Research Article

Some Epidemiological Aspects of Congenital Cardiovascular Anomalies among Pediatric Patients Attending Minia University Hospital

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Abstract
Background: Congenital heart diseases (CHDs) are associated with multiple risk factors such as maternal febrile illness, maternal history of Diabetes Mellitus (DM), Hypertension (HTN), SLE, Epilepsy, maternal alcohol consumption, maternal cigarette smoking, maternal caffeine intake, maternal receiving medication during pregnancy, family inherited diseases history and birth weight of child. **The aim of the study**: The current study was aimed to study the relationship between some risk factors and the development of congenital heart diseases. **Participants and Methods**: A cross-sectional study was done on all pediatric patients attending Cardio-Thoracic Surgery clinic in Minia University Hospital from December 2015 to May 2016. A total of 220 patients were included in the study. **Results**: It was found that the most common type of congenital heart diseases was VSD (32%) followed by ASD (30%), PDA (27%), and then Fallot tetralogy (5.5%), there was a positive significant association ($p<0.05$) between (consanguinity, maternal DM, maternal HTN, maternal infection, maternal smoking, maternal caffeine intake, maternal history of receiving medications and low birth weight) and occurrence of CHD, There were no cases of maternal SLE, maternal Epilepsy, maternal history of drug addiction and maternal alcohol consumption. **Conclusion:** The most common type of congenital heart diseases was VSD followed by ASD, PDA, and then Fallot tetralogy. There was a positive significant association ($p<0.05$) between (consanguinity, maternal DM, maternal HTN, maternal infection, maternal smoking, maternal caffeine intake, maternal history of receiving medications and low birth weight) and occurrence of CHD.

Keywords: Congenital heart diseases, Epidemiological aspects, pediatrics, risk factors.

Introduction
Congenital heart diseases (CHDs) are the most common types of birth defects among live births (CDC, 2016). (CHDs) represent one of the most prevalent malformations among live births and remain the leading cause of death from congenital malformations (Botto et al., 2003).

Congenital heart disease refers to a problem with the heart's structure and function due to abnormal heart development before birth, and congenital heart malformations are the most common of all birth defects (Tandon et al., 2010).

The prevalence of CHD in Egypt was 1/1000 live birth (Bassilli et al., 2000) Recently congenital heart diseases (CHD) affect 1–2% of newborn children in Egypt in 2016 and is the leading cause of death in infants under 1 year of age (Mazen et al., 2016).

Congenital heart diseases (CHDs) are responsible for the largest proportion (30–50%) of mortality caused by birth defects in a pediatric age in Egypt (Atwa and Safar, 2014).

CHD affects about 8-10 per 1000 live births in India and is a leading cause of infant mortality. This emphasizes the importance of this group of heart diseases. It is known that 180,000 children are born with CHD each year in India. Approximately 10% of present infant mortality in India may be accounted for the CHD alone (Saxena, 2005).

The incidence of CHD in America varies from 4/1000 to 50/1000 live births.
Types of CHD are atrial septal defect (ASD), ventricular septal defect (VSD), atrioventricular septal defect (AVSD), aortic stenosis (AS), pulmonary stenosis

(PS), coarctation of aorta (Coarc), bicuspid aortic valve (BAV), double outlet right ventricle (DORV), single ventricle(SV) and patent ductus arteriosus (PDA) (Hoffman and Kaplan, 2002).

There are some epidemiological factors of CHD such as First-cousin marriage may be a significant risk factor for specific types of congenital heart disease in a consanguineous population. Consanguinity may contribute to the risk of disease, particularly since the prevalence of consanguinity reaches over 50% in some areas of the world and in certain populations. 1st-cousin consanguinity was significantly associated with a ventricular septal defect (VSD), atrial septal defect (ASD), atrioventricular septal defect (AVSD), pulmonary stenosis (PS), and pulmonary atresia (PA). There was no relationship between consanguinity and tetralogy of Fallot (TOF), tricuspid atresia (TA), aortic stenosis (AS), coarctation of the aorta (Coarc), and patent ductus arteriosus (PDA) (Becker and Al-Halees, 2001).

Also there are other risk factors of CHD such as maternal febrile illness, maternal history of Diabetes mellitus (DM), Hypertension(HTN) ,Systemic Lupus Erythematosus(SLE), Epilepsy ,maternal alcohol consumption, maternal cigarette smoking , maternal exposure to radiation, maternal caffeine intake ,maternal receiving medication during pregnancy (Jenkins et al., 2007), socio-economic status of the family and paternal residence, family inherited disease history and birth weight of child <2500 grams (Tandon et al., 2010).

Justification of the study was to prevent CHD by following a healthy lifestyle and avoiding of risk factors in a pregnant woman, assessment of these relations is important for several reasons.

The aim of this study was to identify the relation between some risk factors and the development of congenital heart diseases.

Subjects and Methods

Study design:

This study is a hospital-based cross-sectional study among all pediatric patients attending the outpatient clinic of the Cardio-Thoracic department of Minia University Hospital during the period from Dec. 2015 to May 2016. The study was conducted to assess the relationship between congenital heart disease and some epidemiological aspects include Consanguinity, family history of congenital heart disease, Maternal past history of (Diabetes, Hypertension, cardiac disease, SLE, infection during pregnancy (fever), obesity, history of receiving medication during pregnancy,etc.).

Administrative methodology:

An approval was taken from the Department of Public Health and Preventive Medicine administration and Dean of Faculty of Medicine, Minia University. An approval was taken from Director of Minia University Hospital, Head of Department of Surgery and Head of Unit of Cardio-Thoracic Surgery, Minia University Hospital to interview parents of CHD patients.

Ethical methodology:

The study was approved by the Department of Public Health and Preventive Medicine administration, Minia University and referred me to the ethical committee of the Faculty of Medicine, Minia University where the approval was taken. Prior to data collection, a verbal consent was obtained from all parents′ of CHD patients after supplying comprehensive information about

the nature of the study, objectives of the study and uses of the data.

Study population:
Taken from all pediatric patients attending Cardio-Thoracic outpatient clinic suffering from CHD and can be contacted, in the age group of 1 week to 18 years. Pediatric patients include neonates (birth to 1 month), infants (1 month to 2 years), children (2 to 12 years) and adolescents younger than 18 years old.

This study takes a group of ages from one week to 18 years because the discovery of CHD starts mostly at age of one week and to the age of 18 years as this is enough time to detect the disease.

Sample size:
The study population includes all pediatric patients attending Cardio-Thoracic Surgery outpatient clinic during the duration of the study from December 2015 to May 2016. We collected 220 cases of congenital heart disease patients during this period.

Data collection:
Data were collected using a constructed questionnaire asking about risk factors of CHD and it was applied to the patient's parents attending the Cardio-Thoracic outpatient clinic. This clinic was visited twice weekly, Monday and Wednesday during the study period in Minia University Hospital because this is a time of outpatient clinic which was selected from the hospital administration as a process of regulatory.

Inclusion criteria:
All pediatric patients attending Cardio-Thoracic clinic with congenital heart diseases aged (1week -18 years) during the duration of the study from Dec. 2015 to May 2016.

Exclusion criteria:
Neonate with congenital heart disease less than 1 week, Patient with congenital heart disease more than 18 years, Pediatric patients with CHD who follow up in the outpatient clinic without their parents, Pediatric patients with heart disease other than congenital heart disease, Pediatric patients with CHD who attending other clinic outside Cardio-Thoracic Surgery clinic and Uncooperative parents.

Data collection tool:
A well-constructed questionnaire was designed to identify possible risk factors for congenital heart diseases. The questionnaire was prepared in English and included both closed and open questions

The questionnaire included:
Personal history, Type of CHDs, Risk factors of CHDs, Medical and surgical correction, Follow up and Complications

Data management:
After filling out the questionnaires, the data were gathered and entered into SPSS, version 15 weekly.

Results

Table 1: This table shows that (43.5%) of child with CHD have a history of parental positive consanguinity compared to (56.5%) of child with CHD have a history of parental negative consanguinity, 16.5% of patient with ASD have a history of parental positive consanguinity compared to 13.5% of patient with ASD have history of parental negative consanguinity. The difference between positive and negative consanguinity regarding the types of CHD is statistically significant (P=0.00001).

Table2: this table shows that the most important risk factors for developing a child with ASD were a maternal infection, consanguinity, passive cigarette smoking, maternal HTN, maternal obesity, and Shisha smoking. The odds ratio was respectively maternal infection 13.5, consanguinity 2.6, passive cigarette smoking 2.4 and maternal HTN 2.

Table 3: this table shows that the most important risk factors for developing child with VSD were maternal DM, consanguinity, maternal HTN, cigarette smoking, maternal history of receiving medication and sibling suffer from CHD and Odds ratio was respectively maternal DM 4.5, consanguinity 2.1, maternal HTN 2, maternal cigarette smoking 1.5 and maternal receiving medication 1.45.

Table 4: this table shows that the most important risk factors for developing a child with PDA were a maternal history of receiving medication maternal HTN, maternal obesity, maternal DM, maternal infection and maternal history of coffee, tea or coke intake. The odds ratio was respectively maternal receiving medication 26, maternal HTN 15.5, maternal obesity 9, maternal DM 6, maternal infection 5 and maternal history of coffee, tea or coke intake 2.8.

Table 5: this table shows that the most important risk factor for developing a child with Fallot tetralogy was maternal HTN. The odds ratio was 15.5.

Figure 1 shows types of CHD in pediatric patients attending the outpatient clinic of Cardio-Thoracic Surgery department of Minia University Hospital. About one third of cases of CHD have VSD (32%), other third have ASD (30%), near third have PDA (27%), (5.5%) have Fallot tetralogy, (5.5%) combination between (PDA, ASD) and no cases of CHD have AVSD, AS, PS, Coarc, and SV.

Table 1: Effect of consanguinity on congenital heart diseases among pediatric patients attending the outpatient clinic of Cardio-Thoracic Surgery department of Minia University Hospital during the period from December 2015 to May 2016:

Congenital Heart Diseases	Parental Consanguinity		No Consanguinity	
	NO	Percent	NO	Percent
ASD	36	16.5%	30	13.5%
VSD	24	11%	46	21%
PDA	30	13.5%	30	13.5%
Fallot tetralogy	0	0%	12	5.5%
Combined ASD,PDA	6	2.7%	6	2.7%
Total	96	43.5%	124	56.5%
P value	0.00001			

Table 2: Logistic regression analysis for most important risk factors for developing a child with ASD among pediatric patients attending the outpatient clinic of Cardio-Thoracic Surgery department of Minia University Hospital during the period from December 2015 to May 2016:

-Risk factors for developing a child with ASD	O.R* (C.I)**	P value
-Maternal infection	13.5 (3-56)	0.0001
-Consanguinity	2.6 (1-5)	0.05
-Passive cigarette smoking:	2.4 (1-5)	0.02
-Maternal HTN	2 (1-7)	0.02
-Maternal obesity	0.13 (.05-.33)	0.0001
-Shisha smoking :	0.15 (.05-.4)	0.001
-Sibling suffers from CHD:	1.8 (.5-6.4)	0.35
-Maternal history of receiving medication:	1.4 (.4-6)	0.5
-Maternal DM	1.4 (.3-7)	0.5

O.R*= Odds ratio C.I**= Confidence interval.

Table 3: Logistic regression analysis for most important risk factors for developing a child with VSD among pediatric patients attending the outpatient clinic of Cardio-Thoracic Surgery department of Minia University Hospital during the period from December 2015 to May 2016:

-Risk factors for developing a child with VSD	O.R* (C.I)**	P value
-Maternal DM	4.5(1.2-16.5)	0.024
-Consanguinity	2.1(.9-7)	0.012
-Maternal HTN	2(.9-4.5)	0.05
-Cigarette smoking:	1.5(1-2)	0.006
-Maternal history of receiving medication:	1.45(1-22)	0.005
-Sibling suffer from CHD:	0.3(.09-1.2)	0.09
-Maternal infection	0.9(.4-1.9)	0.8
-Maternal obesity	0.9(.4-2)	0.9

O.R*= Odds ratio C.I**= Confidence interval.

Table 4: Logistic regression analysis for most important risk factors for developing a child with PDA among pediatric patients attending the outpatient clinic of Cardio-Thoracic Surgery department of Minia University Hospital during the period from December 2015 to May 2016:

Risk factors for developing a child with PDA:	O.R* (C.I)**	P value
Maternal history of receiving medication:	26 (4.5-149)	0.0001
-Maternal HTN	15.5 (4-58.5)	0.0001
-Maternal obesity	9 (4-22)	0.0001
-Maternal DM	6 (1.5-26.5)	0.01
-Maternal infection	5 (1-24.5)	0.04
Maternal history of coffee, tea or coke intake:	2.8 (1-7)	0.02
Consanguinity:	1.4 (.5-3.6)	0.5
Passive cigarette smoking:	1.6 (.7-3.8)	0.2

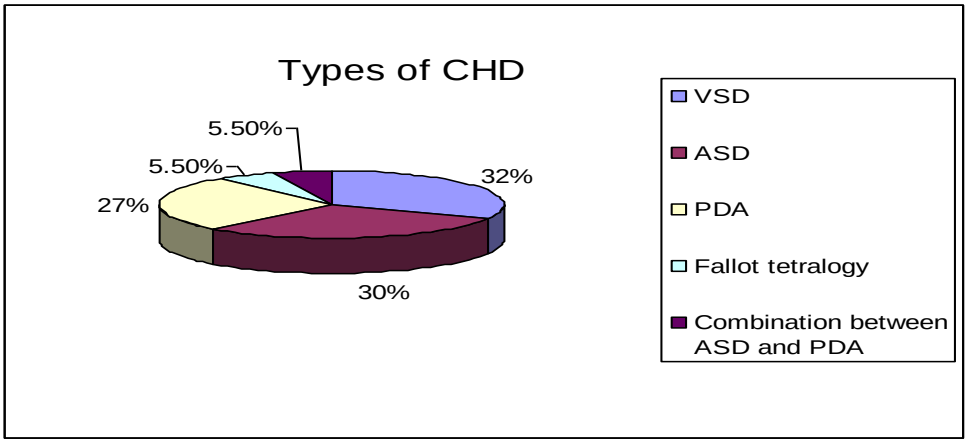
O.R*= Odds ratio C.I**= Confidence interval.

Table 5: Logistic regression analysis for most important risk factors for developing a child with Fallot tetralogy among pediatric patients attending the outpatient clinic of Cardio-Thoracic Surgery department of Minia University Hospital during the period from December 2015 to May 2016:

Risk factors for developing a child with Fallot tetralogy:	O.R* (C.I)**	P value
-Maternal HTN	15.5 (4-63.5)	0.00001
-Cigarette smoking:	2.5(00)	1
-Shisha smoking :	0.000(000)	0.99
-Maternal history of receiving medication:	0.000(000)	0.99
-Maternal DM	0.000(000)	0.99
-Maternal infection	0.000(00)	0.99
-Maternal obesity	1.5(.4-6)	0.5

O.R*= Odds ratio C.I**= Confidence interval.

Figure 1 shows types of CHD in pediatric patients attending the outpatient clinic of Cardio-Thoracic Surgery department of Minia University Hospital. About one third of cases of CHD have VSD (32%), other third have ASD (30%), near third have PDA (27%), (5.5%) have Fallot tetralogy, (5.5%) combination between (PDA, ASD) and no cases of CHD have VSD, AS, PS, Coarc, and SV.



Discussion

This study has been conducted to identify the possible risk factors for congenital heart diseases in Minia governorate (Webb et al., 2011).

Types of CHD it was observed from the study that the most common type of congenital heart diseases was VSD 32% followed by ASD 30% followed by PDA 27% then, Fallot tetralogy 5.5% (figure1) which was in agreement with (Faheem et al., 2011) in Karachi, Pakistan, who revealed that the most common cardiovascular malformation was VSD 39% followed by ASD, PDA and Fallot tetralogy. Our results also were in agreement with (Khalid et al., 2006) in Beirut, Lebanon, who stated that the most common cardiovascular malformation was VSD followed by ASD. On the other hand (Tandon et al., 2010) in their study revealed that the most common type of CHD was ASD followed by VSD, Fallot tetralogy, and PDA. This difference may be due to the different sample size.

Effect of genetic factors as risk for developing a child with CHD This study was manifested by a high percentage of consanguineous marriages 43.5%, In our study, it was found that positive significant association p=0.00001 (Table 1) between consanguinity and CHD. This also was in agreement with (Faheem et al., 2011) in Karachi, Pakistan, who study the risk factors predisposing to congenital heart defect and (Khalid et al., 2006) who study consanguineous marriage and CHD in Beirut, Lebanon, and found that there was significant association between consanguinity and CHD p<.05 but they found no significant association between consanguinity and PDA p=0.2. Our results also go with (Tandon et al., 2010) in India and (Khalid et al., 2006) in Beirut, Lebanon, studies who revealed that there was significant association p<0.001 between consanguinity and CHD overall.

The most important risk factors for developing child with ASD: In our study it was found by logistic regression (Table 2) that the most important risk factor for developing child with ASD were maternal infection (p=0.0001) odds ratio (13.5) followed by consanguinity (p=0.05) odds (2.6), passive cigarette smoking (p=0.02) odds (2.4) and maternal HTN (p=0.02) odds (2). Such results were similar to that of (Tandon et al., 2010) who identified that there was a positive significant association (p<0.001) between maternal infection and ASD. A study was done by (Khalid et al., 2006)
found that there was a significant association between consanguinity and ASD p=0.009. Also, the study was done by

Alverson et al., (2011) in Baltimore-Washington identified that there was a positive significant p<0.001 between passive cigarette smoking and the occurrence of ASD. Regarding the relationship between hypertension and CHD, a study done by (Caton et al., 2009) in the USA identified an approximately twofold increased risk (p<0.001) of CHD among infants born to mothers with uncontrolled hypertension during pregnancy and occurrence of ASD.

The most important risk factors for developing child with VSD: Our study was found by logistic regression (Table 3) that the most important risk factor for developing child with VSD were maternal DM (p=0.024) odds (4.5) followed by consanguinity (p=0.012) odds (2.1), maternal HTN (p=0.05) odds (2), maternal cigarette smoking (p=0.006) odds (1.5) and maternal receiving medication 0.005 odds (1.45). Which was in agreement with (Khalid et al., 2006) who studied consanguineous marriage and congenital heart defects congenital heart defect which was found that there was a significant association between consanguinity and VSD (p=0.006). A study was done by (Banhidy et al., 2010) who studied the relation between nongenetic risk factors and congenital heart defects in Budapest, Hungary agrees with our study in founding that diabetes has been associated with VSD. (Caton et al., 2009) in the USA found that there was a positive significant (p<0.001) association between maternal HTN and occurrence of VSD. (Alverson et al., 2011) in Baltimore-Washington identified that there was a positive significant (p<0.001) association between maternal cigarette smoking and the occurrence of VSD.

The most important risk factors for developing a child with PDA: From our study, it was found by logistic regression (Table 4) that the most important risk factor for developing a child with PDA was maternal receiving medication (p=0.0001) odds (26)

followed by maternal HTN (p=0.0001) odds (15.5), maternal obesity (p=0.0001) odds (9), maternal DM (p=0.01) odds (6), maternal infection p=0.04 odds (5) and maternal caffeine intake (p=0.02) odds (2.8). Which in agreement with (Caton et al., 2009) in USA who found that there was positive significant p<0.001 association between maternal HTN and occurrence of PDA, This is in agreement with (Blomberg and Kallen, 2010) in Sweden who identified that there is a positive significant association between excess weight among potential mothers and the development of CHD and the strong association between maternal obesity and development PDA. (Banhidy et al., 2010) also, agree with our study in founding that DM has been associated with PDA. In agreement with our results, (Tandon et al., 2010) identified that there was a positive significant association (p<0.05) between maternal infection and PDA.

The most important risk factors for developing a child with Fallot tetralogy: Our study revealed by logistic regression (Table 5) that the most important risk factor for developing a child with Fallot was maternal hypertension (p=0.00001) odds ratio (15.5).This is in agreement with (Caton et al., 2009) in USA who found positive significant (p<0.001) association between maternal HTN and occurrence of Fallot tetralogy

Conclusion

The most common type of congenital heart diseases was VSD followed by ASD, PDA, and then Fallot tetralogy. There was a positive significant association (p<0.05) between (consanguinity, maternal DM, maternal HTN, maternal infection, maternal smoking, maternal caffeine intake, maternal history of receiving medications and low birth weight) and occurrence of CHD, There were no cases of maternal SLE, maternal Epilepsy, maternal history of drug addiction and maternal alcohol consumption.

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