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Research Article

Congenital Anomalies in Neonates: Findings from Six Baghdad Hospitals

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Abstract:

Background: Birth defects are the leading cause of both neonatal and post-neonatal deaths, as an estimated 240,000 neonates die in their first month of life worldwide each year. In Iraq, local studies have shown varying frequencies and types of congenital anomalies.

Objectives: To provide a new insight into the incidence and types of congenital anomalies and to explore their possible risk factors in Baghdad City.

Methods: In this cross-sectional observational study, a total of 2007 neonates were enrolled from six hospitals in Baghdad during the period extending between September and December 2020. Hospital records and personal interviews were used for data collection. These data included the neonates' demographic and clinical characteristics, maternal, pregnancy, and immediate postnatal conditions. Description of the defects in those with birth defects was recorded from hospital records and as described by the parents. Statistical analysis was performed as required.

Results: There were 64 (3.2%) neonates with birth defects, i.e., an incidence of 32/1000 total births (28/1000 live births); of them, 38 (59.4%) were males, 8 (12.5%) were stillborn, 43 (66.2%) were born with a cesarean section, the majority (87.5%) had maternal age between 20 and 40 years, and 35 (54.6%) had a low birth weight and were statistically significant. In addition, reduced fetal movement, prematurity, and not receiving tonics during pregnancy were also statistically significant. Among the 64 births with congenital anomalies, multiple congenital anomalies were the most common defects [26 (40.6%)]. An isolated defect was detected in 38 (57.8%) of them. The predominant system involved was the gastrointestinal tract (GIT) [12 (18.8%)] cases, followed by the central nervous system (CNS) with 11 (17.2%) cases, and the musculoskeletal system (MS) with 6 (9.4%) cases.

Conclusion: The incidence of birth defects in Baghdad is close to global figures at 28/1000 live births with multiple congenital anomalies, gastro-intestinal, central nervous, and musculoskeletal systems defects being the most frequent, while cardiovascular, genitourinary, and skin defects being the least frequent. Possible risk factors included maternal age, drug intake, and not receiving tonics during pregnancy.

Keywords: Birth defects; Multiple Congenital Anomalies; Gastrointestinal Tract; Neural Tube Defects; Baghdad.

Introduction

According to the World Health Organization (WHO), congenital disorders (also known as congenital abnormalities (CA), congenital malformations, or birth defects) are structural or functional anomalies that occur during intrauterine life and can be identified prenatally, at birth, or sometimes only later in infancy (1).

Congenital disorders affect about 7.9 million infants annually, with significant mortality and long-term disability implications (2). Approximately 240,000 newborns die within 28 days of birth from these disorders, and they cause an additional 170,000 deaths in children under five years. The burden is particularly high in low- and middle-income countries (3), including Iraq. Globally, the number of recognizable patterns of human malformations have more than tripled during the last 25 years (4).

Birth defects are common, costly, and critical (5). Despite these facts, national government interest has waned. Without global action to improve primary prevention and care for children born with birth defects, the sustainable development goal targets for child survival will not be met (6), which is worrying. Among various birth defects of known etiology, approximately 36-40% are caused exclusively by genetic factors, whereas 50-75% result from complex gene-environmental interactions (7). It is often difficult to identify the exact cause in approximately half up to two-thirds of the cases (2).

The most common severe congenital disorders are heart defects, neural tube defects, and Down syndrome (1). The first two represent more than half of birth defects (6).

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Most birth defects are potentially preventable, and various prevention strategies can be employed (8). Prevention requires a sufficient understanding of etiology, including underlying genetic and environmental causes (9). It may be directed to correction of nutritional deficiencies, iron/ folate and other vitamin supplementation (10), avoidance of smoking, and alcohol, and education about the doubling effect of consanguinity on the risk of birth defects (11).

Regular antenatal care visits, with at least two ultrasound scans during pregnancy, can prove effective in the early detection of birth defects. Genetic counseling and family planning are decisive in high-risk groups (12), aiming for early detection of chromosomal aneuploidies and major birth defects in the first trimester (9).

The subject of incidence and types of birth defects in Iraq continues to be concerning as it remains an important health problem, a major cause of perinatal mortality, as well as childhood morbidity and mortality (13,14).

In the last few decades, ongoing conflicts in Iraq have contributed to poor health conditions, including nutritional deficiencies and environmental pollution, potentially increasing the risk of birth defects (15,16). Earlier studies suggested a rise in such disorders following the second Gulf War in 1991 and the 2003 invasion of Iraq. Those reports not only claim a significant increase in the number of birth defects but also the occurrence of odd malformations not previously reported, probably caused by the use of depleted uranium and white phosphorous (15-23).

A more recently published Iraqi article reviewed the available research evidence and concluded that they do not provide a clear increase in birth defects and a clear indication of possible environmental exposure, including depleted uranium, although the country has been facing several environmental challenges since 1980 (7).

A combined WHO and Iraqi Ministry of Health (MOH) study in 2013 found birth defect rates comparable to regional averages (24), though its findings have faced scrutiny over methodology (25). The debate and controversy continued.

Looking at the studies and reports conducted following the invasion of Iraq in 2003, a probable bias caused by political issues cannot be completely excluded.

Conducting research to identify the true incidence, types, and detection of risk factors for birth defects is challenging for a variety of reasons. These include inconsistent and incomplete data gathering requiring large enough sample sizes for meaningful analysis, (26), challenges related to how birth defects are defined, diagnosed, classified, and reported across different regions and healthcare systems (5), exposure assessment on modifiable risk factors (26), resource limitations as significant financial and logistical resources may not be available in all regions, especially in low-resource settings (27), and finally translating research outcomes and demonstrating public health impact (5).

Understanding these issues is important for researchers planning studies, reviewers evaluating the scientific merit of results from these studies, and consumers of the research, including fellow researchers, policy makers, health care providers, and families (26).

Despite improvements in many areas of Iraq in the last decade, challenges persist, particularly among families in refugee camps. This context prompted a new study in Baghdad to determine the incidence and types of birth defects and their possible associated risk factors, conducted in late 2020.

Patients and Methods

This cross-sectional study was carried out during four months extending from the 1st of September to the 31st of December 2020, aiming to enroll 2000+ births. This figure was determined based on the latest population estimates for Baghdad, using a sample size calculator, without considering the number of infants born with birth defects in this sample.

Six main hospitals in Baghdad City were included in the study, namely: Al-Yarmouk Teaching Hospital, Al-Imamain Al-Kadhimiein Teaching Hospital, Al-Karkh Maternity Hospital from Al-Karkh side of Baghdad, and Al-Elweya Teaching Hospital, Al-Nu'man Teaching Hospital, and Fatimat Al-Zahraa Hospital from Al-Rusafa side of Baghdad. Hospital records of births occurring in those hospitals during the study period were reviewed twice weekly in each hospital. A personal interview was carried out for parents of those with birth defects whenever possible. Parents who live outside Baghdad were excluded from this study.

Demographic and clinical characteristics of the enrolled neonates along with pregnancy, maternal, and immediate postnatal conditions were recorded. All neonates were examined by a pediatrician. Internal defects, when suspected, were investigated by various imaging techniques. The description of the defects in those with birth defects was recorded from hospital records or as described by the parents when the former was insufficient to classify or fully describe the defects.

Collected data were entered into a Microsoft Excel 2016 sheet. All data were coded and then exported to IBM-SPSS software version 26 for statistical analysis. Discrete variables are presented as numbers and percentages. The Chi-square test was used for categorical variables, and the student's t-test was used for continuous variables. A p-value <0.05 was considered significant, and a *p*-value <0.01 was considered highly significant.

Ethical approval of this study was obtained from the Research Ethics Committee of the Department of Pathology & Forensic Medicine, College of Medicine, University of Baghdad (ISU No. 77 at 12.07.2020) and approval was also obtained from the hospital administrations. Verbal informed consent was obtained from the parents of all enrolled neonates, maintaining total anonymity of their data.

Results

General characteristics:

During the study period, 2007 births were enrolled; 851 (42.4%) births were from Al-Karkh side, and 1156 (56.6%) births were from Al-Rusafa side. Of all births, 64 neonates had congenital malformations, making the incidence of birth defects in this study 3.2% (32 / 1000 total births) and 2.8% (28 / 1000 live births). Twenty-four (37.5%) of those neonates with CA were born in Al-Rusafa side and 40 (62.5%) in Al-Karkh side. Stillbirth was found to be highly significantly associated with the presence of congenital anomalies (p = 0.000). Unplanned cesarean section (CS) was significantly associated with birth defects than planned CS or normal delivery (p = 0.003). The same applies to prematurity ($p<0.05$), low birth weight (p = 0.000), as well as maternal and paternal ages between 20 and 40 years (p = 0.038). The sex of the neonates and parental consanguinity did not show a statistically significant association with birth defects ($p > 0.05$), Table (1).

Table (1): Distribution of the studied neonates by their characteristics and the presence or absence of congenital anomalies

Variables	Groups	Total No. (%)	Congenital anomaly					*p*-value
			Present		Relative % (n=64)	Absent		
			No.	%		No.	%	
Sex of the neonate	Male	1040 (51.8%)	38	1.9	59.4	1002	49.9	0.433
	Female	967 (48.2%)	26	1.3	41.6	941	46.9	
State of the neonate	Live birth	1962 (97.8%)	56	2.8	87.5	1906	95.0	0.000 *
	Stillbirth	45 (2.2%)	8	0.4	12.5	37	1.8	
Type of delivery	Unplanned CS	860 (42.8%)	39	1.9	61	822	41.0	0.003 *
	Scheduled CS	386 (19.2%)	4	0.2	6.2	382	19.0	
	Vaginal	757 (37.7%)	18	0.9	28.1	739	36.8	
	Not reported	4 (0.1%)	3	0.2	4.6	1	0.1	
Parental Consanguinity	Yes	878 (43.7%)	31	1.5	48.4	847	42.2	0.230
	No	1124 (56%)	28	1.4	43.7	1096	54.6	
	Not reported	5 (0.3%)	5	0.3	7.8	0	0.0	
Paternal age (years)	< 20	67 (3.3%)	0	0.0	0	67	3.3	0.038
	20-40	1671 (83.8%)	56	2.8	87.5	1615	80.5	
	> 40	239 (12%)	2	0.1	3.1	237	11.8	
	Not reported	30 (1.4%)	6	0.3	9.3	24	1.2	
Maternal age (years)	< 20	223 (11.1%)	7	0.4	11	216	10.8	0.038
	20-40	1676 (83.6%)	56	2.8	87.5	1620	80.7	
	> 40	43 (2.1%)	1	0.1	1.5	42	2.1	
	Not reported	65 (3.2%)	0	0.0	0	65	3.2	
Birth weight	Low	391 (19.5%)	35	1.7	54.6	356	17.7	0.000 *
	Normal	1565 (78%)	26	1.3	40.6	1539	76.7	
	Not reported	51 (2.5%)	3	0.2	4.6	48	2.4	
Gestational age	Full term	1525 (76%)	19	0.95	29.7	1506	75	0.000*
	Pre-term	456 (22.7%)	42	2.1	65.6	414	20.7	
	Post-term	26 (1.3%)	3	0.15	4.7	23	1.1	
Total		2007 (100%)	64	3.2	100	1943	96.8	

**** = statistically significant; CS = cesarean section***

Characteristics of birth defects:

Among the 64 births with congenital anomalies, multiple congenital anomalies (MCA) were the most common defects encountered, as seen in 26 (40.6%) neonates, including four known syndromes. A single system defect was detected in 38 (57.8%) neonates. The predominant system involved was the gastrointestinal (GI) system with 12 (18.8%) cases, followed by the central nervous system (CNS) with 11 (17.2%) cases, and the musculoskeletal system (MS) with 6 (9.4%) cases. The exact or most likely etiology for those defects was also reported whenever possible; see Table (2).

Table (2): Types and frequencies of congenital anomalies detected in this study

System involved [No. (%)]	Preliminary diagnosis	Presumed etiology	No.	%
Unspecified MCA [22 (34.4%)]	Multiple congenital anomalies	Chromosomal, monogenic, congenital infection, others	22	34.4%
Specific syndrome (syndromic MCA) [4 (6.25%)]	Down syndrome	Chromosomal trisomy	1	1.6%
	Edward syndrome	Chromosomal trisomy	1	1.6%
	Patau syndrome	Chromosomal trisomy	1	1.6%
	Goldenhar syndrome	Single gene disease: AD	1	1.6%
GIT [12 (18.75%)]	Gastroschisis	Multifactorial	6	9.4%
	Cleft lip and palate	Multifactorial	5	7.8%
	Esophageal atresia	Multifactorial	1	1.6%
CNS [11 (17.19%)]	Spina bifida	Multifactorial	7	10.9%
	Isolated hydrocephalus	Multifactorial	2	3.1%
	Encephalocele with hydrocephalus	Multifactorial	1	1.6%
	Anencephaly	Multifactorial	1	1.6%
MS [6 (9.37%)]	Achondroplasia	Single gene disease: AD	3	4.7%
	Osteogenesis imperfecta	Single gene disease	1	1.6%
	Isolated limb defects	Single gene disease	2	3.1%
CVS [4 (6.25%)]	Isolated congenital heart defect	Multifactorial	4	6.3%
Skin [3 (4.69%)]	Harlequin-type ichthyosis	Single gene disease: AR	2	3.1%
	Unspecified bullous lesions	? monogenetic; further workup is required to confirm this	1	1.6%
Genitourinary [2 (3.12%)]	Genital ambiguity	? Chromosomal / Monogenic	1	1.6%
	Bilateral kidney defects	Multifactorial or monogenic	1	1.6%
Total			64	100%

MCA = multiple congenital anomalies; CNS = central nervous system; GIT = gastrointestinal tract; CVS = cardiovascular system; MS = musculoskeletal system; AD = autosomal dominant; AR = autosomal recessive? = probable

Only 12 (18.8%) of those with birth defects were diagnosed prenatally. In addition to maternal age, drug intake during pregnancy and reduced fetal movement were statistically significantly associated with birth defects ($p<0.05$); Table (3).

Higher maternal educational level and regular tonic intake prior to and during pregnancy were statistically significantly associated with a lower risk of birth defects ($p<0.05$).

Low parity, low hemoglobin level, abnormal general urine examination, exposure to radiation during pregnancy, and abnormal amniotic fluid volume did not show a statistically significant association with birth defects ($P > 0.05$), Table (3).

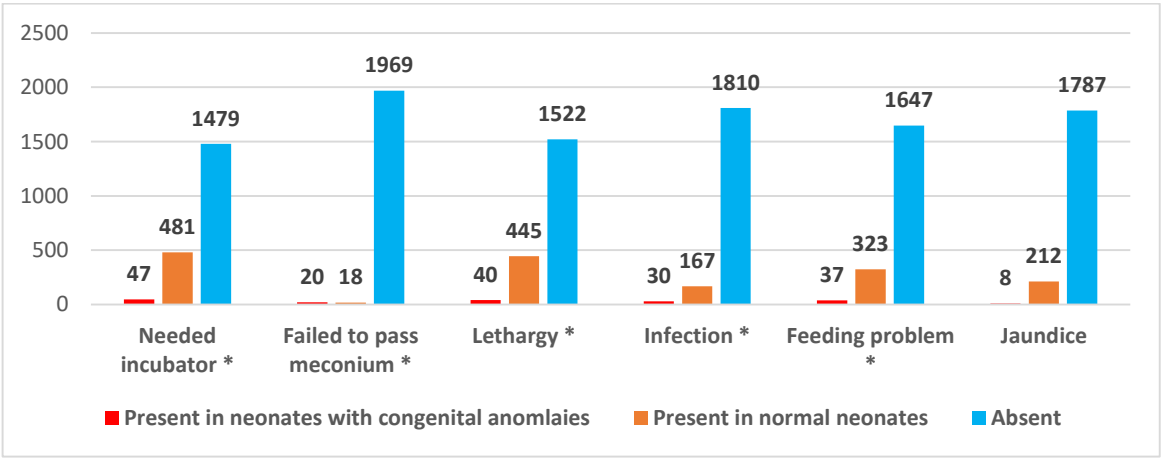
Table (3): Pregnancy and maternal conditions in relation to congenital anomalies

Variable	Groups	No. (%)	Mothers of babies born with birth defects					*p*-value
			Present		Relative %	Absent		
			No.	%	(n=64)	No.	%	
Parity	Primiparous	402 (20.0%)	11	17.1%	0.55%	391	19.5%	1.000
	Multiparous	1464 (72.9%)	40	62.5%	1.99%	1424	71.0%	
	Not reported	141 (7.0%)	13	20.3%	0.65%	128	6.4%	
Maternal age (years)	< 20	223 (11.1%)	7	11.0%	0.35%	216	10.8%	0.038 *
	20-40	1676 (83.6%)	56	87.5%	2.79%	1620	80.7%	
	> 40	43 (2.1%)	1	1.5%	0.05%	42	2.1%	
	Not reported	65 (3.2%)	0	0%	0%	65	3.2%	
Hb. level of the mother	Low	954 (47.6%)	31	48.4%	1.54%	924	46.0%	0.212
	Normal	1038 (51.7%)	23	35.9%	1.15%	1014	50.5%	
	Not reported	15 (0.7%)	10	15.6%	0.50%	5	0.3%	
GUE of the mother	Normal	1098 (54.8%)	36	56.2%	1.79%	1062	52.9%	0.089
	Abnormal	893 (44.5%)	17	26.5%	0.85%	876	43.7%	
	Not reported	16 (0.7%)	11	17.1%	0.55%	5	0.3%	
Radiation exposure during pregnancy	Yes	5 (0.2%)	0	0%	0.00%	5	0.3%	0.731
	No	1953 (97.4%)	46	71.8%	2.29%	1907	95.0%	
	Not reported	49 (2.4%)	18	28.1%	0.90%	31	1.5%	
Drug intake during pregnancy	Yes	358 (17.8%)	16	25.0%	0.80%	342	17.0%	0.01 *
	No	1494 (74.5%)	31	48.4%	1.54%	1463	72.9%	
	Not reported	155 (7.7%)	17	26.5%	0.85%	138	6.9%	
Amniotic fluid volume	Reduced	191 (9.5%)	8	12.5%	0.40%	183	9.1%	0.3
	Normal	1702 (84.9%)	41	64.1%	2.04%	1661	82.8%	
	Increased	55 (2.7%)	2	3.1%	0.10%	53	2.6%	
	Not reported	250 (12.4%)	21	32.8%	1.05%	229	11.4%	
Fetal movement	Reduced	155 (7.8%)	10	15.6%	0.50%	145	7.2%	0.0016 *
	Normal	1722 (85.8%)	39	60.1%	1.94%	1683	83.9%	
	Increased	70 (3.5%)	0	0%	0%	70	3.5%	
	Not reported	60 (2.9%)	15	23.4%	0.75%	45	2.2%	
	Total	2007 (100%)	64	100%	3.2%	1943	96.8%	

** = statistically significant; Hb = hemoglobin; GUE = general urine examination*

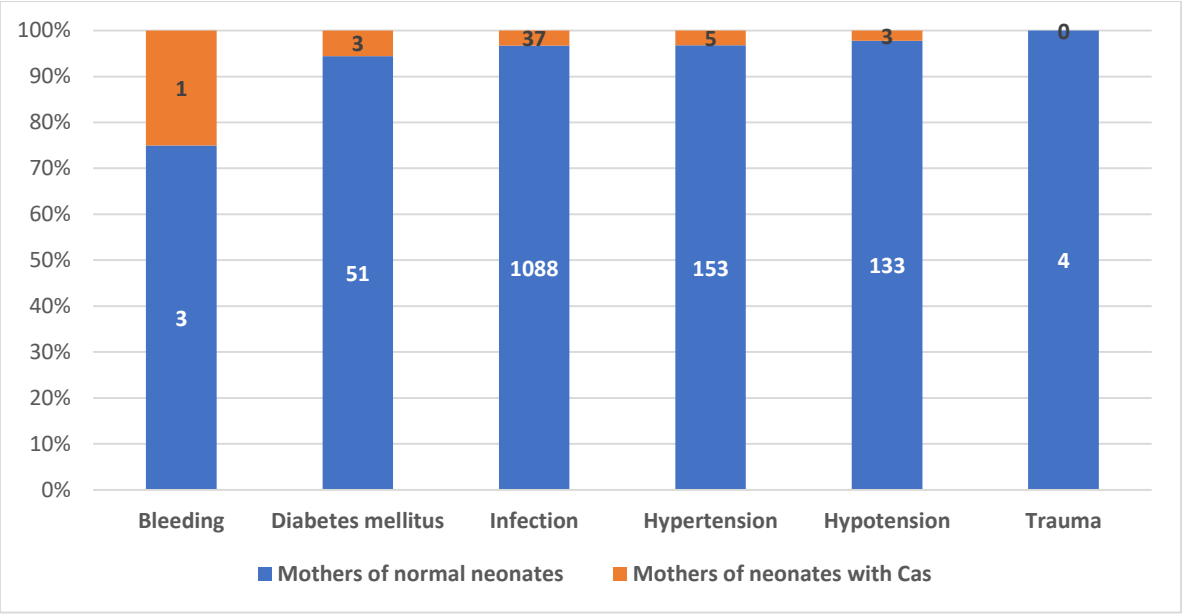
Some neonatal problems in the hospital nursery were statistically highly significantly associated with congenital anomalies ($p<0.001$). These included feeding problems, infections, lethargy, failure to pass meconium, and the need for incubators. Early jaundice was not significantly associated, Figure 1.

Maternal conditions during pregnancy like hypertension, hypotension, diabetes mellitus, infections, bleeding, and trauma were not significantly associated with having a baby with a congenital anomaly, Figure 2.



* p-value < 0.05

Figure (1): Problems encountered in the immediate postnatal life in normal and congenitally abnormal neonates



P > 0.05

Figure (2): Problems encountered during pregnancy in mothers who had neonates with congenital anomalies compared to those who had neonates without congenital anomalies

Discussion

Comparing the results of the current study regarding the incidence of birth defects with four most recently conducted independent Iraqi studies after 2003 (28-31) with two national reports in 2019 and 2020 (13,14) showed a fluctuating incidence from as low as 2.9/1000 births to as high as 48/1000 births in various parts of Iraq. A summary of their results is shown in table (4).

In Baghdad, the highest incidence was reported in 2013 (48/1000 LB), followed by the current study (28/1000 LB), and then 12/1000 LB in 2007, (28,30) while the official national reports from MOH have reported a much lower incidence (2.9 and 3.7 / 1000 LB) in Baghdad during 2019 and 2020 respectively (13,14).

The variation in birth defect incidence in those studies can generally be explained by the varying local incidence in different cities or centers within Baghdad, different study periods (2002-2020), relatively small sample sizes in some (e.g. 1200+ births or so), and inconsistent or incomplete data gathering.

Although the national reports seem to include all cases and all births in Baghdad, the incidence of the other studies cannot be ignored, especially the current study, where the data correspond to the last quarter of the same year of one report (2020), with a big difference.

All local independent studies found higher incidence rates of birth defects than national reports. A probable cause is the underestimation and poor registration of all birth defect cases in hospital records submitted for the national reports, unlike local researchers reporting cases from one hospital or center. For example, some cases of Down syndrome are difficult to diagnose at birth, especially in preterm babies and more so for the untrained nurse or doctor (33). This observation warrants further investigation via independent nation-wide inclusive studies to confirm or exclude it. This effort can be made possible through a governmental major institute, e.g., Iraqi MOH, assisted by international bodies, e.g., WHO, and independent researchers.

Despite these discrepancies, the incidence of birth defects is still within the worldwide incidence of birth defects that ranges between 10-60/1000 live births detected at birth. (2, 16) Except for one report that estimated birth defects to be > 69.9/1000 live births in most Arab countries, other international reports showed the incidence of birth defects in Europe, North America, and Australia to be < 52.1/1000 live births (34).

In the US, and despite the dramatically increasing incidence of some birth defects, one-third of all States have no system for tracking birth defects, and systems are inadequate in most others (32)

Table 4: Local Iraqi independent studies and official reports showing incidence, types, and possible associated risk factors of birth defects in the last two decades

Reference	City (Year of study)	No. of births	No. of CA	%	Incidence / 1000 LB	PC	Sex	GA	LBW	SB	Parity	Cesarean section	Maternal Age	Types
This study	Baghdad (2020)	2,007	64	3.19* TB (2.8% LB)	28	NS	M>F NS	Preterm **	19.5% **	**	Multi NS	62% *	20-40 yrs	MCA > GIT > CNS > MS > CVS > GUT, Skin
Official MOH report 2020 (13)	Baghdad (2020)	210,162	601	0.29	2.9	NR	M > F	NR	8.3%	1535 (0.7%)	NR	110605 (52.5%)	NR	CVS > HC > GIT > AC > SC > LL > DS > UL > SB > other chrom
Official MOH report 2019 (14)	Baghdad (2019)	216,824	789	0.37	3.7	NR	M > F	NR	17886 (8.3%)	1623 (0.43%)	NR	110294 (50.9%)	NR	CVS > HC >GIT > AC> SC > LL> DS > UL > SB > CLP
Naoom MB et al (28)	Baghdad (2013)	1,235	60	4.8	48	73.3% NS	M>F NS	Term 86.7%*	26.7% NS	NR	Multi NS	55% NS	20-35 yrs	CVS > GIT > GUS > CNS
Taboo ZAQ (29)	Mosul (2009/2010)	46,775	323	0.69	6.9	**	F>M	36 weeks	NR	NR	NR	21.9 NS	20-40 yrs	CNS > MCA > Sk > CVS > GIT
Hameed NN (30)	Baghdad (2007)	8,090	100	1.23	12.36	27%	F>M	NR	NR	NR	Low 60%	NR	20-30 yrs	CNS > Sk > GIT > GUS > CV > chrom
Al-Janabi et al (31)	Al-Anbar (2000-2002)	1283	109	0.85	8.5	71% **	NS	NR	**	11.5% **	>4 **	NR	Advanced *	CNS > Sk > GIT > GUS > MCA

*** =** This number was calculated according to the total births while the incidence was calculated by live not total births;
CA = congenital abnormality; **PC** = parental consanguinity; **GA** = gestational age; **LBW** = low birth-weight; **SB** = stillbirth; **TB** = total births; **CVS** = cardiovascular system; **HC** = hydrocephaly; **GIT** = gastrointestinal tract; **AC** = anencephaly; **LB** = live birth; **SC** = spinal cord; **Sk** = skeletal system; **chrom**. = chromosomal abnormality; **MOH** = ministry of health; **GUS** = genitourinary tract; **MCA** = multiple congenital anomalies; **CNS** = central nervous system; **DS** = Down syndrome; **UL** = upper limb; **LL** = lower limb; **SBD** = spina bifida; **CLP** = cleft lip and palate; ***** = statistically significant; ****** = statistically highly significant; **NS** = not significant; **NR** = not reported

The top ten most common birth defects in Iraq, according to the national Iraqi reports in 2019 and 2020, affected the cardiovascular system (CVS), followed by hydrocephaly, gastrointestinal tract (GIT), anencephaly, other spinal cord defects, reduction defects in lower limbs, Down syndrome, reduction defects in upper limbs, spina bifida, and other chromosomal disorders (13,14).

The current study found these and other types in different frequencies. The most common defects were multiple congenital anomalies, followed by GIT, central nervous system (CNS) (including all neural tube defects, hydrocephaly), musculoskeletal defects (upper and lower limbs included), CVS defects, skin, and then genitourinary system (GUS).

While the national report used a different classification of birth defects based on the International Classification of Diseases (ICD)-10 codes, the current study, as well as other local studies, used a system-based classification. The latter may be preferred as grouping defects that share embryology and pathogenesis increases the likelihood that a teratogenic effect will be apparent (35).

Converting the national report into system-based classification results in the redistribution of the ranking as follows: CVS (24.27/1000 LB) followed by CNS (14.6/1000 LB), then skeletal (7.57/1000 LB), chromosomal anomalies (6.13/1000 LB), and finally the GIT (5.96/1000 LB) defects complete the list.

This comparison and analysis raise an important issue that may explain the controversy. Using a different classification system as well as inconsistent criteria to diagnose a particular disorder results in such variability in types and frequencies in different studies. Unfortunately, this is not the only problem. Varying definitions of the term "birth defect" add to the challenges of tracking their incidence and understanding their causes.

The CVS and CNS are included in top ten defects in all studies and reports. These are understandable as the CNS is the first system to develop in the embryo, followed by the heart and major vessels (26). Both systems constitute the majority of birth defects when the teratogenesis starts very early in pregnancy. This is also reflected by the global incidence of birth defects being concentrated in those two systems (16). Earlier local studies from Baghdad (28,30) found that CVS and CNS were most commonly affected, with GIT, skeletal defects, and GUS falling behind.

Multiple congenital anomalies were reported by all local studies, including the current study, and national reports, except for two studies from Baghdad (28) and Mosul (29). The national reports also did not include skin and genitourinary tract in their top ten defects.

According to the "March of Dimes", a birth defect is "an abnormality of structure, function, or metabolism present at birth that results in physical or mental disability, or is fatal" (32). The definition adopted by the WHO and the ICD-10, limits the term to structural malformations and deformations (1).

Minor structural birth defects, such as an extra nipple or a rudimentary extra finger are signs of abnormal development that signals an underlying cause that should not be ignored (32).

Some minor defects may represent the milder end of a spectrum and thus have the same risk factors as corresponding major defects, e.g. spina bifida occulta and open spina bifida (5). In general, reliance on ICD codes as the only determinant of case status can lead to inappropriate inclusion or exclusion of cases (36).

Detection of more than one defect, where one major defect may overshadow a minor or a hidden defect can affect interpretation (5). The researcher's ability to detect and properly diagnose a neonate with multiple anomalies as a specific syndrome, and proper reporting of neonates with anomalies are other challenging factors (26). Moreover, population-based surveillance systems should capture birth defects occurring among multiple pregnancy outcomes (i.e., live births, stillbirths, pregnancy terminations). If only live births are ascertained, the prevalence of birth defects can be substantially underestimated (5).

The study of possible risks or associated factors is very important. Detection of a treatable or preventable risk has practical implications (16). Risk factors have not been reported in the national reports in Iraq. Only local one-center studies with small sample sizes have addressed some of these factors, including the current study.

Studying risk factors is closely tied to how birth defects are categorized. Proper case classification is crucial to avoid bias in risk factor studies (5). While defects may be grouped together for analysis if they share a common cause, some grouped defects may have distinct risk factors. For instance, neural tube defects are often analyzed as one category, but anencephaly and spina bifida have different risk factors (37). The issue of determining when to "lump" birth defects into a single category and when to "split" them out into different categories has long been a challenge for researchers (38).

Researchers should aim for homogeneity within their case groups, keeping the unique characteristics of each birth defect. Analyzing all defects or even by body system (e.g., cardiac, gastrointestinal) is unlikely to yield informative results (5). This issue applies to past local studies and the current study utilizing system-based categorization. However, detailing risk assessments of specific types of birth defects in each system can preclude this limitation.

In this study, parental age between 20 and 40 years, the most common reproductive age in both males and females, was four times associated with a neonate with a birth defect and was statistically significant. This was also shown in other local studies (20-35 and 20-40 years), but the significance of this association was not stated (28-30). It is known that some defects are seen more often among young mothers, e.g., gastroschisis. The risk for some other defects (chromosomal aneuploidies such as Down syndrome) increases especially with advanced maternal age, (40), as seen in Al-Anbar study (31).

Among the other associated conditions, parental consanguinity was only reported to be significant in one study from Mosul (29). This contrasts the

findings of this study and other local studies from Baghdad (28,30).

Some birth defects are known to affect boys more than girls, e.g. infantile pyloric stenosis, cleft lip, and polydactyly, while others can affect girls more than boys, e.g. some types of NTDs and cleft palate (39). Most Iraqi reports showed that birth defects occurred slightly more in males than females, including the current study, but without statistical significance.

One population-based study showed that 44 of 110 (40%) unique subtypes were more prevalent in males, while 13 of 110 (12%) unique subtypes were more prevalent in females. There is growing evidence of sex-specific differences in the prevalence of a wide range of congenital anomaly subtypes (40).

Preterm births and low birth weight are known to be linked to increased incidence of birth defects, whether one leads to another or both are due to one common cause. Similar results were found when the analysis was stratified by maternal age, race, and the infant's sex (41). This is similarly reported in the current study, where preterm birth was 8 times, low birth weight was 5.4 times, and reduced fetal movement was 3.2 times more common in neonates with birth defects than normal neonates. Most other local studies showed similar results. Another local study reported that term pregnancies but not low-birth-weight neonates are statistically associated with birth defects (28).

In the current study and the national reports, (13,14); cesarean section (CS) was performed for the majority of pregnancies affected with birth defects but was significantly associated with them only in the current study. However, other local studies have shown a non-significant association between CS and birth defects, probably because of the type of defects enrolled in those studies. (28, 29) Cesarean delivery may improve neonatal outcomes for fetuses with certain birth defects, e.g. isolated meningomyelocele, hydrocephalus with concomitant macrocephaly, anterior wall defects with extracorporeal liver, sacrococcygeal teratomas, and hydrops. Others, e.g. hydrocephalus without macrocephaly, anterior wall defects without an extracorporeal liver, ovarian cysts, and skeletal dysplasias, may safely be delivered vaginally (42).

Other variables that were found to be significantly associated with birth defects in this study, like not receiving tonics during pregnancy, postnatal problems, e.g., the need for an incubator, feeding problems, infections, lethargy, and failure to pass meconium, were significantly linked to the presence of a birth defect in the neonates. These and other variables were not particularly studied by earlier local studies, except for a significant association of taking tonics, e.g., folate supplementation, with reduced incidence of neural tube defects (30).

Other reported risk factors, e.g. maternal smoking, alcohol intake during pregnancy, having certain medical conditions, such as uncontrolled diabetes, seizure disorder, or hypertension, a positive family history of birth defects, getting certain infections during pregnancy, or having a fever greater than 38.3ºC (43), could not be included in the current study as not all parents were interviewed and such data were not regularly included in hospital records. The incomplete data were omitted from the analysis.

Limitations:

This cross-sectional observational study enrolled a relatively small sample size. Due to the local nature of this study, the results can give an insight on the current situation in those hospitals in Baghdad at the time of study. However, the results cannot be generalized.

Conclusion:

The incidence of birth defects in Baghdad is close to global figures at 28/1000 live births with multiple congenital anomalies, gastro-intestinal, central nervous, and musculoskeletal systems defects being the most frequent, while cardiovascular, genitourinary and skin defects being the least frequent. Possible risk factors included maternal age, drug intake, and not receiving tonics during pregnancy.

Authors' declaration:

Dr. Bassam M. Al-Musawi is an editorial member in the journal but did not participate in the peer review process other than his role as an author.

We confirm that all the Figures and Tables in the manuscript belong to the current study.

The project was approved by the local ethical committee in the Department of Pathology & Forensic Medicine, College of Medicine, University of Baghdad according to Ref. number 77 on 12/07/2020.

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Author contributions:

Study conception & design: (BMSA). Literature search: (BMSA). Data acquisition: (AMK, NAK, and MZM). Data analysis & interpretation: all authors. Manuscript preparation: (BMSA). Manuscript editing & review: (BMSA).

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التشوهات الولادية عند حديثي الولادة: نتائج ست مستشفيات في بغداد

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الخلاصة:
خلفية البحث: تعد التشوهات الولادية السبب الرئيس لوفيات حديثي الولادة وما بعدها حيث يموت 240 ألف حديث ولادة في الشهر الأول من العمر في العالم سنويا. أظهرت دراسات محلية عديدة في العراق اختلافا في نسبة حدوث وأنواع التشوهات الولادية.
الاهداف: تقديم نظرة جديدة عن نسبة حدوث وأنواع التشوهات الولادية ودراسة عوامل الخطورة والعوامل المرتبطة بها في مدينة بغداد.
المرضى والمنهجية: في هذه الدراسة المقطعية الرصدية سجل 2007 طفلا حديث الولادة من ست مستشفيات في بغداد: ثلاث منها في جانب الكرخ وثلاث أخر في جانب الرصافة خلال الربع الأخير من سنة 2020. جمعت المعلومات من وثائق المستشفيات والمقابلات الشخصية. اشتملت المعلومات على الصفات الديموغرافية والسريرية للأطفال حديثي الولادة مع حالة الأم والحمل وحالة الطفل المباشرة بعد الولادة. اعتمد تشخيص ووصف التشوهات في الأطفال المشوهين ولاديا على المعلومات المسجلة في وثائق المستشفى وكما وصفها الوالدان. استخدمت العمليات الإحصائية كلما اقتضى الأمر ذلك.
النتائج: سجلت 64 (3.2%) حالة ولادة مشوهة أي بنسبة حدوث 32 لكل ألف ولادة كلية (28 لكل ألف ولادة حية). كان 38 (59.4%) منهم طفلا ذكرا، 8 (12.5%) ولادة ميتة، و43 (66.2%) ولادة بعملية قيصرية. كانت معظم الولادات لأبوين ضمن الفئة العمرية 20-40 سنة، وكان 35 (54.6%) قليلي الوزن. فضلا عن ذلك، كانت قلة حركة الجنين، والولادة المبكرة، وعدم تناول المقويات أثناء الحمل مهمة احصائيا. كانت التشوهات المتعددة هي الأكثر شيوعا [26 (40.6%)] من بين الـ 64 طفلا المولودين بتشوه ولادي، بينما سجلت التشوهات المعزولة في 38 (57.8%) منهم. كان الجهاز الأكثر إصابة هو الجهاز الهضمي بـ 12 (18.8%) حالة يليه الجهاز العصبي بـ 11 (17.2%) حالة ومن ثم الجهاز العضلي الحركي بـ 6 (9.4%) حالات.
الاستنتاجات: إن معدل حدوث العيوب الخلقية في بغداد يقترب من الأرقام العالمية عند 1000/28 ولادة حية. كانت التشوهات الخلقية المتعددة وعيوب الجهاز الهضمي والجهاز العصبي المركزي والجهاز العضلي الهيكلي هي الأكثر شيوعا، في حين أن عيوب القلب والأوعية الدموية والجهاز البولي التناسلي والجلد هي الأقل شيوعا. شملت عوامل الخطر المحتملة عمر الأم، وتناول الأدوية، وعدم تناول المقويات أثناء الحمل.
الكلمات المفتاحية: التشوهات الولادية، التشوهات الولادية المتعددة، الجهاز الهضمي، تشوهات الأنبوب العصبي، بغداد