Dijlah Journal of Medical Sciences (DJMS) Vol. 3, No. 3, September, 2026, pp. 1-12
P-ISSN: 3078-3178, E-ISSN: 3078-8625, paper ID: 01

ORIGINAL ARTICLE

Factors Associated with Congenital Heart Disease Among Children in Baghdad: A Cross-Sectional Study

Mays Qahtan Hameed*, Muna Abdulkadhum Zeidan and Hwaida Shakir Mustafa
College of Health and Medical Techniques, Middle Technical University, Baghdad, Iraq

Article Info

Article history:

Received May, 04, 2026
Revised May, 21, 2026
Accepted June, 01, 2026

Keywords:

Congenital Heart Disease,
Consanguinity,
Maternal Health,
Socioeconomic Status,
Baghdad

ABSTRACT

Congenital heart disease (CHD) is the most common congenital anomaly worldwide and a leading cause of morbidity and mortality in children. Its etiology is multifactorial, involving genetic, environmental, and socio-demographic determinants. The study aims to determine the factors associated with socio-demographic, familial, and maternal characteristics among children with CHD in Baghdad. A descriptive cross-sectional study was conducted on 400 children diagnosed with CHD across nine hospitals in Baghdad. Infants under one year represented the largest proportion of cases (35.5%), with a slight male predominance (56.0%). Most patients were from urban areas (72.3%), and nearly half belonged to low socioeconomic status families. Parental consanguinity was reported in 51.7% of cases, while a family history of CHD was present in 12.5%. Maternal comorbidities during pregnancy were reported in a minority of cases. No statistically significant associations were found between CHD type and family history, consanguinity, genetic disorders, or maternal chronic diseases ($P > 0.05$). No statistically significant associations were identified between CHD type and most socio-demographic or familial characteristics. Several socio-demographic and maternal characteristics were frequently observed among children with CHD; however, no significant associations were identified with CHD types. Clinical indicators such as respiratory symptoms and feeding patterns were significantly associated with cyanotic CHD. Strengthening prenatal care, improving maternal health awareness, and promoting timely diagnosis and management are essential to reduce the burden of CHD.

Corresponding Author:

* Mays Qahtan Hameed
College of Health and Medical Techniques, Middle Technical University, Baghdad, Iraq
Email: eac5004@mtu.edu.iq

1- INTRODUCTION

Congenital heart disease (CHD) represents the most common structural birth defect globally, accounting for up to 28% of all major congenital anomalies and serving as a primary cause of infant mortality [1]. Epidemiologically, the global prevalence is notably high, particularly in Asia, where it reaches approximately 9.3 cases per 1,000 live births [2]. The pathogenesis of CHD is a multifactorial process occurring predominantly during the highly vulnerable first eight weeks of gestation, driven by complex interactions between genetic predispositions and teratogenic environmental exposures [3, 4].

Extensive research highlights several crucial modifiable and non-modifiable risk factors that disrupt fetal cardiogenesis. Advanced maternal age, pre-gestational diabetes, and viral infections (such as rubella) profoundly impact embryonic development. Furthermore, nutritional gaps especially periconceptional folic acid deficiency and high rates of consanguineous marriages significantly amplify the risk of structural cardiac defects [5, 6]. In Iraq, CHD poses a substantial burden on public health and child survival, necessitating strategic interventions for proper management. To address this challenge, local health authorities and international partnerships have initiated efforts to establish high quality pediatric cardiac surgery programs in post conflict settings [7]. In summary, the epidemiological study of congenital heart disease in Baghdad city is vital for improving public health responses, optimizing referral systems to tertiary centers, and ultimately decreasing the morbidity and mortality associated with these defects. There is limited comprehensive epidemiological study on CHD in Baghdad in the previous year's [8]. The study examines which socio-demographic, familial, and maternal characteristics are associated with congenital heart disease among children diagnosed in Baghdad. It also assesses how these characteristics and selected clinical indicators relate to the various types of congenital heart disease.

2- MATERIALS AND METHODS

2.1 Study Design and Setting

A cross-sectional study was conducted in nine hospitals distributed across the three districts of Baghdad governorate. The nine hospitals covering the entire geographical area of Baghdad governorate in Ibn Al-Bitar Specialized Center For Cardiac Surgery, Central Teaching Hospital of Pediatric, Al-Kadhimiya Hospital for Children , Ibn Al-Nafis Hospital, Al-Alawiya Children's Hospital, Ibn Al-Balady Children & Maternity Hospital, Child Welfare Teaching Hospital, Private Nursing Home Hospital, Iraqi Specialized Heart Center.

2.2 The Study Sample

The study population included 400 children who had a confirmed diagnosis of congenital heart disease.

2.3 Inclusion and exclusion criteria

The study covers male and female pediatric patients aged 0 to 14 years who permanently reside in the Baghdad governorate and have a confirmed diagnosis of Congenital Heart Disease (CHD). Eligibility requires definitive confirmation of CHD through echocardiographic imaging or official medical records. Conversely, individuals older than 14 years or living outside Baghdad governorate are not eligible to participate. Patients with acquired cardiac conditions, including rheumatic heart disease or myocarditis, are also excluded, as are those without verifiable diagnostic records and cases in which a parent or guardian declines to provide informed consent.

2.4 Data Collection

Data were collected through interviews with children's parents by using a structured questionnaire filled by the researcher and questions asked using a clear Arabic language. Patients' data were entered into the questionnaire using the English language. Hospitals visits were conducted over approximately three months. Duplicate follow-up visits for the same patient were excluded to avoid repeated data collection.

2.5 Sample Size Calculation

Formula: $N = Z^2 \times P(1 - P) / d^2$

Calculating Sample Size According to the Formula
$d = 0.05$
$d^2 = 0.0025$
$Z = 1.96$
$Z^2 = 3.8416$
Prevalence (P) = 0.50
1 − Prevalence = 0.50
$P(1 - P) = 0.25$
$n = (3.8416 \times 0.25) / 0.0025 = 384.16 \approx 384$

The calculated minimum sample size was 384 children. To enhance the statistical power and Reliability of the study, the final sample size was increased to 400 children [9].

2.6 The validation of questionnaire and pilot study

The validity of the questionnaire was established through expert review. The questionnaire was self-designed based on the study objectives and reviewed by a panel of ten experts specialized in cardiology, pediatrics, congenital heart diseases, and medical technologies to assess clarity, relevance, and adequacy. Minor modifications were made according to their recommendations. A pilot study was conducted on 40 children with congenital heart disease to evaluate the comprehensibility and applicability of the questionnaire. The pilot study also helped determine the average interview duration, which ranged from 20–25 minutes. The pilot sample was excluded from the main study. Reliability analysis showed good internal consistency of the study instrument, with a Cronbach's alpha value of 0.74, indicating acceptable reliability of the questionnaire.

2.7 Statistical Analysis

The information for each item on the questionnaire was copied to code sheets, the data was input into a personal computer, and the statistical package from SPSS-27 was used to evaluate the data. Simple statistics like frequency, percent, average, standard deviation, and range displayed the data. Chi-square test (χ^2 test) or Fisher exact test was utilized to identify the significance of qualitative data percentage differences. The P-value was considered statistically significant when it was equal to or less than 0.05 [10].

2.8 Ethical Considerations

One of the most important measures taken by the researcher is ethical considerations. Ethical approval was gained from the Middle Technical University/ Medical Ethics Committee with the reference number (MEC: 185). Protecting the values and dignity of participants is one of the most basic principles before collecting data.

3- RESULTS AND DISCUSSION

Table 1 shows the distribution of patients according to Socio-demographic characteristics. It belonged to results revealed that the highest percentage (35.5%) of patients with CHD belonging to ages (<12 months), followed by (29.8%) (1-<5 years), (18.8%) (5-9 years), (12.8%) (10-14 years) and (3.3%) (<1 month).

In terms of sex, (56.0%) of children with CHD were males, and (44.0%) of the children were female. Regarding residence, the results found that the majority (72.3%) of the children' live in urban areas, and (27.8%) live in rural areas. With respect to parental education, a highest proportion of mothers had university level education (25.8%) and primary education (25.5%), whereas among fathers, the highest percentage had university degrees or higher (40.5%). Lower levels of education were less common, particularly among fathers. In terms of occupation, Most mothers were housewives (87.0%), while fathers were mainly employed in lower professional, skilled, or semiskilled jobs (52.8%), followed by those in higher professional and managerial positions (32.3%). Finally, the distribution of patients according to the sequence of the child shows that more than half of the cases (53.5%) were among children of birth order 1–2, followed by (31.0%) in birth order 3–4. A smaller proportion was observed in higher birth orders, with (12.0%) in birth order 5–6 and only (3.5%) in those above six. This indicates that CHD cases were more commonly observed among children of lower birth order.

Table (1): The distribution of the patients according to socio-demographic characteristics

Socio-demographic characteristics		No.	%
Age groups	<1 month	13	3.3
	<12 months	142	35.5
	1-<5 years	119	29.8
	5-9 years	75	18.8
	10-14 years	51	12.8
Sex	Male	224	56.0
	Female	176	44.0
Residence	Urban	289	72.3
	Rural	111	27.8

Mother's Education	Illiterate	21	5.3
	Read & write	50	12.5
	Primary	102	25.5
	Intermediate	71	17.8
	Secondary	53	13.3
	University degree or higher	103	25.8
Father's Education	Illiterate	6	1.5
	Read & write	7	1.8
	Primary	82	20.5
	Intermediate	67	16.8
	Secondary	76	19.0
	University degree or higher	162	40.5
Mother's Occupation	Housewives	348	87.0
	Lower professionals, skilled and semiskilled workers	5	1.3
	High professional & managerial jobs	47	11.8
Father's Occupation	Unskilled workers	60	15.0
	Lower professionals, skilled and semiskilled workers	211	52.8
	High professional & managerial jobs	129	32.3
Sequence of child	1-2	214	53.5
	3-4	124	31.0
	5-6	48	12.0
	>6	14	3.5

In figure 1, the socio-economic status was measured with levels of education, occupation, housing type, and presence or absence of a car, which refer to previous studies in Iraq [11]. A 20-point scoring system was used to classify the people according to their socio-economic status (SES). The total score (20) was divided into three equal categories: 0-11 (low), 12-16 (medium), and 17-20 (high) [12]. The results found that nearly half of the participants (49.0%) were classified as low socio-economic status, followed by high (29.8%) and medium (21.3%) levels.

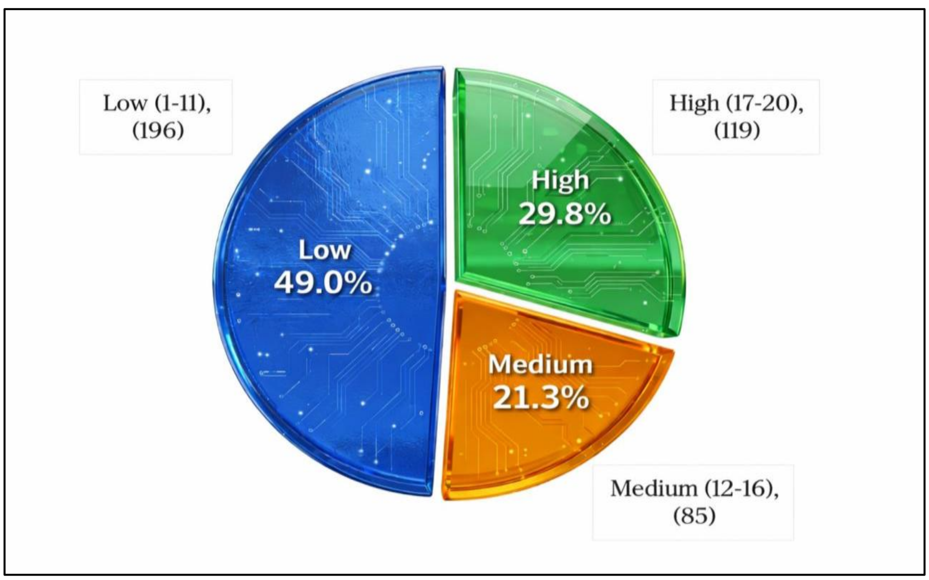

Fig (1): The Distribution of Socio-economic Status

Table 2 shows the distribution of the patients according to medical history. The present study found that (45.5%) of the patients weighed less than 2.5 kg at birth. While a high proportion (80.5%) of full-term infants. Also, this study found that 54.5% of patients with CHD were admitted to the neonatal intensive care unit after birth. The highest percentage of mixed feedings was (48.5%) among children, followed by artificial feeding (41.5%), and then breastfeeding (10.0%), more than half of the children (51.0%) begun complementary feeds after 6 months. Finally, 56.0% of the patients with CHD were partially immunized.

Table (2): The distribution of the patients with CHD according to medical history

Child history		No.	%
Birth weight	Less than 2.5 kg	182	45.5
	Average birth weight	218	54.5
Gestational age	Preterm	78	19.5
	Full term	322	80.5
Neonatal Intensive Care Unit	Yes	228	57.0
	No	172	43.0
Type of feeding	Breast feeding	40	10.0
	Artificial feeding	166	41.5
	Mix feeding	194	48.5
Complementary feeds	Not yet begun	106	26.5
	Before 6 months	90	22.5
	After 6 months	204	51.0
Immunization status	Fully	142	35.5
	Partially	224	56.0
	Never	34	8.5

Figure 2 shows that high percentage (84.0%) of the patients have Acyanotic CHD, while only (16.0%) of the participants have cyanotic CHD.

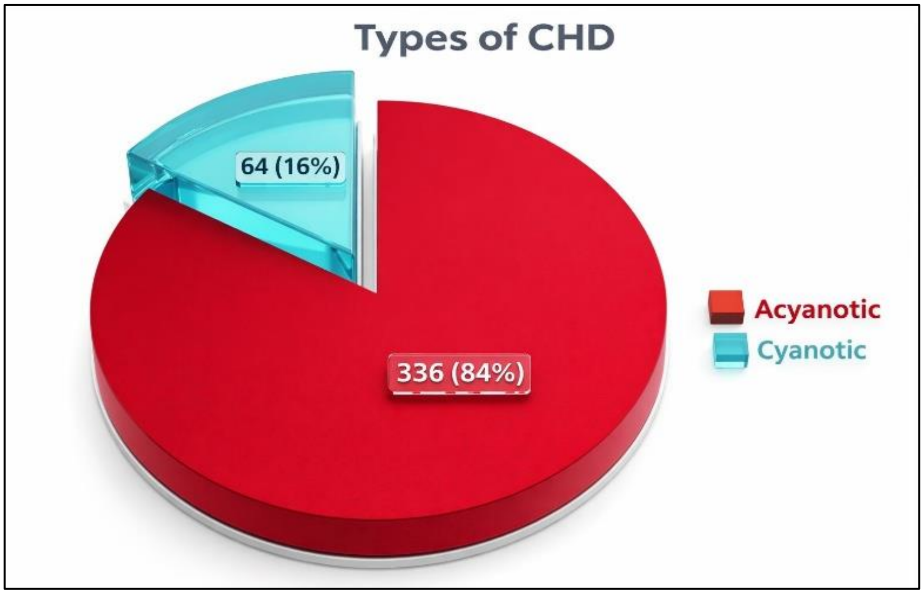

Fig (2): The Distribution of patients according to types of congenital heart diseases

Table 3 shows the distribution of the patients according to family and medical history. The results found that only (12.5%) of patients with CHD had a family history of CHD. Also, only (2.0%) of the patients with CHD had genetic disorder in the family. More than half of the participants (51.7%) belonging to 1st degree consanguinity. While only (9.5%) of the participants had first degree history of chronic disease. Among the 38 participants (9.5%), (42.1%) had hypertension, followed by diabetes (28.9%), then diabetes and hypertension together (13.2%), and finally hypothyroidism (15.8%).

Table (3): The distribution of the patients according to family and medical history

Family and medical history		No.	%
Family history of CHD	Yes	50	12.5
	No	350	87.5
Genetic disorder in the family	Yes	8	2.0
	No	392	98.0
Consanguinity	1st degree	207	51.7
	2nd degree	36	9.0
	3rd degree	22	5.5
	Not related	135	33.8
History of chronic disease	Yes	38	9.5
	No	362	90.5
Type of chronic disease	Diabetes mellitus	11	28.9
	Hypertension	16	42.1
	Diabetes mellitus & hypertension	5	13.2
	Hypothyroidism	6	15.8

Table 4 shows the distribution of the patients according to maternal factors. It indicates to how the patients with congenital heart disease (CHD) are distributed based on the factors related to the maternal characteristics during pregnancy and delivery. According to the results, Mothers aged 23–29 years represented the highest proportion (41.8%), followed by those aged 30–36 years (28.2%). Concerning the fathers age, the highest percentage was of 2837 years (45.3%), and 27 years (27.8%). With respect to the birth spacing time, half of the cases (50.0) had a birth interval of 1-2 years and this indicates relatively to short birth intervals between pregnancies. Regarding the number of prior pregnancies, most of the mothers had 1-2 pregnancies (40.3%), then 3-4 pregnancies (34.8%). In regard to maternal comorbidities, the majority of the mothers did not have comorbidities (83.0%), and 17.0% had medical conditions. The prevalence of comorbidities in the patients was diabetes mellitus (41.2%), hypertension (36.8%), and a combination of diabetes mellitus and hypertension (22.1%). When it comes to the use of medications during pregnancy, most mothers (88.5% of them) did not take medications and only 11.5% used medications. It was also found that TORCH infections or fever were rare, only 6.5% of mothers reported them, but 93.5 percent did not. The majority of the affected mothers had fever (42.3%), then rubella (38.5%), then toxoplasmosis (11.5%), and then rubella and toxoplasmosis combined (7.7%). When it comes to smoking exposure, passive smokers (59.3%), non-smokers (38.5) and active smokers (2.3%) are the largest proportion. Lastly, most mothers (75.8) said that they took pregnancy folic acid and vitamins after pregnancy recognition.

Table (4): The distribution of the patients according to maternal factors

Maternal factors		No.	%
Mother's age at delivery	16-22 years	65	16.3
	23-29 years	167	41.8
	30-36 years	113	28.2
	37-43 years	47	11.8
	44-50 years	8	2.0
Father's age at delivery	18-27 years	111	27.8
	28-37 years	181	45.3
	38-47 years	85	21.3
	48-57 years	20	5.0
	58-67 years	3	0.8
Birth space interval	Less than 1 year	46	11.5
	1-2 years	200	50.0
	>2 years	72	18.0
	First birth	82	20.5
Number of previous pregnancies	1-2 times	161	40.3
	3-4 times	139	34.8
	5-6 times	75	18.8

	>6 times	25	6.3
Maternal Comorbidities	Yes	68	17.0
	No	332	83.0
Type of Maternal Comorbidities	Diabetes mellitus	28	41.2
	Hypertension	25	36.8
	Diabetes mellitus & hypertension	15	22.1
Medications during pregnancy	Yes	46	11.5
	No	354	88.5
TORCH & Fever	Yes	26	6.5
	No	374	93.5
Type Of TORCH	Fever	11	42.3
	Rubella	10	38.5
	Toxoplasmosis	3	11.5
	Rubella & Toxoplasmosis	2	7.7
Smoking	Non smoking	154	38.5
	Smoker	9	2.3
	Passive smoker	237	59.3
Folic acid & Vitamins (After pregnancy recognition)	Yes	303	75.8
	No	97	24.3

Table 5 shows the association between types of congenital heart disease and socio-demographic characteristics. In Table (5), show that There was non-statistically significant association between types of congenital heart disease and socio-demographic characteristics, with a P value > 0.05, except for place of residence associated with congenital heart disease types (P value = 0.012).

Table (5): Association between types of congenital heart disease and socio-demographic characteristics

Variables		**Type**				**P-value**
		A cyanotic (n=336)		**Cyanotic (n=64)**		
		No.	**%**	**No.**	**%**	
Age groups	<1 month	11	84.6	2	15.4	0.735
	<12 months	124	87.3	18	12.7	
	1-4 years	98	82.4	21	17.6	
	5-9 years	62	82.7	13	17.3	
	10-14 years	41	80.4	10	19.6	
Sex	Male	182	81.3	42	18.8	0.091
	Female	154	87.5	22	12.5	
Residence	Urban	251	86.9	38	13.1	**0.012**
	Rural	85	76.6	26	**23.4**	
Mother's Education	Illiterate	18	85.7	3	14.3	0.872
	Read & write	42	84.0	8	16.0	
	Primary	82	80.4	20	19.6	
	Intermediate	59	83.1	12	16.9	
	Secondary	46	86.8	7	13.2	
	University degree or higher	89	86.4	14	13.6	
Father's Education	Illiterate	6	100.0	0	0.0	0.693
	Read & write	6	85.7	1	14.3	
	Primary	68	82.9	14	17.1	
	Intermediate	56	83.6	11	16.4	
	Secondary	60	78.9	16	21.1	
	University degree or higher	140	86.4	22	13.6	

Mother's Occupation	Unskilled workers	293	84.2	55	15.8	0.948
	Lower professionals, skilled and semiskilled workers	4	80.0	1	20.0	
	High professional & managerial jobs	39	83.0	8	17.0	
Father's Occupation	Unskilled workers	54	90.0	6	10.0	0.389
	Lower professionals, skilled and semiskilled workers	175	82.9	36	17.1	
	High professional & managerial jobs	107	82.9	22	17.1	
Socio-economic status	Low (1-11 score)	165	84.2	31	15.8	0.257
	Medium (12-16 score)	67	78.8	18	21.2	
	High (17-20 score)	104	87.4	15	12.6	
Sequence of child	1-2	185	86.4	29	13.6	0.546
	3-4	101	81.5	23	18.5	
	5-6	39	81.3	9	18.8	
	>6	11	78.6	3	21.4	
Consanguinity	1st degree	176	85.0	31	15.0	0.878
	2nd degree	29	80.6	7	19.4	
	3rd degree	19	86.4	3	13.6	
	Not related	112	83.0	23	17.0	

Table (6) shows the association between types of congenital heart disease and child characteristics. It shows significant associations between the type of congenital heart disease and several child characteristics, including birth weight, NICU admission, type of feeding, and immunization status ($P < 0.05$). Cyanotic CHD was more common among children with low birth weight, NICU admission, artificial feeding, and non-immunized status. In contrast, no significant association was found with gestational age or timing of complementary feeding ($P > 0.05$).

Table (6): The association between types of congenital heart disease and child characteristics

Variables		**Type**				**P-value**
		A cyanotic (n=336)		**Cyanotic (n=64)**		
		No.	**%**	**No.**	**%**	
Birth weight	Less than 2.5 kg	141	77.5	41	**22.5**	**0.001**
	Average birth weigh	195	89.4	23	10.6	
Gestational age	Preterm	65	83.3	13	16.7	0.858
	Full term	271	84.2	51	15.8	
Neonatal intensive care unit	Yes	179	78.5	49	**21.5**	**<0.001**
	No	157	91.3	15	8.7	
Type of feeding	Breast feeding	37	92.5	3	7.5	**0.002**
	Artificial feeding	127	76.5	39	**23.5**	
	Mix feeding	172	88.7	22	11.3	
Complementary feeds	Not yet begun	89	84.0	17	16.0	0.505
	Before 6 months	79	87.8	11	12.2	
	After 6 months	168	82.4	36	17.6	
Immunization status	Fully	115	81.0	27	19.0	**0.050**
	Partially	196	87.5	28	12.5	
	Never	25	73.5	9	26.5	

This study examined the socio-demographic, clinical, and maternal factors associated with congenital heart disease (CHD) among children in Baghdad. Regarding age distribution, infants under 12 months represented the largest proportion of cases, consistent with findings from Sudan [13]. However, studies from Duhok reported higher proportions among older children [14], possibly due to delayed diagnosis or differences in access to early screening.
A slight male predominance was observed, in agreement with studies from Iraq [15], although variations have been reported [16]. These differences may reflect biological susceptibility and sociocultural influences affecting healthcare utilization [17, 18]. Urban residency accounted for the majority of cases, similar to findings from

Babylon, Iraq [16]. This likely reflects better healthcare accessibility rather than true disease distribution, while rural underrepresentation may be due to underdiagnosis. Parental education showed variability, with relatively higher education among fathers. Although education is generally associated with better health awareness, CHD occurrence across all levels supports its multifactorial etiology [19]. Regarding birth order, most cases were among first and second children, differing from studies reporting higher risk in later births [20]. This variation may be related to maternal age and healthcare-seeking behavior. Low socioeconomic status was common, consistent with [21], likely reflecting disparities in prenatal care and health awareness. Clinically, a notable proportion of patients had low birth weight, consistent with previous findings [22]. Most patients were born at term, although prematurity was also observed [23].

More than half required NICU admission indicates to disease severity at presentation [24]. Feeding patterns showed low exclusive breastfeeding rates and increased reliance on artificial feeding, consistent with studies highlighting feeding difficulties in CHD patients [25]. Immunization coverage was suboptimal, similar to findings by [6], possibly due to frequent hospitalizations and parental concerns. Acyanotic CHD predominated, consistent with regional and global trends [18]. Family history was uncommon, suggesting that many cases are sporadic, however, Although consanguinity was highly prevalent (51.7%) that indicate a strong potential genetic contribution to the overall occurrence of CHDs , no statistically significant association with CHD suggests that consanguinity acts as a general predisposing factor rather than a determinant of a specific anatomical phenotype. The clinical presentation or specific type of CHD is likely governed by a complex, multifactorial interplay of diverse genetic modifiers and environmental influences during embryonic cardiogenesis [26]. Maternal factors showed that most mothers were within optimal reproductive age, consistent with [27], although advanced age remains a recognized risk factor [28]. Short birth spacing was common and may contribute to maternal depletion [29]. Maternal comorbidities, particularly diabetes and hypertension, were observed and are known to increase CHD risk [30]. Additionally, maternal infections such as TORCH remain important contributors [31]. Environmental exposures, especially passive smoking was frequently reported among mothers and may warrant further investigation in future studies [32]. Despite high folic acid supplementation, other risk factors may override its protective effect [33].

A significant association was found between residence and CHD type, with rural children showing higher rates of cyanotic defects, likely reflecting delayed diagnosis of milder cases [34]. Other socio-demographic factors were not significantly associated, supporting the role of early embryological mechanisms in determining CHD subtype [35].

The present study demonstrated a significant association between CHD type and several child characteristics. NICU admission was strongly associated with cyanotic CHD ($p < 0.001$), reflecting the greater clinical severity and need for intensive care in these cases [36]. Feeding type also showed a significant association ($p = 0.002$), with artificial feeding more common among cyanotic infants due to increased respiratory effort, hypoxia, and fatigue that limit effective breastfeeding, often necessitating formula or tube feeding to ensure adequate nutritional intake [37, 38]. Immunization status was significantly associated ($p = 0.050$), with higher rates of non-immunization among cyanotic cases, likely due to repeated hospitalizations and disruption of routine preventive care in chronically ill infants [39, 23]. In contrast, complementary feeding showed no significant association with CHD type ($p = 0.505$), suggesting that weaning practices are generally guided by standard pediatric recommendations rather than cardiac lesion type. Overall, although many variables were not statistically significant, their high prevalence may indicate potential relevance in the local context.

This study has several limitations. First, the cross-sectional design limits the ability to establish causal relationships between the studied variables and congenital heart disease. Second, the study was conducted in hospitals within Baghdad city only, which may limit the generalizability of the findings. Third, recall bias may have occurred because some information was obtained from parents through interviews. Furthermore, the absence of a control group limited the ability to compare exposures between affected and non-affected children. Finally, the relatively small number of cyanotic CHD cases may have affected the statistical power of subgroup comparisons.

4- CONCLUSION

This study highlighted several socio-demographic, familial, and maternal characteristics commonly observed among children with congenital heart disease in Baghdad. Although most variables were not significantly associated with CHD subtype, the findings provide important descriptive data about affected children in the local setting. Further analytical studies with control groups are recommended to better explore potential associations and causal relationships.

REFERENCES

[1] Portilla-Rojas, E., Harizanov, V., Sarmiento, K., Holguín, J., Gracia, G., Hurtado-Villa, P., and Zarante, I. (2024). Risk factors characterisation for CHD: A case–control study in Bogota and Cali, Colombia, 2002–2020. *Cardiology in the Young*, *34*(1), 178–182. https://doi.org/10.1017/S1047951123001324

[2] Saad, H., Casey, F., Dolk, H., and Loane, M. (2023). Prevalence and trends of congenital heart defects among live births from 2005 to 2014 in Northern Ireland. *Cardiology in the Young*, *33*(6), 939–945. https://doi.org/10.1017/s1047951122001937

[3] Bai, Z., Han, J., An, J., Wang, H., Du, X., Yang, Z., et al. (2024). The global, regional, and national patterns of change in the burden of congenital birth defects, 1990–2021: An analysis of the Global Burden of Disease Study 2021 and forecast to 2040. *EClinicalMedicine, 77*, Article 102873. https://doi.org/10.1016/j.eclinm.2024.102873

[4] Clausen, H. (2025). Improving care for children with congenital heart disease by cardiovascular biomarker profiling and advanced non-invasive cardiac imaging techniques (Publication No. 2025:84) [Doctoral dissertation, Lund University]. Lund University Publications. https://lup.lub.lu.se/record/51d7bfc3-04f2-40cb-b68c-28de600bdc62

[5] Almasri, M., Al-Sulaiti, K., Al Sayegh, D., Sharma, O., El Jerbi, A., Al-Riyami, Z., et al. (2023). Epidemiology of congenital heart disease in Qatar: Preliminary findings from the Sidra Medicine Cardiac Registry [Preprint]. medRxiv. https://doi.org/10.1101/2023.08.24.23294593

[6] Li, Y., He, C., Yu, H., Wu, D., Liu, L., and Zhang, X. (2025). Global, regional, and national epidemiology of congenital birth defects in children from 1990 to 2021: A cross-sectional study. *BMC Pregnancy and Childbirth, 25*(1), Article 484. https://doi.org/10.1186/s12884-025-07612-1

[7] Youssef, T., Bitar, F., Alogla, H., El Khoury, M., Moukhaiber, J., Alamin, F., et al. (2024). Establishing a high-quality pediatric cardiac surgery program in post-conflict regions: A model for limited resource countries. *Pediatric Cardiology, 46*, 279–286. https://doi.org/10.1007/s00246-023-03384-7

[8] Yaseen, M. J., and Mohammed, M. J. (2025). Temporal trend of congenital heart diseases in Iraqi patients. *International Journal of Latest Technology in Engineering, Management & Applied Science*, *14*(7), 882. https://doi.org/10.51583/IJLTEMAS.2025.1407000105

[9] Sadiq, I. Z., Usman, A., Muhammad, A., and Ahmad, K. H. (2025). Sample size calculation in biomedical, clinical and biological sciences research. *Journal of Umm Al-Qura University for Applied Sciences, 11*(1), 133–141. https://doi.org/10.1007/s43994-024-00153-x

[10] Benjamin, D. J., Berger, J. O., Johannesson, M., Nosek, B. A., Wagenmakers, E.-J., Berk, R., et al. (2018). Redefine statistical significance. *Nature Human Behaviour*, *2*(1), 6–10. https://doi.org/10.1038/s41562-017-0189-z

[11] Shabu, S. A., and Al-Tawil, N. G. (2012). Prevalence of childhood obesity among a sample of basic education school children in Erbil city. *Middle East Journal of Family Medicine, 10*(10), 4–13.

[12] El-Gilany, A., El-Wehady, A., and El-Wasify, M. (2012). Updating and validation of the socioeconomic status scale for health research in Egypt. *Eastern Mediterranean Health Journal*, *18*(9), 962–968. https://doi.org/10.26719/2012.18.9.962

[13] Abdelrahman, O., and Diab, R. (2022). Prevalence and pattern of congenital heart disease among children in Khartoum State, Sudan: A reflection of the current cardiac profile. *Cureus*, *14*(1), Article e21196. https://doi.org/10.7759/cureus.21196

[14] Rasheed, Z. A., Sharif, A. M., and Mohammad, A. M. (2024). Outcomes of congenital heart diseases in Duhok, Kurdistan Region of Iraq. *South Eastern European Journal of Public Health*, *25*, 5–11. https://doi.org/10.70135/seejph.vi.2117

[15] Khaleel, R. I. (2025). Patterns and risk factors of congenital heart disease among children under five years in pediatric teaching hospitals at Mosul City. *Global Scientific Journals*. https://www.gsjpublications.com/jgsr15920207.pdf

[16] Mohammed, N. I., and Al-Ghanimi, K. S. (2022). Assessment the risk factors of congenital heart disease among children below 5 years age in Babylon Province. *Medical Journal of Babylon*, *19*(4), 554–559. https://doi.org/10.4103/MJBL.MJBL_113_22

[17] Cabral, G. H. B., Guerra, J. V. N., Pedrosa, K. U., Conrado, P. L. M., Fonseca, J. H. de A., Luna, V. L. M., et al. (2025). Congenital heart disease: Epidemiological profile of live births, geographical distribution and temporal trends in Brazil from 2012 to 2022. *BMC Cardiovascular Disorders*, *25*(1), Article 599. https://doi.org/10.1186/s12872-025-05079-8

[18] Sherzad, A. G., Zalmai, A. S., Zafarzai, I., Zazai, M. K., and Zeng, Q. (2024). Assessing the frequency of congenital heart diseases among children in Eastern Afghanistan. *Pediatric Health, Medicine and Therapeutics*, *15*, 299–309. https://doi.org/10.2147/PHMT.S481934

[19] Khayat, A. M., Alshareef, B. G., Alharbi, S. F., AlZahrani, M. M., Alshangity, B. A., Tashkandi, N. F., et al. (2024). Consanguineous marriage and its association with genetic disorders in Saudi Arabia: A review. *Cureus*, *16*(2), Article e53888. https://doi.org/10.7759/cureus.53888

[20] Obaidi, I. A. L., Al S., Ml, T., Ghanim, E., and Prof, A. (2024). Prevalence of congenital heart disease by Mercy Organization for Childhood Health NGO/Iraq. *7*, 3275–3282. https://share.google/H4EHo41JaVuYgIvMA

[21] Amini-Rarani, M., Karimi, S. E., SoleimanvandiAzar, N., and Nosratabadi, M. (2023). Risk and protective factors related to having a child with congenital heart diseases (CHD): A case-control study in Iran. *Frontiers in Pediatrics*, *11*, Article 1170743. https://doi.org/10.3389/fped.2023.1170743

[22] Yan, H., Zhai, B., Feng, R., Wang, P., Zhang, Y., Wang, Y., et al. (2022). Prevalence of congenital heart disease in Chinese children with different birth weights and its relationship to neonatal birth weight. *Frontiers in Pediatrics*, *10*, Article 828300. https://doi.org/10.3389/fped.2022.828300

[23] Derakhshan, R., Raeisi, N., and Sadeghi, T. (2022). Prevalence of congenital heart disease and related factors among children admitted to the pediatric cardiac center in Rafsanjan, Southeastern Iran. *Journal of Preventive and Complementary Medicine*, *1*(3), 121–126. https://share.google/vRk2KM5HNy5nyoBB3

[24] Zaidi, F., Iqbal, M., Zafar, F., Khan, L., Khalid, A., & Lawa, S. (2025). Prevalence and risk factors of congenital heart disease in patients admitted in NICU: A study from tertiary care hospital in Karachi. *Pakistan Journal of Health Sciences*, 70–75. https://share.google/AQhMgveyzpIpA9sVh

[25] Jat, N. K., Bhagwani, D. K., Bhutani, N., Sharma, U., Sharma, R., and Gupta, R. (2022). Assessment of the prevalence of congenital heart disease in children with pneumonia in tertiary care hospital: A cross-sectional study. *Annals of Medicine and Surgery*, *73*, Article 103111. https://doi.org/10.1016/j.amsu.2021.103111

[26] Albesher, N., Massadeh, S., Hassan, S. M., and Alaamery, M. (2022). Consanguinity and congenital heart disease susceptibility: Insights into rare genetic variations in Saudi Arabia. *Genes*, *13*(2), Article 354. https://www.mdpi.com/2073-4425/13/2/354

[27] Ansari, I. M., and Ambhore, J. (2022). Evaluation of the prevalence, prenatal risk factors, and clinical profiles of paediatric patients with congenital heart disease. *Indian Journal of Child Health*, *9*(1), 16–20. https://share.google/X8QaHC3OfMMabMvSF

[28] Yu, V. T., Ramsay, J. M., Horns, J. J., Mumford, S. L., Bruno, A. M., and Hotaling, J. (2024). The association between parental age differences and perinatal outcomes. *Human Reproduction*, *39*(2), 425–435. https://doi.org/10.1093/humrep/dead236

[29] Palawaththa, S., Islam, R. M., Illic, D., Rabel, K., Lee, M., Romero, L., et al. (2022). Effect of maternal dietary niacin intake on congenital anomalies: A systematic review and meta-analysis. *European Journal of Nutrition*, *61*(3), 1133–1142. https://doi.org/10.1007/s00394-021-02731-9

[30] Turunen, R., Pulakka, A., Metsälä, J., Vahlberg, T., Ojala, T., Gissler, M., et al. (2024). Maternal diabetes and overweight and congenital heart defects in offspring. *JAMA Network Open*, *7*(1), Article e2350579. https://doi.org/10.1001/jamanetworkopen.2023.50579

[31] Su, H., Guo, E., Woodward, M., He, J., Waterboer, T., Schuermans, A., et al. (2025). First trimester maternal infections and offspring congenital heart defects: A meta-analysis. *European Heart Journal*, *47*. https://doi.org/10.1093/eurheartj/ehaf564

[32] Kc, A., Halme, S., Gurung, R., Basnet, O., Olsson, E., and Malmqvist, E. (2023). Association between usage of household cooking fuel and congenital birth defects: 18-month multicentric cohort study in Nepal. *Archives of Public Health*, *81*(1), Article 144. https://doi.org/10.1186/s13690-023-01169-1

[33] Lorente, M., Azpiroz, M. J., Guedes, P., Burgos, R., Lluch, A., and Dos, L. (2023). Nutrition, dietary recommendations, and supplements for patients with congenital heart disease. *International Journal of Cardiology: Congenital Heart Disease*, *12*, Article 100449. https://doi.org/10.1016/j.ijcchd.2023.100449

[34] Chowdhury, D., Elliott, P. A., Asaki, S. Y., Amdani, S., Nguyen, Q., Ronai, C., et al. (2024). Addressing disparities in pediatric congenital heart disease: A call for equitable health care. *Journal of the American Heart Association*, *13*(13), Article e032415. https://doi.org/10.1161/jaha.123.032415

[35] Hu, D., Lan, T., Chen, Y., Chen, L., Li, J., Sun, X., et al. (2023). An 18-year evolution of congenital heart disease in China: An echocardiographic database-based study. *International Journal of Cardiology*, *391*, Article 131286. https://doi.org/10.1016/j.ijcard.2023.131286

[36] Hasan, A. A., Abu Lehyah, N. A. A., Al Tarawneh, M. K., Abbad, M. Y., Fraijat, A. G., Al-Jammal, R. A., et al. (2023). Incidence and types of congenital heart disease at a referral hospital in Jordan: Retrospective study from a tertiary center. *Frontiers in Pediatrics*, *11*, Article 1261130. https://doi.org/10.3389/fped.2023.1261130

[37] Mo, X., Cai, W., Qi, J., Feng, J., Wang, L., Zhang, H., Tang, J., and Chinese Pediatric Cardiac Intensive Care Society. (2023). Expert consensus on nutritional support for children with congenital heart disease (2023 edition). *Congenital Heart Disease*, *18*(6), 571–593. https://doi.org/10.32604/chd.2024.048939

[38] Butto, A., Mercer-Rosa, L., Teng, C., Daymont, C., Edelson, J., Faerber, J., et al. (2019). Longitudinal growth in patients with single ventricle cardiac disease receiving tube-assisted feeds. *Congenital Heart Disease*, *14*(6), 1058–1065. https://doi.org/10.1111/chd.12843

[39] Tairova, S. B., Mukhamadiyeva, L. A., and Mamatkulova, N. S. (2024). Epidemiology and risk factors for congenital heart defects in children. *American Journal of Pediatric Medicine and Health Sciences*, *2*(5), 94–98. https://grnjournal.us/index.php/AJPMHS/article/view/4723