Libyan Med J. 2026;18(9):573-578
https://doi.org/10.69667/lmj.26906

Libyan Medical Journal

https://lmj.ly/index.php/ojs/index *eISSN: 3107-0426*

Original article

Prevalence and Risk Factors of Congenital Anomalies Among Live Births in Al-Bayda, Libya: A Five-Year Retrospective Study

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Keywords:
Congenital Anomalies, Prevalence, Risk Factors, Consanguinity, Neonates.

ABSTRACT

Congenital anomalies represent a major public health challenge worldwide, contributing substantially to neonatal morbidity and mortality. Despite extensive global research, data from Libya remain limited, hindering effective prevention and policy development. This study aimed to determine the prevalence of congenital anomalies among live births in Al-Bayda Medical Center and affiliated regional hospitals during the period 2020–2024, to identify critical maternal and neonatal risk factors, and to provide evidence-based insights for maternal and child health programs in Libya.

Introduction

Congenital anomalies — structural or functional abnormalities present at birth and arising from genetic, environmental, or multifactorial causes — remain one of the most significant unresolved challenges in maternal and child health worldwide. Recent global estimates indicate that between 3% and 6% of newborns are affected by a structural or functional birth defect, and congenital anomalies now rank among the leading causes of death in children under five years of age [1, 2]. Beyond mortality, surviving infants frequently face lifelong disability, repeated hospitalization, and substantial psychosocial and financial burdens for their families, and these consequences fall disproportionately on low- and middle-income countries, where diagnostic, surgical, and rehabilitative services are least accessible [3]. The problem is therefore not simply clinical but also a health-systems and policy problem: without reliable local data on how common these anomalies are and which factors drive them, health authorities cannot design, target, or evaluate the preventive programs needed to reduce this burden.

A substantial body of international evidence has identified specific maternal and neonatal factors that consistently increase the risk of congenital anomalies, and understanding these factors is central to prevention. Advanced maternal age has been repeatedly identified as a significant determinant, with systematic reviews and meta-analyses confirming its association with chromosomal abnormalities and structural malformations [4]. Maternal nutritional status, and folate status in particular, is another well-established determinant: inadequate folate intake before and during early pregnancy remains a critical and largely preventable contributor to neural tube defects and other congenital conditions [5].

Environmental exposures also play an important role — recent meta-analyses report consistent associations between maternal exposure to ambient air pollution, particularly fine particulate matter (PM10), during early pregnancy and increased risks of congenital heart disease, chromosomal anomalies, and nervous system defects [6, 7]. Consanguineous marriage, common in many Middle Eastern and North African populations, has similarly been associated with an increased frequency of autosomal recessive and multifactorial congenital disorders. Taken together, this evidence points to the multifactorial nature of congenital anomalies and underscores the need for integrated, evidence-based maternal-child health programs that address genetic, nutritional, and environmental risk simultaneously.

Despite this substantial international literature, data on the prevalence and determinants of congenital anomalies in Libya remain scarce, fragmented, and largely undocumented in systematic form. This absence of reliable local epidemiological data constitutes the core problem addressed by the present study: without it, clinicians in Libya cannot benchmark their observations against a national baseline, and policymakers lack the evidence needed to justify or design targeted prevention programs — such as premarital genetic counseling, supervised folic acid supplementation, or antenatal screening protocols — that have proven effective elsewhere. The city of Al-Bayda, served by a central medical center and its affiliated referral hospitals, offers a representative population in which to begin closing this gap. This study was therefore conducted at Al-Bayda Medical Center and affiliated hospitals, under the academic supervision of Omar Al-Mukhtar University, with the following aims: (i) to determine the prevalence of congenital anomalies among live births over five years (2020–2024); (ii) to identify the maternal and neonatal characteristics — including consanguinity, maternal age, medication and supplement use, and birth weight — associated with their occurrence; and (iii) to translate these findings into evidence-based recommendations for strengthening maternal and child health programs in Libya.

Received: *02-07-2026 -* ***Accepted:*** *01-09-2026 -* ***Published:*** *08-09-2026*

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Methods

Study Design and Setting

This was a retrospective, descriptive cross-sectional study conducted at Al-Bayda Medical Center and affiliated hospitals in the city of Al-Bayda, Libya, covering five years from 2020 to 2024. These institutions serve as major referral centers in the region, providing specialized neonatal and maternal care, making them suitable settings for investigating the prevalence and distribution of congenital anomalies among live births and their associated maternal and neonatal characteristics.

Study Population and Eligibility Criteria

The source population comprised all live births recorded at Al-Bayda Medical Center and affiliated hospitals during the study period, together with neonates diagnosed with congenital anomalies and their mothers. Inclusion criteria were: (i) live-born neonates with clinically or radiologically confirmed congenital anomalies; and (ii) mothers of affected neonates who consented to provide demographic and clinical information. Exclusion criteria were: neonates with incomplete medical records or uncertain diagnosis; cases in which maternal data were unavailable, or consent was not obtained; and stillbirths or neonates who died before confirmation of a congenital anomaly.

Sample Size

During the five-year study period, a total of 8,396 live births were recorded. Of these, 85 neonates (1.01%) were identified with clinically or radiologically confirmed congenital anomalies and were included, together with their mothers, in the final analysis.

Data Collection

Data were collected retrospectively from hospital records. Neonatal variables included birth outcome, mode of delivery, birth weight, and presence of congenital anomalies confirmed clinically or radiologically. Maternal variables, obtained from obstetric records, included age, parity, history of consanguinity, and medication or supplement use during pregnancy. All cases were identified through medical charts, diagnostic imaging reports, and physician notes. Data extraction was performed by trained medical staff using a standardized data-collection form, and cases with incomplete or ambiguous records were excluded according to the study criteria.

Statistical Analysis

Data were entered and analyzed using the Statistical Package for the Social Sciences (SPSS), version 26.0. Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to summarize maternal and neonatal characteristics. The prevalence of congenital anomalies was calculated as the proportion of affected neonates among total live births for each study year. Associations between categorical variables were assessed using the chi-square test, and continuous variables were compared using the independent-samples t-test; a p-value < 0.05 was considered statistically significant.

Ethical Considerations

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Approval was obtained from the local ethics committee of Al-Bayda Medical Center in collaboration with the Faculty of Medicine, Omar Al-Mukhtar University, before data collection. Informed consent was obtained from mothers of included neonates, and all data were anonymized during entry and analysis to protect participant confidentiality. Participation was voluntary, and mothers retained the right to withdraw at any stage without affecting the medical care provided to them or their neonates.

Results

During the five-year study period, 8,396 live births were recorded, of which 85 neonates were identified with major congenital anomalies and constituted the study population for the descriptive analyses below:

Gender Distribution

Among the 85 cases, males accounted for 43 cases (50.6%) and females for 42 cases (49.4%) (Figure 1), indicating a near-equal gender distribution among affected neonates.

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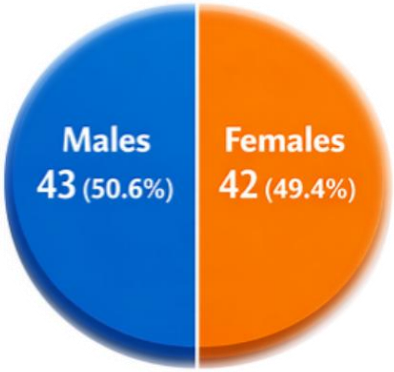

Figure 1. Sample gender distribution of congenital anomalies (n = 85)

Birth Type Distribution

Cesarean delivery accounted for 60% of cases with congenital anomalies, while vaginal delivery accounted for the remaining 40% (Figure 2), reflecting overall delivery practices within the affected study population.

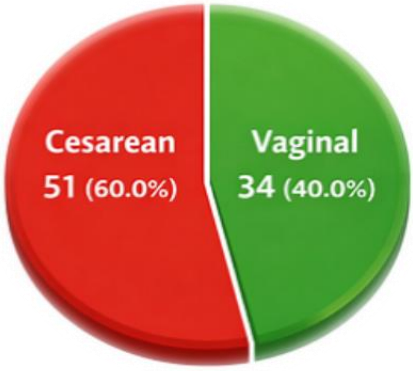

Figure 2. Birth type distribution among neonates with congenital anomalies

Birth Weight Distribution

Infants with birth weights between 1.1 and 2.6 kg accounted for 56.5% of cases, while those weighing between 2.7 and 4.1 kg accounted for 43.5% (Figure 3), indicating that a higher proportion of affected neonates fell in the lower birth-weight range.

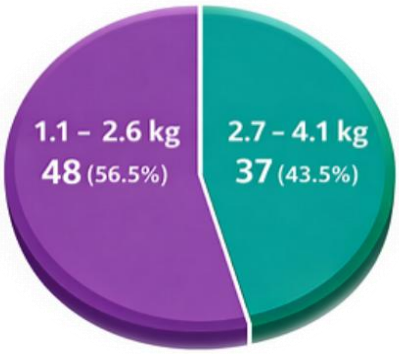

Figure 3. Birth weight distribution among neonates with congenital anomalies

Annual Distribution of Births and Anomalies

The annual number of live births and congenital anomalies fluctuated across the study period. The highest number of births occurred in 2021 (2,502 births; 23 anomalies), while the lowest occurred in 2020 (1,363 births; 12 anomalies). Intermediate values were observed in 2022 (1,431 births; 13 anomalies), 2023 (1,950 births; 18 anomalies), and 2024 (2,150 births; 19 anomalies) (Figure 4).

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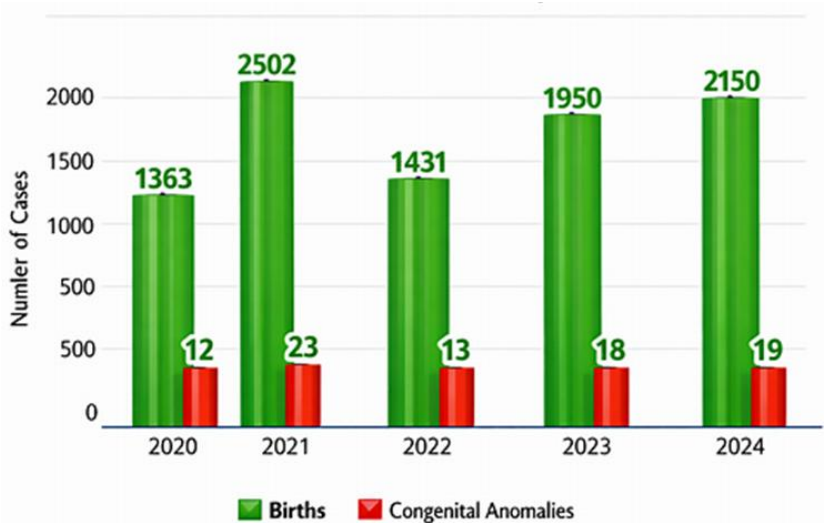

Figure 4. Annual distribution of live births and congenital anomalies, 2020–2024

Prevalence Rate

The annual prevalence rate of congenital anomalies fluctuated over the study period, from 0.88% in 2020, rising to a peak of 0.91% in 2021, then declining to 0.84% in 2022, rising slightly to 0.85% in 2023, and declining further to 0.80% in 2024 (Figure 5). The overall five-year prevalence was 1.01% (85/8,396).

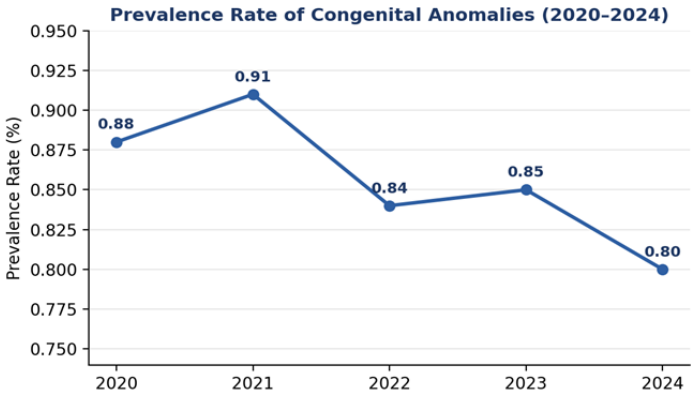

Figure 5. Annual prevalence rate of congenital anomalies, 2020–2024

Maternal Age Distribution

Maternal age among the study group ranged from 19 to 36 years. The largest proportion of mothers were aged 25–30 years (36.5%), followed by 19–24 years (34.1%) and 31–36 years (29.4%) (Table 1), indicating that most mothers of affected neonates were within the mid-reproductive age range.

Table 1. Maternal age distribution among mothers of neonates with congenital anomalies

Type of Use	Number of Cases	Percentage
Painkillers	75	88.2%
Supplements	85	100%
Antibiotics	6	7.1%

Use of Medications and Supplements without Prescription

Nearly all mothers (100%) reported use of dietary supplements. Non-prescription analgesic (painkiller) use was reported by 88.2% of mothers, while 7.1% reported non-prescription antibiotic use (Table 2), indicating a widespread pattern of self-medication with supplements and analgesics, and a comparatively lower rate of antibiotic self-medication.

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Table 2. Self-reported use of medications and supplements without prescription among mothers

Status	Number of Cases	Percentage
Consanguineous	28	32.9%
Non-consanguineous	57	67.1%
Total	85	100%

Consanguineous Marriage

Consanguineous marriage was reported by 32.9% of mothers, while 67.1% reported non-consanguineous marriage (Table 3).

Table 3. Consanguinity status among mothers of neonates with congenital anomalies

Age group (years)	Number of cases	Percentage
19–24	29	34.1%
25–30	31	36.5%
31–36	25	29.4%
Total	85	100%

Discussion

The overall prevalence of congenital anomalies observed in this study (1.01%) is broadly consistent with global estimates reported in recent systematic reviews. Xie et al. [8] reported that the global birth prevalence of major congenital anomalies ranges from 0.86 to 3.11 per 10,000 births depending on anomaly type, with anorectal malformations being the most common. Similarly, Li et al. [2] highlighted that congenital birth defects remain a major global health challenge, affecting approximately 31.6 million children worldwide despite a decline in mortality rates over the past three decades. These findings underscore the importance of continuous surveillance and preventive strategies, particularly in low- and middle-income countries where the burden is disproportionately higher.

In the Libyan context, Assadi et al. [9] reported that congenital anomalies accounted for significant neonatal morbidity and mortality in Misurata, with a mortality rate of 34% among affected infants; the most prevalent anomalies included congenital heart defects, cleft lip and palate, and hydrocephalus. Earlier findings from Benghazi similarly emphasized the role of consanguinity, with nearly 28% of congenital malformations occurring among offspring of consanguineous marriages [10], consistent with the relatively high rate of consanguinity (32.9%) observed among mothers in the present cohort. These local findings align with global evidence that genetic and environmental factors interact to shape the epidemiology of congenital anomalies [11]. Taken together, while the prevalence observed in our study falls within the reported global range, the persistence of high-risk factors such as consanguinity and mid-to-advanced maternal age highlights the continued need for targeted public health interventions in Libya and similar settings.

The widespread use of medications and dietary supplements without medical supervision observed among mothers in this study reflects a pattern reported elsewhere. Non-prescription use of analgesics during pregnancy has been associated with potential risks to fetal development, including an increased risk of major congenital malformations [12], while uncontrolled antibiotic use during pregnancy has been linked to adverse pregnancy outcomes, although the evidence in this area remains mixed [13]. Folic acid supplementation is well established as protective against neural tube defects; a systematic review update conducted for the U.S. Preventive Services Task Force [14] concluded that folic acid supplementation remains strongly protective, while emphasizing the importance of supervised and regulated intake. In low- and middle-income settings, where self-medication practices are common, the lack of medical oversight during pregnancy may exacerbate risks associated with inappropriate drug or supplement use [15]. Collectively, these findings support the need for public health awareness campaigns promoting the safe, supervised use of medications and supplements during pregnancy, particularly in settings with a high prevalence of self-medication.

Conclusion

This study provides a descriptive overview of congenital anomalies among neonates in Al-Bayda, Libya, highlighting their prevalence, distribution, and associated maternal and neonatal characteristics. Congenital anomalies were more frequently observed among infants with low birth weight and those delivered by cesarean section, while mid-reproductive maternal age and consanguineous marriage were prominent among affected cases. The widespread use of medications and supplements without medical supervision further underscores the need for improved antenatal care and public health awareness. Establishing systematic surveillance mechanisms, strengthening maternal health services, and addressing cultural practices such as consanguinity are essential steps toward reducing the burden of congenital anomalies and improving neonatal outcomes in Libya and similar settings.

Conflict of interest. Nil

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Received: *02-07-2026 -* ***Accepted:*** *01-09-2026 -* ***Published:*** *08-09-2026*