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Determining the risk factors of congenital heart defects in children from 2019 to 2023 in Al-Imam Sadiq Hospital in Iraq: a retrospective study

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ABSTRACT

Objective. To determine the relationship between non-inherited risk factors among children with cardiac defects and their certain sociodemographic variables.

Materials and methods. A retrospective study design was used for this study of congenital heart defects children in Babylon Centre for catheterization and cardiac Surgery in Al-Imam Sadiq Hospital Babylon province / Iraq (4/10/2023 to 1/7/2024). A nonprobability convenience sample of 542 patients aged 0-18 years with CHD was collected by administering a constructed tool for the study purposes.

Result. The majority of the infants were between the ages group in 0-12 months with mean ages (22.28) almost equal in their sexes and 60.7% of parents were relative, more than three quarters were full term, less than half was born with additional abnormalities and majority of mothers were aged 36-45 years.

Conclusions. Statistically significant associations were identified between CHD and the following factors: birth weight ($p < 0.14$), parental consanguinity ($p < 0.037$), and parental or relative history of CHD. Analysis of variance revealed significant relationships between CHD and additional abnormalities at birth ($p < 0.001$, $p < 0.03$), gestational term ($p < 0.03$), and maternal age ($p < 0.025$).

Keywords: congenital, heart defect, risk factor, infant, children

INTRODUCTION

Congenital Heart Defects (CHD) are defined as structural or functional defects in the heart or great vessels, comprising 28% of all congenital anomalies [1]. CHD is one of the main concerns in pediatric healthcare, with serious consequences for infant mortality rates worldwide, impacting both patients and families [2]. The pattern of CHD varies by geographic location, and the prevalence of CHD has been reported to differ worldwide [3]. According to a recent global review, the highest live birth prevalence of CHD was reported in Asia (9.30/1000 live births), followed by North America (8.1/1000 live births) and Europe (7.9/1000 live births). Additionally, Africa has the lowest total CHD birth incidence, approximately 2.2 per 1,000 live births [2].

The mortality rate for CHD is extremely high: by the end of the first week, 29% of new-borns die, 42% die by the first month, and 87% by the first year [4]. The cause of most CHD cases remains unknown; many instances are complex, and research has linked CHD to environmental or genetic risk. Several non-hereditary factors play an important role in the occurrence of CHD, including chemical, biological, physical, psychological, and other influences. Older maternal age, and maternal exposure to infectious agents during pregnancy – particulary in the first trimester of pregnancy – are associated with an increased risk of congenital heart disease [2,5].

Multifaceted genetic etiologic variables, including chromosomal abnormalities, gene mutations, and single nucleotide polymorphisms, have been linked to a 2- to 10-fold increase in CHD cases among siblings of affected children or offspring of affected parents, indicating a hereditary component. Most

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cases of CHD have a family history [6,7]. The classification of CHD is based on anatomical defects of the heart, which are categorized into two subtypes: cyanotic CHD and cyanotic CHD [8]. These defects manifest in a variety of clinical presentations, ranging from minor to serious illnesses, leading to various surgical operations that may be required [9]. Children with mild CHD diagnosed early in life may not require treatment, whereas those with moderate or critical CHD may need medications, catheter-based interventions, or surgical procedures [10].

The study aims to identify the risk factors for congenital heart defects in children from 2019-2023.

METHODS

Study design, setting, and sample

A retrospective study was conducted at the Babylon Centre for Catheterization and Cardiac Surgery in Al-Imam Sadiq Hospital Babylon province, Iraq, during the period 4th October 2023 to 1st July 2024. A non-probability convenience sampling method was employed to collect data from 542 children diagnosed with congenital heart defects (CHD) by a physician.

Ethical considerations

The study received approval from the Ethics Committee of the College of Nursing, University of Babylon, on January 4, 2024 (approval code: 4). Informed consent was obtained from all participants included in this study.

Study instrument

Structure: The study instrument is divided into four parts, each addressing specific aspects of the study population:

Part I: Socio-demographic characteristics. Collects data on the child's age, sex, birth weight, and current weight.

Part II: Factors associated with the child's condition. Covers factors influencing the child's health, including:

- Parental consanguinity (parents being related).
- Gestational term (whether the child was born preterm, full-term, or post-term).
- Other health abnormalities related to the child's condition.

Part III: Parents' socio-demographic characteristics. Focuses on the parents, including: age, occupation, education level, economic status, and place of residence.

Part IV: Obstetric history. Examines the mother's reproductive history, including:

- History of miscarriages.
- Number of children in the family (categorized into three levels).
- Type of delivery (cesarean or normal).
- Birth intervals and contraceptive use.

Validation: The validity of the instrument (questionnaire or survey) was confirmed by a panel of 21 experts. This means the tool was reviewed to ensure that it accurately measures what it is intended to.

Data collection

After obtaining official permissions, data collection was conducted in Al-Hilla City at Babylon Centre for Catheterization and Cardiac Surgery, Al-Imam Sadiq Hospital, Babylon province, Iraq, between 15th January 2024 to 15th March 2024. Data were collected by using a medical records review method, supplemented by a questionnaire in its English version.

Statistical analysis

Data management was carried using Microsoft Excel 2013, and analysis was performed using Statistical Package for the Social Sciences (SPSS) version 27. The statistical methods included descriptive statistics (frequencies, percentages, and valid percentages) and inferential statistics, such as the Chi-Square test.

Results were considered statistically significant when the p-value ≤0.05. The outcomes were presented in Tables and Figures, showing the numbers (n), percentages (%), and valid percentages (%) to meet the study's objectives.

Inclusion criteria and exclusion criteria

The study included all patients clinically diagnosed with congenital heart defects (CHD) who underwent surgery at the Babylon Centre for Catheterization and Cardiac Surgery, Al-Imam Sadiq Hospital, Babylon. All available samples at the center were included in the study, and no patients were excluded.

RESULTS

Patient characteristics

A total of 542 patients diagnosed with congenital heart defects (CHD) were included in the study. Of these, 273 were girls (50.4%) and 269 were boys (49.6%), resulting in a girl-to-boy ratio of 1.04:1. The age of the patients ranged from 1 day to 18 years, with a mean age of 22.2 ± 29.0 months. Most patients were in the infancy group (0-12 months), accounting for 321 patients (59.2%), followed by toddlers (23.6%, n = 128), preschool-aged children (6.5%, n = 35), and school-aged children (9.8%, n = 53). Only one patient (0.2%) was an adolescent.

TABLE 1. Distribution of sociodemographic characteristics of children with congenital heart defects

		Frequency	Percent
Child age	Neonate	4	0.7
	Infant	321	59.2
	Toddler	128	23.6
	Preschool	35	6.5
	School-age	53	9.8
	Adolescent	1	0.2
	Total	542	100.0
Sex	Boy	269	49.6
	Girl	273	50.4
	Total	542	100.0

TABLE 2. Distribution of factors associated with the congenital heart defect

		Frequency	Percent	Valid percent
Parents' consanguinity	Yes	170	31.4	60.7
	No	110	20.3	39.3
	Total	280	51.7	100.0
	Missing System	262	48.3	
	Total	542	100.0	
Gestational Term	Preterm	47	8.7	16.8
	Full term	199	36.7	71.1
	Post-term	34	6.3	12.1
	Total	280	51.7	100.0
	Missing System	262	48.3	
	Total	542	100.0	
Was the child born with other abnormalities associated with CHD?	Yes	117	21.6	41.7
	No	163	30.1	58.3
	Total	280	51.7	100.0
	Missing System	262	48.3	
	Total	542	100.0	

The analysis of factors associated with CHD revealed the following key findings:

- Parental consanguinity was reported in 60.7% of cases.
- Gestational term: more than three-quarters of the patients were born full-term.
- Associated abnormalities: 41.8% of children were born with other abnormalities in addition to CHD.

The socio-demographic profile of mothers (Table 3) showed:

- Age: 24.6% of mothers were aged 36-45 years.
- Occupation: A majority of the mothers were housewives, with unemployment predominating compared to employment.
- Education: Approximately one-third of mothers had completed primary school education.
- Residency: 56.8% of the mothers lived in rural areas, compared to 43.2% in urban areas.

The obstetric history of mothers (Table 4) revealed the following:

- Miscarriages: 45% of mothers had experienced previous miscarriages, with one-third of these due to unknown causes.
- Number of children: less than half of the mothers had three or fewer children.
- Delivery type: 60.4% of mothers had a normal delivery, while the rest had a caesarean section.
- Birth intervals: one-third of mothers reported birth intervals of less than one year.
- Contraceptive use: the majority of mothers used contraceptives before pregnancy, with 40% using pills.

The analysis revealed significant relationships between specific risk factors and CHD types (Table 5):

- Child's birth weight: $p < 0.14$.
- Parental history of CHD: $p < 0.037$.
- Parental consanguinity: $p < 0.015$.
- Associated abnormalities in the child: $p < 0.001$.
- Gestational term: $p < 0.03$.
- Maternal age: $p < 0.025$.

DISCUSSION

TABLE 1. Distribution of sociodemographic characteristics of children with congenital heart defects results

Sociodemographic characteristics

Current studies show that more than half of the children with CHD were aged 0-12 months, with a slight predominance of females. This result aligns with a previous study conducted in Pakistan on 123 children, which reported a high percentage prevalence of CHD among infants, particularly females [11]. Similarly, a study in China found that the CHD prevalence was higher in females, consistent with a study conducted in Turkey on 1731 children, which reported a greater prevalence of congenital heart defects in females compared to males [12,13].

Factors associated with CHD

The current study highlights that 60.7% of parents were consanguineous, a figure comparable to a retrospective study in Egypt on 1,005 children under three years of age, which reported a similar prevalence of parental consanguinity (Table 2) [14]. Regarding gestational age, more than three-quarters of the children were born full-term, consistent with findings from a descriptive study in Nigeria [15]. Furthermore, 58.3% of children in the current study were born without additional abnormalities,

TABLE 3. Distribution of socio-demographic characteristics of the mother

		Frequency	Percent	Valid Percent
Age of mother	16-25	87	16.1	31.1
	26-35	122	22.5	43.6
	36-45	69	12.7	24.6
	46-55	2	0.4	0.7
	Total	280	51.7	100.0
	Missing data	262	48.3	
	Total	100.0	542	
Occupation	Employed	42	7.8	15.0
	Unemployed	238	43.9	85.0
	Total	280	51.7	100.0
	Missing data	262	48.3	
	Total	542	100.0	
Educational level	Not able to read and write	39	7.2	13.9
	Able to read and write	10	1.9	3.6
	Primary school	104	19.2	37.1
	Intermediate school or above	65	12.0	23.2
	Institute or above	62	11.4	22.1
	Total	280	51.7	100.0
	Missing data	262	48.3	
	Total	542	100.0	
Residence	Urban	121	22.3	43.2
	Rural	159	29.4	56.8
	Total	280	51.7	100.0

TABLE 4. Distribution of obstetric history of mother with child of CHD

		Frequency	Percent	Valid Percent
Number of Children	Three or less child	128	23.7	45.7
	Four to six children	127	23.4	45.4
	≥7 children	25	4.6	8.9
	Total	280	51.7	100.0
	Missing System	262	48.3	
	Total	542	100.0	
Type of Delivery	Cesarean section	111	20.5	39.6
	Normal	169	31.2	60.4
	Total	280	51.7	100.0
	Missing System	262	48.3	
	Total	542	100.0	
Birth intervals	Less than one year	97	17.9	34.4
	From 1 to <2years	65	12.0	23.3
	From 2 to <3 years	52	9.6	18.6
	More than 3 years	66	12.2	23.7
	Total	280	51.7	100.0
	Missing System	262	48.3	
	Total	542	100.0	
Used the contraceptive before you became pregnant?	Yes	236	43.6	84.3
	No	44	8.1	15.7
	Total	280	51.7	100.0
	Missing System	262	48.3	
	Total	542	100.0	
Previous miscarriages	Yes	126	23.3	45.0
	No	154	28.4	55.0
	Total	280	51.7	100.0
	Missing System	262	48.3	
	Total	542	100.0	

TABLE 5. Relationship between risk factors and types of defect

Risk factors	Types of defect	Frequency	Percent	Chi-Square Tests (p-value) and Assess.
Child weight at birth	Low birth weight g<1500	56	10.3	0.014 Sig
	Normal birth weight g >2500	83	15.3	
	More than 2500g	141	26.1	
	Total	280	51.7	
	Missing Data	262	48.3	
	Total	542	100.0	
Parents or relative has CHD	Yes	131	24.2	0.037 Sig
	No	149	27.5	
	Total	280	51.7	
	Missing data	262	48.3	
	Total	542	100.0	
	Missing data			
	Total	542	100.0	
Parents' consanguinity	Yes	170	31.4	0.015 Sig
	No	110	20.3	
	Total	280	51.7	
	Missing data	262	48.3	
	Total	542	100.0	
Was the child born with other abnormalities associated with CHD?	Yes	117	21.6	0.001 Sig
	No	163	30.1	
	Total	280	51.7	
	Missing data	262	48.3	
	Total	542	100.0	
Gestational Term	Preterm	47	8.7	0.03 Sig
	Full term	199	36.7	
	Post-term	34	6.3	
	Total	280	51.7	
	Missing data	262	48.3	
	Total	542	100.0	
Mother's age	16-25	87	16.1	0.025 Sig
	26-35	122	22.5	
	36-45	69	12.7	
	46-55	2	0.4	
		280	51.7	
	Missing data	262	48.3	
	Total	542	100.0	

similar to findings from Northern Ireland, where most children with CHD did not have other abnormalities [16].

Maternal characteristics

Table 3 indicates that 24.6% of mothers were aged 36-45 years. This finding aligns with a retrospective study in Colombia, where maternal age was similarly distributed. A study in Thailand by Khouenkoup et al. (2022) found that less than half of mothers were aged 31-40 years, further corroborating the maternal age pattern in the current study [17]. Regarding maternal occupation, the majority were housewives, a trend also noted in other studies conducted in Iraq, Iran, and Ethiopia, which found that mothers of children with CHD were predominantly unemployed due to cultural and societal factors [3,18,19]. Educational levels showed that one-third of the mothers had only completed primary school, aligning with studies in Ethiopia and Iran that reported similar education levels among mothers [19,20]. Additionally, 56.8% of mothers resided in rural areas, consistent with findings from a cross-sectional survey in Iraq and studies conducted on rural populations globally [21].

Obstetric history

Table 4 reveals that two-fifths of mothers had three or fewer children, and 60.4% of deliveries were normal vaginal births. These findings align

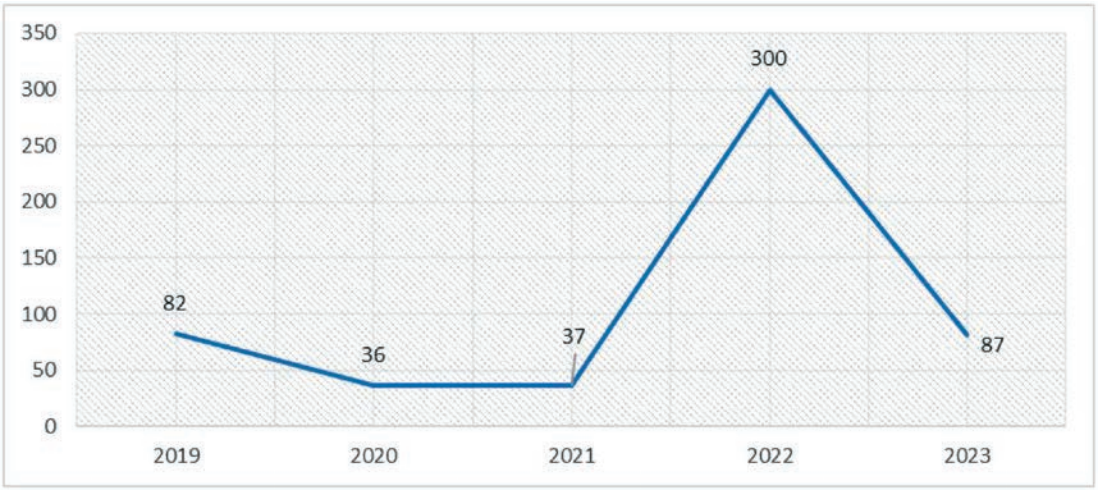

FIGURE 1. Incidence rate of CHD

with a descriptive study conducted in Colombo, where a significant proportion of families had similar numbers of children and delivery methods [22,23]. Regarding birth intervals, one-third of mothers had intervals of less than one year, and the majority used contraceptives before pregnancy, with 40% reporting pill use. This is supported by retrospective analyses in Turkey and Indonesia, which found similar trends in birth intervals and contraceptive usage [26,27].

Additionally, 45% of mothers experienced previous miscarriages, with one-third attributed to unknown causes. A study in Iraq on 27,049 children with CHD also reported that one-third of mothers had a history of miscarriage, supporting the findings in this study [29].

Risk factors and CHD types

Birth weight and a family history of CHD or congenital anomalies, including syndromes, showed a significant association with congenital heart defects ($P < 0.05$) [16]. Similarly, the study identified significant relationships between parental consanguinity, gestational term (full-term births), and children born with other abnormalities linked to CHD. These findings align with studies from north-western China, which also reported a strong correlation between gestational term, consanguinity, and CHD ($P < 0.05$) [30] (Table 5).

However, a study investigating the correlation between CHD prevalence in the North of England and maternal age at delivery found no significant overall association. There was a slightly higher frequency of severe CHD in women aged 35 years compared to those aged 25-29 years, though this difference was not statistically significant ($P = 0.97$). Conversely, a significant relationship was observed between maternal exposure to teratogenic risk factors and CHD types ($P < 0.005$) [31].

Distribution of incidence rate of congenital heart defects for the last five years

The distribution of CHD incidence over the last five years shows the highest rates in 2022 and the lowest in 2023 (Figure 1). The study, conducted across various governorates of Iraq using data from the Babylon Center for Catheterization and Cardiac Surgery at Imam Sadiq Hospital, suggests that the elevated rates of CHD may be attributed to several non-hereditary factors, including exposure to teratogenic risk factors [3].

CONCLUSION

The majority of children with CHD in this study were infants, with an equal distribution between sexes and most of them screened at 2-6 months of age. Significant demographic variables included maternal age parental consanguinity. Key child-related risk factors included birth weight, gestational term, associated abnormalities, and family history of CHD.

Recommendations

All infants should undergo comprehensive examinations to identify both overt and hidden congenital defects. For an instant hospital outcome, a congenital anomaly record system must be established. nurses and midwiferies provide pregnant care center posters and booklets that highlight healthy eating during pregnancy, list congestive heart failure risk factors, and caution against using prescription medications during pregnancy.

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