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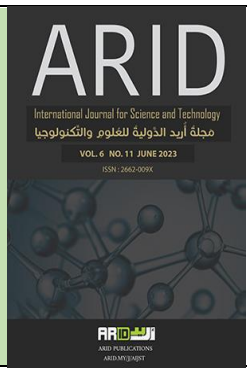

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The Impact of Environmental Pollution on Congenital Anomalies of New Birth in Kirkuk City – Iraq

Rezan Hassan Mahammad

Department of Radiology and ultrasound,College of medical Technique, University of Alkitab, Kirkuk ,Iraq

أثر التلوث البيئي على التشوهات الخلقية للمواليد الجدد في محافظة كركوك - العراق

ريزان حسن محمد
قسم الأشعة و السونار - كلية التقنية الطبية - جامعة الكتاب
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dr.rezanhasan@uoalkitab.edu.iq
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ABSTRACT

The Birth abnormalities or congenital malformations can emerge during the fetal development stage or from a parent's genetic composition. The main contributors to neonatal and childhood disease and impairment are congenital abnormalities. Increase the observation of congenital anomaly (CA) in Mama Village that belong to Kirkuk city has been made with information about frequency and nature of these abnormalities.

This study was conducted to estimate the prevalence of congenital anomaly in Mama Village that belong to Kirkuk city.

A Cross sectional study that includes 60 couples who are living in Mama Village for the duration from March 2020 to March 2022 to investigate the risk of congenital anomaly that increases in frequency in 2019. The data was collected by direct interview of the participants and took a full history of the performing ultrasonography.

The highest prevalence of CA that reach 55%, 96.7% of participant were cousin. Nearly two third of participant had single anomaly. Central nervous system anomaly was the most prevalent anomaly in the current study, and hydrocephalous was presented in 18.3% of them. Young age group mother, cousin marriage and history of infant death were a risk factor for CA.

It is concluded that a higher prevalence of congenital anomaly in the current study especially when compared with the number of area population. The central nervous system was more probable which shown to be substantially correlated with maternal history of prior previous child death, paternal consanguinity, and age. Higher prevalence of central nervous system could be related to the environment effect which is (weapon-related) occur in the studied area previously.

Key words: Congenital anomaly, cousin marriage, weapon explosion.

الملخص

يمكن أن تظهر تشوهات الولادة أو التشوهات الخلقية خلال مرحلة نمو الجنين أو من التركيب الجيني لأحد الوالدين، لكن زيادة ملاحظة التشوهات الخلقية في قرية ماما التابعة لقضاء الدبس / محافظة كركوك بنيت بمعلومات حول تكرار وطبيعة هذه التشوهات.

هدف الدراسة كان لتحديد أنواع مختلفة من التشوهات الخلقية وتكرارها بين العوائل الموجودة في قرية ماما التابعة لمحافظة كركوك وما إذا كانت هناك علاقة بين هذه التشوهات وانفجار الغير معلومة المصادر وتحقيق في مخاطر التشوهات الخلقية التي تزداد وتيرتها منذ عام 2019.

دراسة المقطعية شملت 60 عائلة من الأزواج الذين يعيشون في قرية ماما من مارس 2020 إلى مارس 2022 وتم جمع البيانات عن طريق إجراء مقابلة مع المشاركين وإجراء فحص الموجات فوق الصوتية.

توصلت الدراسة لارتفاع معدل انتشار التشوهات الخلقية في الدراسة الحالية خاصة إذا ما قورنت بعدد سكان المنطقة وعلاقتها بانفجارات وتلوث البيئي في المنطقة.

I. Introduction

In wealthy nations, birth abnormalities continue to be the main contributor to perinatal death and childhood impairment. In contrast, poverty and infection are the major causes of death in several underdeveloped nations where infant mortality is still relatively high. However, due to limited diagnostic resources and the unreliability of medical records and health statistics, birth abnormalities in the poor countries are frequently underreported. Therefore, a rise in the occurrence of birth abnormalities should be treated with care as it can only be explained by the use of more accurate diagnostic tools or better medical records. [1]

Birth defects, commonly referred to as congenital malformations that include structural or functional malformations arising during pregnancy as a consequence of an anomaly or deficiency in the developmental period. [2] Congenital birth defects cause of death of

549 000 deaths in 2019, the global incidence was 62.9 cases per 1000 livebirths and estimated that 50.9 million of babies lived with birth defects in 2019. [3]

Congenital anomaly prevalence varies significantly by country that range 1- 8%. Geographic factors, sociocultural, racial, and ethnic factors are responsible for the variance in the incidence of congenital abnormalities. [4] In community based study the prevalence of birth defect in Saudi population was 0.04% [5] ,1.28% in Jordan [6] while the birth defect in Fallujah city was 14.7% .[7]

Single-system malformations and multiple-system malformations are two basic categories of congenital defects. Major congenital defects are those that, if left untreated, may significantly affect a person's ability to perform their regular bodily activities or even shorten their life

expectancy. Minor congenital abnormalities are those that are neither physically nor functionally disabling and can be considered to be typical variations. [8]

Birth abnormalities have been linked to a variety of reasons, including genetics, environmental teratogenic factors, a lack of certain micronutrients, and multifactorial inheritance. Familial marriage, maternal age, pharmaceuticals, smoking, alcohol intake, and maternal diseases are among the frequent risk factors mentioned in the literatures. Although genetic, viral, dietary, or environmental factors may contribute to congenital malformations, it is sometimes challenging to pinpoint their precise causes. [9] While the origins of the majority of birth abnormalities are still unclear, an increasing number of studies that suggested an environmental variable as contributor to genetic mutations and interact with genetic risk factors for birth defects. As a result, it can be said that the majority of birth abnormalities have multifactorial causes that result from a mix of genetic and environmental variables. [10] Previous studies showed that 37% of congenital abnormalities are related to genetic and environmental interactions, and 10% are linked to chemicals with teratogenic effects that have been scientifically proven. Only 40 of the 2500 compounds that have been identified as teratogenic agents are shown to produce teratogenic effects in humans, including carbon monoxide, ozone, lead chromate, lead acetate, lead phosphate, 1,2-dibromo-3-chloropropane, and 2-bromopropane. [11]

The majority of Iraqis marry in consanguineous relationships. According to the Central Organization of Statistics and Information Technology (COSIT) in 2044 about 33% of Iraqis were first cousin consanguineous. The incidence of consanguinity varies, however, tend to be higher in Arabic community that reach 56% in Saudi Arabia [12], 54% in Qatar [13] and 27.5% in Jordan. [14] Increase the autosomal recessive diseases as a result of the high rate of consanguinity that ranges from 20–60% of all their marriages. Congenital malformations were

substantially more common in children born to consanguineous parents than in non-consanguineous households. [15]

Since the introduction of depleted uranium in First Gulf War, study has concentrated on contamination caused by this substance as a probable factor in rising congenital abnormality (CA) and cancer rates. According to recent investigations, the US military may also employ conventional weapons in Iraq that have somewhat enriched uranium (U-235 mass percentage >0.711%, 2%). [16] As a result, we refer to metallic uranium (of unknown isotopic composition) released to the environment in Iraq by the use of conventional weapons as "weaponized uranium". Studies on non-human in vivo animals have demonstrated that exposure to uranium oxides can cause teratogenic and carcinogenic consequences. Uranyl ions (the metabolism product of uranium oxides) easily interact with other molecules and are distributed throughout the body through systemic circulation and. The blood-brain barrier and the placental barrier are both permeable to uranium. It has been demonstrated that after absorption, uranium increases the presence of reactive oxygen species, breaks DNA strands, and changes gene expression, all of which have negative clinical implications. [17] Compared to veteran populations, local communities are more at risk of unfavorable health impacts from chronic exposure situations .[18]

Strategies to avoid babies with congenital defects also focus on the risk factors that are common to other unfavorable pregnancy outcomes, successfully seeking to cut down on reproductive waste and improve pregnancy outcomes. [19] The most efficient way to decrease the frequency of major congenital abnormalities and raise the survival rate of individuals born with these problems is through fetal anomaly screening. If a correctable anomaly is found, it may be advised that birth take place in a facility with pediatric surgical capabilities, and if a severe,

irreparable condition is found, a pregnancy termination option may be made available. If congenital abnormalities are not treated properly, survivors may have permanent physical, mental, visual, and auditory impairments. This can have a detrimental impact on the affected person's social and professional life, as well as the lives of their families and communities. Following the delivery of a child with significant defects, parents may experience emotions including denial, guilt, concern, sadness, and embarrassment. [2]

The aim of current research is to estimate prevalence of congenital anomaly in Mama Village which underwent Explosion in 2004.

II. Material and method

2.1 Study design:

A Cross sectional study that include 60 couples who live in Mama Village which belong to Dibs district in Kirkuk, during the duration March 2020 to March 2022 to investigate the risk of congenital anomaly that increase in frequency in 2019. The study included every couples who give birth to new born recently, willing to participate in the study and had no medical history that could cause a congenital anomaly to the child.

The data were collecting by direct interviewing the participant and took a full history about their age, degree of consanguinity with husband, number of living children, number of dead baby, presence of abortion or intrauterine death, presence of congenital anomaly, time of diagnosis and type of anomaly.

The ultrasonography done for every participant included in this study from first trimester till birth.

2.2 Statistical analysis:

The data was analyzed using the SPSS version 25.0 program, frequency percentage and charts were used to describe the data. The factors that contribute to congenital anomaly were identified using a logistic regression analysis.

III. Results

33 Newborn were born with congenital anomaly from 60 new born, the prevalence of anomaly in the current study was 55%.

The age distribution shows that 18.3% were aged 15-20 yrs., 36.75 were 21-25 yrs., 10% were 26-30 yrs. and 35% were > 31. 96.7% were Relative to the husband. 35% had >4 children and 35% had 3-4 children. 25% had one previously dead baby and 13.3% had two previously dead baby. 15% had single abortion, 11.7% had two abortion and 1.7% had 3 previous abortion, only 8.3% had history of IUD.

Those who included in the study, 55% had congenital anomaly, 72.7% had single anomaly and 27.3% had multiple. Regarding time of diagnosis, 42.4% were diagnosed in 2nd trimester, 18.2% in the 3rd trimester and 39.4% after delivery, as presented in Table I.

Table(I): participant baseline data.

		N	%
Age group	**15 – 20**	**11**	**18.3%**
	21- 25	**22**	**36.7%**
	26 - 30	**6**	**10.0%**
	> 31	**21**	**35.0%**
Relative with his husband	**No**	**2**	**3.3%**
	Yes	**58**	**96.7%**
No. of children	**no children**	**2**	**3.3%**
	1-2 children	**16**	**26.7%**
	3-4 children	**21**	**35.0%**
	more than 4	**21**	**35.0%**
N. of dead baby	**0**	**37**	**61.7%**
	1	**15**	**25.0%**
	2	**8**	**13.3%**
No. of abortion	**0**	**43**	**71.7%**
	1	**9**	**15.0%**
	2	**7**	**11.7%**
	3	**1**	**1.7%**
No. of IUD	**0**	**55**	**91.7%**
	1	**5**	**8.3%**
Presence of congenital anomaly	**No anomaly**	**27**	**45.0%**
	Presence	**33**	**55%**
N. of congenital anomalies	**Single**	**24**	**72.7%**
	Multiple	**9**	**27.3%**
Time of diagnosis of abnormalities	**2nd Trimester**	**14**	**42.4%**
	3rd Trimester	**6**	**18.2%**
	After delivery	**13**	**39.4%**

The most common anomaly was hydrocephalous in 18.3%, followed by cleft palate in 11.7%, spina bifida in 8.4%, small for date baby in 6.7%, low IQ in 5%, heart disease, anencephaly, hydronephrosis and intestinal obstruction were presented in 3.3% in baby for each, as presented in figure 1

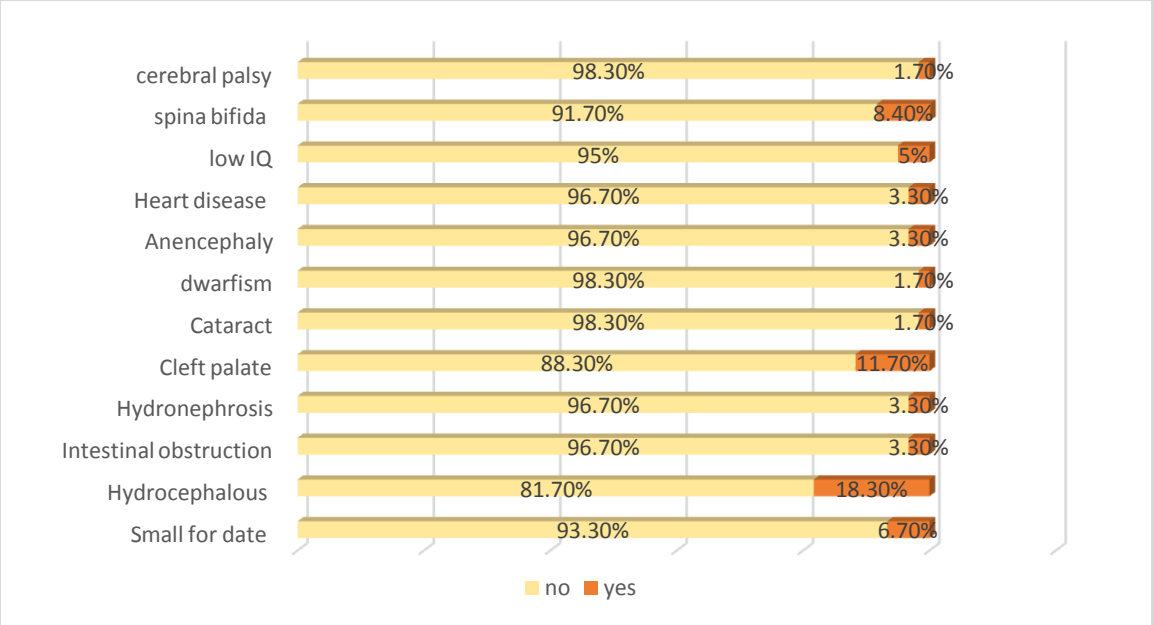

Figure 1: percentage of anomaly in

Figure(1): the babies of participant

The logistic regression analysis shows that being both parent relative had a statistical effect on presence of congenital anomaly, relative parents had 1.45 increase risk of having congenital anomalies in their baby in compare to non-relatives, p was 0.05.

Those with younger age group 15-20 years had 3.6 increase risk of anomaly, and those who aged 21-25 had 3.49 increase risk, p-value 0.01 and 0.05, respectively.

Presence of dead baby in the family increase risk of anomaly by 12 times in those with one dead child and by 12.9 in those with two dead child, p-value 0.003 and 0.02, respectively.

Both abortion and IUD were not a risk factors for anomaly in the current data, as presented in Table II.

Table(II): logistic regression analysis of Cousin Marriage, age group, history of dead baby, history of abortion and IUD on presentation of anomaly.

		Odd ratio	p-value
Cousin marriage	No	Reference	/
	Yes	1.45 (0.07-30.08)	0.05*
Age group	15-20	3.62 (0.73-17.87)	0.01*
	21-25	3.49 (0.96-12.60)	0.05*
	26-30	0.52 (0.21-2.60)	0.67
	≥ 31	Reference	
dead baby	No death	Reference	
	One	12.0 (2.34-61.52)	0.003*
	Two	12.92 (1.43-116.78)	0.02*
Abortion	No abortion	Reference	
	One	0.32 (0.07-1.507)	0.15
	Two	0.87 (0.17-4.44)	0.86
	three	1.0 (0.43-4.5)	0.09
IUD	No death	Reference	
	One	0.97 (0.14-6.56)	0.9

***p-value ≤ 0.05**

IV. Discussions

Major congenital abnormalities often have a negative impact on a child's physical, mental, or social development, and they can raise their risk of morbidity due to a variety of medical conditions. A significant worldwide issue is the contribution of medications, infectious diseases, and environmental contaminants to congenital abnormalities.

The underlying reasons of the majority of congenital malformations are still unknown, though, and multifactorial inheritance is thought to be the root cause of the majority of common abnormalities.

The prevalence of congenital anomaly in current study was high and reach to 55%, the percentage was higher than the observed in other studies, 10.6% in Ethiopia [20], 2.4% in

Malaysia [21], 7.4% in Egypt [22], 0.02% in Fallujah city [23], 0.01% in Baghdad city [24] and 0.36% in Erbil city [2].

Congenital anomaly prevalence may vary over time or by region, which may be a result of intricate interplay between genetic and environmental factors as well as social and racial influences factors

Due to collecting the sample size from one village which is (Mama village) not from all Kirkuk city in the current study, the prevalence of congenital abnormalities could be high in comparison to other study.

An approximated proportion between those who aged 21-25 and those who are > 31 years, in Al-Alwani M et al [23] study, those who aged 20-29 years were forming nearly half of participant. While in Kamal NM et al [25] those who aged 26-35 years were forming one third of participant. Difference between the studies could be related to use different classification for age as well as cultural idea of community about age of marriage and having children.

Nearly all couples were Consanguineous (96.7%). The current percentage was higher than previously reports, Tayebi N et al [26] reported that cousin marriage was reported in 25% of participant, other study shows that 68% of participant were consanguineous [27], another study reported that 75.5% were consanguineous and 82.3% of those with consanguineous marriage were from rural area [28]. The high incidence of consanguineous marriage is ascribed to societal practices that involve planned marriages within families and general public ignorance of the negative implications of such a practice.

Although majority of participant report no previous neonatal death, abortion or intrauterine death, but one third report a history of dead baby and one forth report history of abortion and less

than 10% had IUD. Taye et al [29] reported lower number of child death, abortion and stillbirth. In Al-Musawi et al [30] study more than half of participant had history of abortion or IUD.

Over one third of participant who had a newborn with congenital anomaly discovered in the 2nd trimester and remaining discovered after delivery or in third trimester. Although majority had single anomaly, over one forth had multiple anomaly. Regarding each anomaly, hydrocephalous was the most common anomaly then cleft palate, spina bifida and small for date baby were also commonly presented, heart disease, anencephaly, hydronephrosis and intestinal obstruction all were common but in lesser extent than hydrocephalous. The most prevalent type of abnormality identified in this study was a malformation of the central nervous system, which can affect one or more systems, followed by cleft lip and palate deformity, genitourinary system, gastrointestinal, cardiovascular system, skeletal deformity and others.

In a study that was carried in India, musculoskeletal disorders were the commonest, followed by craniovertebral anomalies [31]. In Iranian study, skeletal abnormalities were the most common congenital followed by genitourinary system abnormalities [32], both were inconsistent with current study finding.

The similar observation was found in studies carried in Baghdad [24] , Al Mosul [33], Erbil [2] and Karbala. [34]

The high prevalence of central nervous system abnormalities may be explained by that the environment can play an important role. ‘Environment” is a broad term that includes familiar contributors such as nutrition, adequacy of prenatal care, smoking and alcohol use, maternal age, and socioeconomic disparities, as well as less familiar contributors including pollution and chemical agents encountered both indoors and outdoors. In many cases, two or more

environmental factors may be interrelated or synergistic. [35] Etiological, epidemiological, or environmental factors that may contribute to, for example, the complex socioeconomic status of the general population in Iraq, or it may be due to a lack of medical services, particularly after the military operations in Iraq since 2003. Additionally, several genetic changes and mutations are anticipated as a result of the deployment of chemical weapons starting with the second Gulf War. [16]

Cousin marriage increase the risk of CA by 1.54 in current study population that agreed with previous studies [36-38]. The homozygous expression of recessive genes acquired from their common ancestors is most likely the cause of the increased occurrence of genetic abnormalities in the kids of consanguineous marriages. [39]

Mothers with aged below 20 had 3 times increase risk of newborn with CA that agreed with [40], but the result were different from Anele et al. [41], who observe association between CA and advance age of mothers ≥36 years, without regard to geographic area.

According to Tsehay et al. [42], young maternal age reflects risk for some particular CA.

Low maternal education is frequently linked to worse socioeconomic situations and is identified as a risk factor for pregnancy problems and reduced adherence to guidelines [34].

The small sample size and study design were a limitation point to the current study, a suggestion to the future research should focus on providing information to help women prevent congenital abnormalities as well as effectively treat patients with congenital malformations. Future studies should assess certain categories of congenital abnormalities, including their risk factors and prevalence rates, since more study is needed to determine the causes of the many forms of congenital malformations.

Ⅴ. Conclusion

A higher prevalence of congenital anomaly in the current study especially if compared with number of area population. The central nervous system was more probable which shown to be substantially correlated with maternal history of prior previous child death, paternal consanguinity, and age. Higher prevalence of central nervous system could be related to the environmental effect (explosion occur in the studied area previously), consanguineous marriages due to exposure of parent to same environmental condition.

List of Abbreviations:

CA: Congenital anomaly

US: United State

IUD: Intra uterine death

COSIT: Central Organization of Statistics and Information Technology

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