital anomalies.

On the other hand, the prevalence reported in this study is higher than findings from São Paulo, Brazil (1.6%) [23], Bishoftu, Ethiopia (1%) [16], and Gojjam, Ethiopia (1.61%) [24]. These variations may reflect differences in healthcare infrastructure, prenatal screening practices, population genetics, and possibly an increasing trend in the prevalence of congenital anomalies over time [13]. Improvements in diagnostic capacity, increased awareness among healthcare

providers, and better record-keeping could also contribute to a higher observed prevalence in more recent studies.

Maternal factors were found to play an important role in the occurrence of congenital anomalies in this study. Maternal use of iron and folate supplementation during pregnancy was identified as a protective factor (AOR = 0.321, 95% CI: 0.12, 0.86; p = 0.024). This finding aligns with prior studies conducted in Tanzania [21] and in central and southern Ethiopia [9], which demonstrated that folic acid supplementation during pregnancy significantly reduces the risk of congenital anomalies, particularly neural tube defects. Folic acid is known to play a critical role in DNA synthesis and cell division, which are essential processes during early fetal development. Lack of sufficient folate during pregnancy has consistently been linked to structural malformations in newborns.

Maternal age was another significant predictor of congenital anomalies. In the present study, neonates born to mothers aged ≤20 years were nearly 80% less likely to develop congenital anomalies compared to those born to mothers aged ≥35 years (AOR = 0.2, 95% CI: 0.06, 0.63; p = 0.006). This finding is consistent with a study from Bishoftu, Ethiopia, which reported that mothers aged above 35 years had a 6.5 times greater chance of giving birth to infants with congenital anomalies than younger mothers [16]. Advanced maternal age is widely recognized as a risk factor for chromosomal abnormalities, including Down syndrome, and other structural defects due to cumulative exposure to environmental toxins, maternal comorbidities, and age-related changes in oocyte quality.

Neonatal factors were also significantly associated with congenital anomalies. Preterm neonates were 3.02 times more likely to be born with congenital anomalies compared to term neonates (AOR = 3.02, 95% CI: 1.27, 7.2; p = 0.012). This finding is consistent with studies from São Paulo, Brazil, and Mwanza, Tanzania, which reported a higher proportion of congenital anomalies among preterm infants [21, 23]. Preterm birth may reflect underlying maternal or fetal conditions that simultaneously increase the risk of structural or functional malformations.

Similarly, low birth weight was associated with congenital anomalies. Neonates with birth weights ≤2.5 kg were 2.7 times more likely to have congenital anomalies than infants weighing ≥2.5 kg (AOR = 2.7, 95% CI: 1.3, 5.8; p = 0.01), a finding consistent with previous research conducted in Bishoftu, Ethiopia [16]. Low birth weight may result from intrauterine growth

restriction or prematurity, both of which are often linked to congenital anomalies. This emphasizes the importance of monitoring fetal growth and providing targeted interventions for at-risk pregnancies.

Interestingly, maternal chronic diseases, such as diabetes mellitus and hypertension, were not associated with congenital anomalies in the present study. This contrasts with several other studies reporting maternal chronic illness as a well-established risk factor for congenital anomalies and adverse birth outcomes. For example, research in western Ethiopia [24] and Arsi, southwest Ethiopia [17], demonstrated significant associations between maternal chronic medical conditions and congenital anomalies. The lack of association in the current study may be due to the relatively low prevalence of maternal chronic illnesses among the study population or underreporting in medical records.

Furthermore, antenatal care visits and maternal residency were not associated with the occurrence of congenital anomalies in this study. This differs from findings in Bishoftu, Ethiopia, where urban mothers were less likely to have neonates with congenital anomalies compared to rural mothers, potentially due to higher antenatal care coverage and better access to healthcare services in urban areas [16, 25]. The absence of such associations in the current study may reflect uniform access to ANC services across urban and rural populations in Dire Dawa or limited variability in healthcare-seeking behaviors.

Overall, the findings of this study underscore the importance of maternal nutrition, age, and neonatal characteristics in the occurrence of congenital anomalies. The protective effect of iron and folate supplementation, coupled with the increased risk associated with advanced maternal age, prematurity, and low birth weight, highlights potential targets for intervention. These results support the need for health education campaigns focusing on the importance of preconception care, adequate maternal nutrition, and early prenatal screening. Additionally, the findings suggest that targeted monitoring of high-risk pregnancies could help reduce the incidence of congenital anomalies and improve neonatal outcomes in the study area.

5. Strengths and Limitations of the Study

5.1. Strength of Study

The strength of this study is that it includes all birth records and delivery summaries, which avoids selection bias and omission of congenital anomalies. It addresses the positive and negative determinants of congenital anomalies in this region.

5.2. Limitations of the Study

This study is unable to determine congenital anomalies that were diagnosed later, such as congenital heart defects, Downsyndrome and early terminations of pregnancy, since the study shows congenital anomalies diagnosed only at birth. It also fails to address the effect of some variables, such as alcohol drinking and smoking, medication use and chemical exposure, due to the study design.

6. Conclusion

Based on the findings of this study, the overall magnitude of congenital anomalies was low compared to that of other anomalies. The most common congenital anomalies in this study were anencephaly and spinal bifidia. Neonates who are born to mothers aged ≥35 are at higher risk of being born with congenital anomalies. The majority of neonates born with congenital anomalies were premature and had low birth weights. Maternal iron/foliate use during pregnancy protects neonates from congenital anomalies. Dire Dawa Health Bureau should enhance resources for managing congenital anomalies and promote folic acid use. Policymakers should address risk factors, expand surgical centers, and consider iron/folate food fortification. Women are encouraged to have children before age 35. Researchers should conduct studies to identify additional risk factors and assess the community burden of congenital anomalies.

Abbreviations

ANC: Antenatal Care, AOR: Adjusted Odds Ratio, CA: Congenital Anomaly, CI: Confidence Interval, COR: Crude Odds Ratio, CMI: Chronic Medical Illness, DM: Diabetes Mellitus, HTN: Hypertension, kg: Kilogram, NICU: Neonatal Intensive Care Unit, NTD: Neural Tube Defects, SPSS: Statistical Package for Social Science, WHO: World Health Organization.

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Authors Contribution

YA conceived the idea of the study, prepared the study proposal, collected data in the field, performed the data analysis, and drafted the manuscript. YS & YM assisted with the preparation of the proposal and the interpretation of data, participated in data analysis, critically reviewed the manuscript and participated in the critical comments of the proposal and manuscript preparation. All authors read and approved the final manuscript.

Ethics Approval

Ethical clearance was obtained from the Dire Dawa University Institutional Review Board, (SOP/DDU-IRB/98/03) and a permission letter was received from the Dire Dawa Health Bureau and respected health institutions in the city. All the study participants were informed about the objective of the study, and their informed verbal consent was obtained. Additionally, the study subjects were informed that confidentiality and privacy of the information were maintained throughout the study.

Conflicting Interests

The author declare that they have no potential conflicts of interest related to the research, authorship, or publication of this article.

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Availability of Data and Materials

The data supporting this finding can be available at any time with a request. If someone wants to request the data you can communicate the corresponding Authors with email.

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