Original
ISSN 2512-8492

Epidemiological and Clinical Aspects of Congenital Heart Disease in Fallujah Maternity and Children Hospital, Iraq

Samira Telfah Abdilghani Alaani*, Firas Sadiq Alkubaisy, Abdulqadir Abdulkareem Merie

Birth Defect Unit, Fallujah Maternity and Children Hospital, Fallujah, Anbar, Iraq.
*Correspondence to: Samira T. Abdilghani (E-mail: samiraalaani@hotmail.com)
(*Submitted: 13 February 2023 – Revised version received: 05 March 2023 – Accepted: 09 April 2023 – Published online: 26 June 2023*)

Abstract

Objective: This study aimed to analyze the descriptive characteristics of children diagnosed with Congenital Heart Disease (CHD) at Fallujah Maternity and Children Hospital (FMCH).

Methods: The prospective study included 1,025 pediatric patients born between 1st December 2018 and 30th September 2022, admitted to the newborns and children's wards, and diagnosed with CHD. Data were collected through interviews with patients' guardians using a registration and questionnaire form, capturing variables related to the child (e.g., name, sex, birth weight, type of CHD) and the mother (e.g., age, occupation, consanguinity, previous CHD births, chronic diseases during pregnancy). Residence (rural or urban) was also recorded.

Results: Among the CHD cases, Atrial Septal Defect (ASD) was the most common (72%), followed by Ventricular Septal Defect (VSD) (25%) and Patent Ductus Arteriosus (PDA) (21%). Most diagnoses occurred in children aged 1–28 days. The male-to-female ratio was 1.2:1, and 0.2% had an ambiguous gender. About 58% of children weighed ≥ 2.5kg at birth, and 20% had a family history of CHDs.

Conclusion: The increasing prevalence of congenital heart diseases in Fallujah requires preventive strategies targeting modifiable risk factors, better monitoring of high-risk pregnancies, and increased awareness of genetic counseling for families with congenital anomalies. The cardiology department should receive more attention and resources to improve diagnostic and therapeutic capabilities. Further research is needed to understand the reasons behind the recent rise in CHD cases in newborns.

Key words: Heart Defects, congenital, frequency, child, fallujah, Iraq

Introduction

Congenital heart diseases (CHD) are one of the most common congenital diseases in newborns. They have a significant impact on morbidity, mortality, and healthcare costs in children and adults. In fact, about 30% of infants dying at birth have some type of CHD.[1] The pattern of CHDs is different in various geographic locations, and the prevalence of CHD has been reported to be different around the world. The global prevalence of CHD among newborns ranges from approximately 3.7 to 17.5 per 1,000 births, which accounts for 30–45% of all congenital defects. Continental variations in birth prevalence have been reported, from 6.9 per 1,000 births in Europe to 9.3 per 1,000 in Asia.[2,3] Etiology of CHD is multifactorial, and a large collection of environmental and genetic causes have a role in its pathogenesis. CHD is often divided into two types: Cyanotic (blue skin color caused by a lack of oxygen), including Ebstein anomaly,[4] Hypoplastic left heart syndrome (HLHS), Pulmonary atresia, Tetralogy of Fallot (TOF), Total anomalous pulmonary venous return (TAPVR), Transposition of the great vessels (TGA), Tricuspid atresia, Truncus arteriosus, Double outlet right ventricle (DORV), and Non-cyanotic, including Aortic stenosis (AS), Bicuspid aortic valve (BAV), Atrial septal defect (ASD), Atrioventricular canal (endocardial cushion defect), Coarctation of the aorta (COA), Patent ductus arteriosus (PDA), Pulmonic stenosis, and Ventricular septal defect (VSD). The most common CHD has been ventricular septal defect, followed by atrial septal defect, patent ductus arteriosus, tetralogy of Fallot, single ventricular, atrioventricular septal defect, and double outlet right ventricular

The warning signs of congenital heart disease in infants and children may include a heart murmur or abnormal heart sound, cyanosis (a bluish tint to the skin, fingernails, and/or lips), fast breathing, anorexia, poor weight gain, an inability to exercise, and excessive sweating. In this study, we made specific efforts to detect all possible cases of CHDs by examining patients admitted to the neonatal and pediatric wards suspected to have CHDs in the pediatric cardiology clinic in our hospital, which was established in late 2018 and operates one day a week.

CHD is the most common congenital anomaly in Fallujah, with a prevalence of 19.7 per 1000 live births, making it the first most common congenital anomaly 3,4,5.[5,6]

Materials & Methods

This prospective descriptive study was conducted at the Birth Defect Unit in Fallujah Maternity and Children Hospital. The unit is comprised of a fetal medicine clinic, clinical genetics clinic, pediatric cardiology clinic, chromosomal laboratory, and a unit for registration, documentation, data analysis, and research studies. Several research studies and case reports have been issued by the unit, all of which confirm a significant increase in the incidence and severity of birth defects in children born after 2005.

The study enrolled patients who were admitted to the newborn and children's wards and were diagnosed with CHD between December 1, 2018, and September 30, 2022.

All children suspected of having CHD underwent a comprehensive evaluation using trans-thoracic echocardiography, which included M-mode, two-dimensional, color, pulse Doppler, and continuous wave echocardiogram with a GE Vivid 5 echo machine. The echocardiogram was performed by a consultant pediatric cardiologist at the pediatric cardiology clinic, which operates one day a week.

The data collected were obtained through face-to-face interviews with the parents or one of their first-degree relatives, using a registration form that included variables and factors related to the child, such as name, sex, birth weight, type of CHD, and presence of other associated anomalies. The

form also included variables related to the mother, such as name, age, occupation, degree of consanguinity between parents, history of previous births with congenital CHD or other anomalies, type of pregnancy (singleton or twins), presence of chronic maternal disease, history of exposure during pregnancy to fever, X-ray irradiation, or harmful drug use, number of previous abortions, and family residence (rural or urban).

Results

This descriptive study aimed to determine the characteristics of a group of children with CHDs and their maternal conditions during pregnancy. A total of 1025 children born to 1018 mothers (14 were twins) were investigated. Categorical variables were reported as frequencies and percentages, and the baseline characteristics of the patients are presented in Table 1. Of the children investigated, 486 (47%) were aged 1–28 days, 357 (35%) were 29 days to 12 months old, 73 (7%) were 13 months to 5 years old at diagnosis, and 109 (11%) were over 5 years old. Males comprised 53.9% of all participants, while females accounted for 45.9% and only 0.2% were of ambiguous gender. With regards to their birth weight, 58% weighed ≥2.5 kg while 42% weighed <2.5 kg. Singletons and twins accounted for 96% and 4%, respectively.

Among the one thousand twenty five children enrolled in this study, only 20% had a previous family history of CHDs and 8% had other different congenital anomalies. Seven percent of them were born with other associated congenital defects in addition to their CHD. The largest group of children involved in the study (53%) were born with more than one heart defect. About 15% of the total number were born with ≥ 4 or more defects, 9% were born with 3 defects, 29% with 2 defects, and 47% were diagnosed with a single heart defect.

The majority of mothers (52%) were aged between 14 and 30 years at the time of delivery of their child with CHD. About 38% of the 1018 mothers were aged between 31 and 40 years, while only 10% were over 40. Consanguineous marriage was reported in 76% of cases, with 33% being first cousins and 43% being distant marriages. About 96% of the mothers were housewives, 2% were employed, and 2% were students. Of the 1018 families, 58% resided in urban areas, while 42% were from rural areas. During pregnancy, 5% of the mothers had a history of fever, and only 0.1% reported exposure to X-ray irradiation and harmful drugs. Hypertension during pregnancy was reported in 13% of mothers, 2% had diabetes mellitus, and 1% had both hypertension and diabetes. Additionally, 0.4% of all mothers were known cases of epilepsy and were using antiepileptics, 0.2% were cases of hypothyroidism and were on thyroxine therapy, and 0.1% were known to have SLE and sickle cell anemia (Table 2).

ASD was the most frequent isolated and combined defect in 68% of the study population followed by VSD (25%), PDA (21%), PPH (8%), TOF (4%), D-TGA (2.7%), L-TGA (3%), CAVC (2%), PS (1.6%), P V atresia, BAV (1.8%), Dextrocardia (1.4%) and other less frequent defects were all shown in Table 3 in frequency and percentage.

Age distribution of the most frequent heart defects in the study sample is shown in (Table 4).

The frequency of all the defects was found to be higher in the age range of 1–28 days, except for CAVC which was reported in equal percentages during both the 1st 28 days and the 1st year of age. In this study, ten TOF cases who were above 2 years of age were presented for follow-up after total correction. Only one case was corrected at the age of 1 year, and the other was corrected at the age of 10 months, both of which were also presented for follow-up and reported in this study. A previous family history of CHDs was reported in 20% of all the patients involved in this study, and 7.6% of the patients had reported other congenital anomalies and diseases as shown in Table 5.

Apart from congenital heart defects, 72 patients (7% of the total population in the study) were also found to have associated anomalies. Down syndrome was the most common anomaly, reported in 46 patients (4.5%). Other less frequent anomalies are shown in the frequency and percentage table below (Table 6).

Among the patients with Down syndrome in this study, single heart defect was diagnosed in only 35%, while 41% were found to have two defects, and 24% had three heart defects (see Table 7 for details).

Table 1. **Child variables associated with congenital heart defects in Fallujah maternity and children hospital in number and percentage of the total number of study sample**

Child's variable		
No.	**Percentage of total (1025)**	**Age**
1–29 day	486	47
1–12 months	357	35
13 months–5 years	73	7
> 5 years	109	11
Gender		
Male	552	53.9
Female	471	45.9
Ambiguous	2	0.2
Birth wt		
≥2.5 kg	594	58
<2.5 kg	431	42
Pregnancy type		
Singleton	989	96
Twin	36	4
Family history of CHD		
Yes	205	20
No	820	80
Family history of other birth defects		
Yes	78	8
No	947	92
Presence of other congenital anomalies		
Yes	73	7
No	952	93
No. of children born with		
Single heart defect	486	47
2 heart defects	295	29
3 heart defects	87	9
≥4 heart defects	157	15

Table 2. **Maternal variables associated with congenital heart defects in Fallujah maternity and children hospital in number and percentage of the total number of study sample**

Maternal variables	No.	Percentage % of the total (1018)
Maternal age at pregnancy (yr)		
14–30	532	52
31–40	384	38
>40	103	10
Maternal occupation		
Housewives	976	96
Employed	24	2
Student	18	2
Presence of paternal consanguinity		
Cousins	340	33
Distant marriage	439	43
Consanguinity –ve	239	24
Maternal exposure during pregnancy to		
Fever	48	4
x.ray irradiation	1	0.1
harmful drug use	1	0.1
Maternal chronic illness		
Hypertension	135	13
Diabetes mellitus	22	2
Hypertension & diabetes	10	1
Epilepsy	4	0.4
Hypothyroidism	2	0.2
SLE	1	0.1
Sickle cell anemia	1	0.1
Presence of previous abortion & IUD		
1 abortion	109	1
2 abortions	85	8
3 abortions	32	3
≥4 abortions	22	2
1 IUD	5	0.5
Residence of the family		
Urban	586	58
Rural	432	42

Table 3. **Frequency & percentage (%) of different types of congenital heart disease in the study population**

Variables		No. & percentage%
ASD	isolated	403 (39)
	+ other defects	295 (29)
	Total	695 (68)
VSD	isolated	55 (5)
	+ other defects	202 (20)
	Total	257 (25)

(*Continued*)

Table 3. **Frequency & percentage (%) of different types of congenital heart disease in the study population—Continued**

Variables		No. & percentage%
PDA	isolated	5 (0.5)
	+ other defects	207 (20)
	Total	212 (21)
PH	isolated	1 (0.1)
	+ other defects	89 (8.7)
	Total	90 (8.8)
TOF		41 (4)
D-TGA	isolated	1 (0.1)
	+ other defects	27 (2.6)
	Total	28 (2.7)
L-TGA		3 (0.3)
CAVC		20 (2)
P S	isolated	10 (1)
	+ other defects	6 (0.6)
	Total	16 (1.6)
P V atresia		14 (1.4)
Dextrocardia	with situs inversus	4 (0.4)
	With multiple heart defects	10 (1)
Total		14 (1.4)
BAV	isolated	11 (1.1)
	+ other defects	7 (0.7)
Total		18 (1.8)
AS		9 (0.9)
MR		21 (2.1)
MV atresia		5 (0.5)
MS		4 (0.4)
LVOTO		9 (0.9)
DORV		9 (0.9)
T V atresia		6 (0.6)
T V dysplasia		2 (0.2)
Single Ventricle	isolated	1 (0.1)
	+ other defects	5 (0.5)
Total		6 (0.6)
TAPVR		4 (0.4)
COA	isolated	2 (0.2)
	+ other defects	2 (0.2)
	Total	4 (0.4)
HLHS		9 (0.9)
Truncus	Arteriosus	2 (0.2)
Cor-Tri-Atriatum		1 (0.1)
Common atrium		2 (0.2)

In our study, the most common congenital heart defects observed in children with Down syndrome were ASD, accounting for 72% of cases, followed by PDA (35%), VSD (30%), PPH (24%), CAVC (13%), TOF (9%), MR (4%), and

Table 4. **Age distribution of the most frequent heart defects in the study sample in no. & percentage % of the total no. of each defect**

Heart Defect	Total no.	1–28 days old		29 days–12 months		13 months–5 years		>5 years	
		no.	%	no.	%	no.	%	no.	%
ASD	698	376	54	236	34	22	3	64	9
VSD	257	116	45	102	40	21	8	18	7
PDA	212	142	67	36	17	3	1	31	15
PPH	90	48	53	32	36	2	2	8	9
TOF	41	10	24	11	27	14	34	6	15
D.TGA	27	12	44	7	26	5	19	3	11
CAVC	20	9	45	9	45	1	5	1	5

Table 5. **Types of previous congenital anomalies (diseases) in the families of children involved in this study in number & percentage of the total**

Congenital anomaly	No.	Percentage of the total (1025)
Congenital heart disease	205	20
Congenital brain atrophy	25	2.4
Down syndrome	16	1.6
Skeletal anomalies	8	0.8
Cleft lip	4	0.4
Eye abnormalities	4	0.4
Cleft palate	3	0.3
Spina bifida	3	0.3
Multiple congenital anomalies	3	0.3
Hydrocephaly	2	0.2
Congenital hypotonia	2	0.2
Thalassemia major	2	0.2
Congenital goiter	1	0.1
Omphalocele	1	0.1
Cleft lip & palate	1	0.1
Microcephaly	1	0.1
Esophageal atresia	1	0.1
Inborn errors of metabolism	1	0.1
Total	283	27.6

Table 6. **Frequency & percentage of the other associated congenital anomalies in the study sample**

Congenital anomaly	No. of children	Percentage of the total (1025)
Down syndrome	46	4.5
Dysmorphic features	4	0.4
Cleft palate	3	0.3
Diaphragmatic hernia	2	0.2
Metatropic dysplasia	2	0.2
Holt Oram syndrome	1	0.1
Cleft lip & palate	1	0.1
Syndactyly	1	0.1
Marfan syndrome	1	0.1
Achondroplasia	1	0.1
Omphalocele	1	0.1
William syndrome	1	0.1
Spina bifida	1	0.1
Edward syndrome	1	0.1
Turner syndrome	1	0.1
Congenital brain atrophy	1	0.1
Microphthalmia	1	0.1
DDH	1	0.1
Multiple congenital anomalies	1	0.1
Total	72	7

*DDH, Developmental Dysplasia of the Hip.

AR (2%). Table 8 provides a detailed breakdown of these findings.

Table 7. **Distribution of heart defects no. in children with Down syndrome**

No. of heart defects	No. of children	Percentage% of total no. (46)
Single defect	16	35
Two defects	19	41
Three defects	11	24

Discussion

Our study found that ASD was the most common congenital heart defect, accounting for 72% of all cases. This finding is consistent with a previous study conducted at Fallujah General Hospital by Mohammed Tafash Dagash et al. (2008–2011),[7] except for one year when VSD was the most frequent. Similar results were reported in two other Iraqi provinces, Sulaimani in 2017 and Mosul in 2015.[8,9] However, studies conducted in Ramadi,[10] Baghdad, and Basrah found that VSD was the most frequent. In Iran in 2008, ASD was also the most frequent defect,[11,12] but in Jordan, Saudi Arabia, Turkey, Alexandria in Egypt,[13,14] Oman, and Mysore hospitals in India, VSD was the most common.[15,16]

Our study also found that 54% of ASD cases were diagnosed in children aged 1-28 days, with 34% diagnosed between

Table 8. **The most frequent types of congenital heart defects in No. & percentage of the total in children with Down syndrome in the study sample**

Heart defect	No. of patients	Percentage % of the total (46)
ASD	33	72
PDA	16	35
VSD	14	30
PPH	11	24
CAVC	6	13
TOF	4	9
MR	2	4
AR	1	2

29 days to 1 year old. Children above 5 years of age accounted for 9% of the total number, while only 3% of ASD cases were reported in children aged 13 months to 5 years old.

In addition, our study found that VSD was the second most frequent defect, accounting for 25% of all cases, followed by PDA (21%), PPH (8.8%), TOF (4%), D-TGA (2.7%), and CAVC (2%). This sequence was similar to that reported in the Mosul study but differed from the Fallujah General Hospital study and all other previously mentioned Iraqi studies.

Furthermore, about 7% of our patients had other associated congenital anomalies, with Down syndrome being the most frequent, reported in 4.5% of the total number. Of these cases, 65% had 2–3 cardiac defects, while only 35% had a single heart defect. Congenital heart defects are a leading cause of mortality and morbidity during the first two years of life in the Down syndrome population. Studies have shown that 40% to 60% of Down syndrome patients have CHD, with left-to-right shunt lesions predominating.[17] In our study, the most common CHD types reported in Down syndrome cases were ASD (72%), PDA (35%), VSD (30%), PPH (24%), AVSD (24%), and TOF (9%). MR (4%) and AR (2%) were reported in only a small percentage of Down syndrome cases. These findings differ from those reported in Nigeria,[18] where complete AVSD was the most frequent type of CHD in Down syndrome children. Higher proportions of complete AVSD among Down syndrome children were also reported in studies conducted in Kano, Nigeria;[19] Morocco; Algeria; and Turkey.[20–23]

In this study, there was little difference in the gender distribution, with a male/female ratio of 1.2/1, consistent with previous studies in Basra, Fallujah, Sulaymaniyah, Ramadi, and Baghdad. However, the M/F ratio was higher in Mosul at 1.4/1. Out of 14 babies, 7 twins were reported to have congenital heart defects. Around 58% of children had a normal birth weight of 2.5 kg or more, which was lower than in Sulaymani at 68.8%.

Consanguineous unions can increase the risk of inherited susceptibility genes and potentially lead to disease, and in this study, 20% of children had a previous family history of CHD. Parental consanguinity was reported in 76% of the study population, with 33% being cousins. This is different from the Sulaimani study, where consanguinity was reported in about 41.8% of the study sample.

In terms of maternal variables, around 52% of mothers were under 30 years old at conception, 38% were between 31–40 years old, and only 10% were over 40, similar to findings in other studies. The majority of mothers in this study were housewives (96%), similar to a previous study on congenital malformations in the hospital. Only 2% were working women.

Regarding maternal risk factors during pregnancy, 5% of all women reported a history of fever, and only 0.1% had a history of harmful drug use and x-ray radiation, which were lower than those reported in the FGH study. Out of 1,018 mothers, 13% had a history of hypertension, 2% had diabetes mellitus, and only 1% reported having both hypertension and diabetes, which were lower than the percentages reported in the Mosul study. Other less common diseases were reported in 0.4% of all cases.

Previous abortions were reported in 25% of cases, which was lower than in the FGH study. In terms of family residence at the time of child birth, 58% were urban and 42% were rural, similar to the Sulaimani study.

Limitations of the Study

1. A major limitation of this study is the lack of a healthy control group, which could have led to bias in the data.
2. Another limitation is the relatively small sample size (1025). A larger sample size could have resulted in more accurate reporting of frequencies.
3. The study only included hospitalized children during the study period, as the cardiology clinic operates only one day per week. This may have resulted in important cases being missed.
4. The study was also limited by a poor registration and documentation system.

Conclusion and Recommendations

Congenital heart defects remain a significant problem in Fallujah, as evidenced by this study and previous reports. However, conducting research studies on congenital malformations remains challenging due to the poor and unreliable registration system. Thus, it is crucial to establish strict rules and procedures to improve the health registration and statistical system. Furthermore, efforts should be made to provide preventive strategies for modifiable risk factors, monitor high-risk pregnancies, and raise awareness about the importance of genetic counseling, particularly for those with a family history of congenital anomalies in general and congenital heart diseases in particular. Additionally, the cardiology clinic in the hospital must be supported with more pediatric cardiologists and sufficient facilities to handle cases that require more invasive diagnostic and therapeutic measures. Finally, it is recommended that more research studies be conducted to investigate the underlying causes behind the marked increase in the number of newborns with congenital heart defects in recent years.

Abbreviations

ASD = Atrial septal defect, VSD = Ventricular septal defect, PDA = Patent ductus arteriosus, PPH = Primary Pulmonary hypertension, TOF = Tetralogy of Fallot, D.TGA = D-Transposition of great arteries, L-TGA = Levotransposition of great

arteries, CAVC = Common atrioventricular canal, AVSD = Atrioventricular septal defect, PS = pulmonary stenosis, BAV = Bicuspid aortic valve, AS = Aortic stenosis, AR = Aortic regurgitation, MR = Mitral regurgitation, MS = Mitral stenosis, LVOTO = Left ventricular outflow tract obstruction, AVSD = Atrio-ventricular septal defect, DORV = Double outlet right ventricle, TV = Tricuspid valve, TAPVR = Total anomalous pulmonary venous return, COA = Coarcitaion of the aorta, HLHS = Hypoplastic left heart syndrome, IUD = Intra Uterine death, DDH = Developmental Dysplasia of the Hip, DS = Down syndrome, M/F = male/female, FGH = Fallujah General Hospital, FMCH = Fallujah Maternity and Children Hospital.

Acknowledgment

The authors would like to express their gratitude to Ms. Reem Harbi, a bio-technologist from the chromosome laboratory, for her valuable assistance in collecting patient data and conducting interviews with the doctors in the birth defect unit at Fallujah Maternity and Children Hospital.

Ethical Approval

This study was granted ethical approval by the scientific committee at Fallujah Maternity and Children Hospital.

Competing Interests

The authors declare that they have no competing interests.

Source of Funding

All costs were paid by the researchers.

References

1. American Heart Association. Statistical Fact Sheet, Congenital Cardiovascular Defects, American Heart Association. [Updated 2013; cited Apr 2014]. Cir. 2013; 127:e6-e245. Available from: http://www.uptodate.com/contents/congenital-heartdisease- chd-in-the -newborn-presentation-and-screening-for-critical-chd and http://www.heart.org/HEARTORG/Conditions/CongenitalHeartDefects/AboutCongenitalHeartDefects/Ventricular-Septal-Defect -VSD_UCM_307041_Article.jsp.
2. Badi, M. A. H., & Triana, B. E. G. (2014). Congenital heart diseases in neonatal unit at Al-Wahda Pediatric Teaching Hospital, Aden, Yemen (2012-2013). Revista Habanera de Ciencias Médicas, 13(5), 708–718.
3. Niaz Kamal, et al, Incidence and Types of Congenital Heart Diseases among Children in Sulaimani Governorate, Kurdistan Journal of Applied Research (KJAR) | Print-ISSN: 2411-7684 – Electronic-ISSN: 2411-7706 | kjar.spu.edu.iq Volume 2 | Issue 2 | july 2017 | DOI: 10.24017/science.2017.2.15.
4. Alaani S, Al Fallouji MA, Busby C, Hamdan M (2012) Pilot Study of Congenital Anomaly Rates at Birth in Fallujah, Iraq, 2010. J IMA 44: 44-1-10463.
5. Samira T. Abdulghani, Demographic Factors Associated with Congenital Malformations Among Young Infants in Fallujah Maternity and Children Hospital, Fallujah City, Iraq, Genetic Genomics, 2020; 1(1): 2–5.
6. Alabdulgader AA. Congenital heart disease in 740 subjects: Epidemiological aspects. Ann Trop Paediatr 2001;21:111–8.
7. Mohammed Tafash Dagash,et al, Prevalence of Congenital Heart Disease in Fallujah General Hospital, western of Iraq (2007–2011), Anb Med J Vol.12 No.1; 83–95.
8. Eman Ghanim Sheet Al-Hyali, Prevalence and Risk Factors for Congenital Heart Anomalies Among Hospital Attendees in Mosul City, The Iraqi Postgraduate Medical Journal, Vol. 14, No. 2, 2015, pp. 229–236.
9. Fakhri J. Al-Dalla Ali, et al, Pattern of Congenital Heart Disease among Children Referred for Echocardiography in Ramadi City, West of Iraq, Al-Anbar Medical Journal Anb. Med. J. 15(2):40–44, 2019.
10. Husam T Al-Zuhairi, et al, Pattern of Congenital Heart Disease In Children Attending Central Teaching Pediatric Hospital, Baghdad, Al-Kindy College Medical Journal, 2019; 15(2): 82–86.
11. Jawad Khadim, Sawsan Issa, Spectrum of Congenital Heart Diseases in Basra: An Echocardiogrphy Study, The Medical Journal of Basrah University, Mjbu, 2009; 27(1): 15–18.
12. Rahim F, Ebadi A, Saki G, Remazani A. Prevalence of congenital heart disease in Iran: A clinical study. J Med Sci 2008;8:547–52.
13. Baspinar O, et al prevalence and distribution of CHD in central Anatolian region,Turkey. Turk J Pediatr. 2006 Jul–Sep ;48(3):237–43. PMD:17172068.
14. Bassili A, Mokhtar SA, Dabous NI, Zaher SR, Mokhtar MM, Zaki A. Congenital heart disease among school children in Alexandria, Egypt: An overview on prevalence and relative frequencies. J Trop Pediatr 2000;46:357–62.
15. Subramanyan R, Joy J, Venugopalan P, Sapru A, al Khusaiby S. Incidence and spectrum of congenital heart disease in Oman. Ann Trop Paediatr 2000;20:337–41.
16. Smitha R, Karat SC, Narayanappa D, Krishnamurthy B, Prasanth SN, Ramachandra NB. Prevalence of congenital heart diseases in Mysore. Indian J Hum Genet 2006;12:11–6.
17. Joseph T.C. Shieh, et al, Consanguinity and the risk of congenital heart disease, Am J Med Genet A.2012 May ; 158A (5):1236–1241.
18. Asani M, Aliyu I, Also U. Pattern of congenital heart diseases among children with Down syndrome seen in Aminu Kano Teaching Hospital, Kano, Nigeria. Niger J Basic Clin Sci. 2013; 10: 57–59.
19. Ujuanbi Amenawon Susan,et al, Prevalence and pattern of congenital heart disease among children with Down syndrome seen in a Federal Medical Centre in the Niger Delta Region, Nigeria, Journal of Cardiology and Cardiovascular Medicine. 2022;7:30–35. https://doi.org/10.29328/journal.jccm.1001129.
20. Benhaourech S, Drighil A, El Hammiri A. Congenital heart disease and Down syndrome: various aspects of a confi rmed association. Cardiovasc J Afr. 2016; 27: 287–290. PubMed: https://pubmed.ncbi.nlm.nih.gov/27805241.
21. Boussouf K, Zoubida Z, Mounira A, Naima H, Malika M, et al. Study of congenital heart diseases in patients with Down syndrome in Algeria. East Mediterr Health J. 2017; 23: 632–636.
22. Nisli K, Candan SKH, Tansel TTE, Karaman B, Omeroglu RE, et al. Congenital heart disease in children with Down's syndrome: Turkish experience of 13 years. Acta Cardiol. 2008; 63: 585–589. PubMed: https://pubmed.ncbi.nlm.nih.gov/19014001/.
23. Khaled Amro, Pattern of Congenital Heart Disease in Jordan, Eur J Gen Med 2009; 6(3): 161–165.