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Research Article

Profile Of Congenital Heart Disease (CHD) Patients In Cirebon, Indonesia: Maternal Passive Smoking Risk

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ABSTRACT

Background: Congenital heart disease (CHD) is the most common congenital disorder and a leading cause of infant mortality. Maternal pregnancy history is considered a potential risk factor for CHD. This cross-sectional study aimed to investigate the patient and maternal profile of CHD cases in Cirebon, Indonesia.
Methods: The study was conducted at Hasna Medika Cardiovascular Hospital from November 2019 to March 2020, and data were collected through questionnaires and medical records. The study included 28 CHD patients, of whom 57.1% were female, and most had acyanotic CHD (82.1%).
Results: None of the mothers had a history of active smoking, but all were exposed to passive smoking. Additionally, 17.9% of the samples had a history of fever during the first trimester, 17.9% took medication during pregnancy, and all consumed vitamins and supplements. Hormonal contraceptive failure accounted for 17.9% of CHD cases, while 7.1% of mothers had gestational hypertension. None of the mothers had gestational diabetes mellitus.
Conclusions: The study suggests that passive smoking may be closely related to CHD, but further research is needed to confirm this association. Therefore, it is crucial for pregnant women to avoid exposure to cigarette smoke. Health promotion programs that educate the public about the risks of smoking during pregnancy and infancy are highly encouraged.

Keywords : Congenital Heart Disease, Maternal Profile, Passive smoking, Pregnancy, Smoking.

INTRODUCTION

Congenital heart disease (CHD) is the most common type of congenital disease and the major cause of infant mortality worldwide.[1] Data for 2010-2017 estimated that the worldwide prevalence of CHD was 9.4 per 1,000 live births.[2] In Indonesia, CHD affects 8 per 1,000 live births.[3] Moreover, the impact of CHD on health cost, family finances, psychological well-being, and quality of life makes it a significant health issue.[4–6]

Although epidemiological studies found that genetic factors contribute to CHD, environmental exposure factors also play an important role in the development of CHD. Previous studies showed that maternal risk factors, such as infection, maternal smoking, and gestational diabetes mellitus, are associated with CHD. Other studies also showed that fetal factors, including premature birth, low birth weight, and stillbirth, have also been correlated with CHD. However, the modifiable risk factors for CHD are still not completely understood, making prevention efforts challenging.[7–9]

Data regarding patients and maternal profiles in CHD cases in Indonesia are still limited. Therefore, this study aims to find out the patients' and maternal profiles of CHD cases in Cirebon, Indonesia.

METHODS

This cross-sectional study was conducted at Hasna Medika Cardiovascular Hospital in Cirebon, Indonesia. All CHD patients who came to the outpatient clinic between November 2019 and March 2020 were eligible for inclusion in the study, regardless of whether they had previously been diagnosed or were newly diagnosed. Patients aged older than 18 years were excluded from the study.

Samples who met the criteria and whose parents agreed to participate in the study were asked to sign an informed consent. Primary data were collected through a questionnaire that asked about patients' baseline characteristics, parental information, and maternal history. Mothers were categorized as passive smokers if their husband or other household members smoked. Mothers who consumed vitamins and supplements were assumed to have received a sufficient intake of iron and folic acid during pregnancy.

Some secondary data were obtained from the patient's medical record, including basic patient data, Down syndrome diagnosis, and CHD types. The data were presented descriptively using tables and figure. This study received ethical approval from Health Research Ethics Committee (No. 043/LAIKETIK/KEPKRSGJ/XI/2019)

RESULTS

In this study, a total of 28 CHD patients were enrolled, with a majority of infants (53.6%) and females (57.1%). Most patients (82.3%) were a first or second child, and 3.6% had Down Syndrome, while 10.7% were born with low birth weight. A total of 92.9% of the samples used national health insurance, while 7.1% paid out of pocket. The parents of most patients had low education level (elementary school graduates, 42.9%), with fathers mostly

working as laborers and mothers as housewives. None of the CHD cases in this study had a family history of CHD or consanguine marriage. The baseline characteristics of the CHD patients are summarized in Table 1.

Table 1. Baseline characteristics of CHD patients

Characteristics	Frequency (n=28)	Percentage
Age		
Infant (1 month – 2 years)	15	53.6
Young child (2 – 6 years)	5	17.9
Child (6 – 12 years)	7	25.0
Adolescent (12 – 18 years)	1	3.6
Gender		
Male	12	42.9
Female	16	57.1
Birth Order		
1	10	35.7
2	13	46.6
3	3	10.7
4	2	7.1
Down Syndrome		
Yes	1	3.6
No	27	96.4
Birth weight		
Low birth weight	3	10.7
Normal	25	89.3
Health financing		
National health insurance	26	92.9
Private health insurance	0	0
Out of pocket	2	7.1
Mother's education level		
Elementary school	12	42.9
Junior high school	7	25.0
Senior high school	5	17.9
University	4	14.3
Mother's occupation		
Housewife	23	82.1
Laborer	2	7.1
Civil servant	2	7.1
Entrepreneur	1	3.6
Father's education level		
Elementary school	12	42.9
Junior high school	5	17.9
Senior high school	7	25.0
University	4	14.3
Father's occupation		
Laborer	11	39.3
Civil servant	5	17.9
Entrepreneur	10	35.7
Others	2	7.1

Characteristics	Frequency (n=28)	Percentage
Family history of CHD		
Yes	0	0
No	28	100
Consanguine marriage		
Yes	0	0
No	28	100

Note: CHD, congenital heart disease

Table 2 presents data regarding the maternal history of CHD patients. The mothers' age at delivery ranged from 19 to 41 years, with an average of 30 years. Approximately 21.4% of mothers were categorized as advanced maternal age (≥35 years old). None of the mothers had a history of active smoking, but all were exposed to passive smoking. Among the mothers, 17.9% took medication during pregnancy, and all consumed vitamins and supplements. About 17.9% of the mothers became pregnant due to hormonal contraception failure. In addition, 7.1% of mothers had gestational hypertension, 17.9% had a history of previous pregnancy loss, and none had gestational diabetes mellitus. Vaginal delivery was the most common method of delivery (78.6%), while 21.4% delivered by caesarean section. Approximately 14.3% of CHD patients were born preterm.

Table 2. Maternal history of CHD patients

Maternal History	Min-Max; Mean±SD	Types of CHD		
		Overall	Acyanotic	Cyanotic
Maternal age at delivery (years)	19-41; 30.14±5.29			
<35		22 (78.6)	17 (77.3)	5 (22.7)
≥35		6 (21.4)	6 (100)	0
Active smoking				
Yes		0	-	-
No		28 (100)	23 (82.1)	5 (17.9)
Passive smoking				
Yes		28 (100)	23 (82.1)	5 (17.9)
No		0	-	-
Fever during first trimester				
Yes		5 (17.9)	3 (60)	2 (40)
No		23 (82.1)	20 (87)	3 (13)
Took Medication				
Yes		5 (17.9)	4 (80)	1 (20)
No		23 (82.1)	19 (82.6)	4 (17.4)
Consumed vitamins and supplements		28 (100)	23 (82.1)	5 (17.9)
Yes		0	-	-
No				
Hormonal contraceptive failure		5 (17.9)	5 (100)	0
Yes		23 (82.1)	18 (78.3)	5 (21.7)
No				
Gestational hypertension				

Maternal History	Min-Max; Mean±SD	Types of CHD		
		Overall	Acyanotic	Cyanotic
Yes		2 (7.1)	2 (100)	0
No		26 (92.9)	21 (80.8)	5 (19.2)
Gestational Diabetes Mellitus		0	-	-
Yes		28 (100)	23 (82.1)	5 (17.9)
No				
History of pregnancy loss				
Yes		5 (17.9)	5 (100)	0
No		23 (82.1)	18 (78.3)	5 (21.7)
Delivery method				
Vaginal		22 (78.6)	18 (81.8)	4 (18.2)
Caesarean section		6 (21.4)	5 (83.3)	1 (16.7)
Gestational age				
Pre-term		4 (14.3)	4 (100)	0
Term		22 (78.6)	17 (77.3)	5 (22.7)
Post-term		2 (7.1)	2 (100)	0

The majority of CHD cases were classified as acyanotic type (n=23; 82.1%). Among male patients, the most common acyanotic type was atrial septal defect (ASD), followed by ventricular septal defect (VSD), patent ductus arteriosus (PDA), and complex acyanotic. In contrast, among female patients, the majority had ASD, followed by PDA, VSD, and complex acyanotic, respectively. The samples with cyanotic CHD in this study (17.9%) had more complex defects. The data are presented in Table 3 and Figure 1.

Table 3. Echocardiographic findings of CHD patients

Type of CHD	Echocardiographic finding	Frequency	%
Acyanotic	ASD	10	43.5
	PDA	7	30.4
	VSD	4	17.4
	Complex acyanotic	2	8.7
	Total	23	100
Cyanotic	RV hypoplasia with truncus arteriosus, PA	1	20
	DORV with PS, CAVSD	1	20
	Ebstein anomaly with PFO, VSD	1	20
	ToF	1	20
	ToF with ASD	1	20
	Total	5	100

Note: CHD, congenital heart disease; ASD, atrial septal defect; PDA, patent ductus arteriosus; VSD, ventricular septal defect; RV, right ventricular; PA, pulmonal atresia; DORV, double outlet right ventricle; PS, pulmonary stenosis; CAVSD, complete atrio-ventricular septal defect; PFO, patent foramen ovale; ToF, tetralogy of fallot.

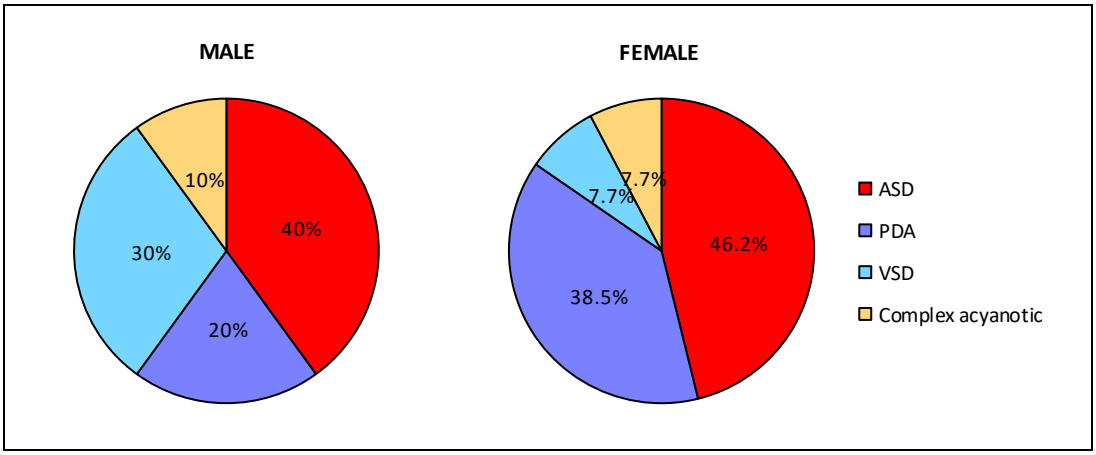

Figure 1. Proportion of acyanotic CHD types by gender.

Note: ASD, atrial septal defect; PDA, patent ductus arteriosus; VSD, ventricular septal defect.

DISCUSSION

The findings of this study showed that the majority of CHD patients were female (57.1%), while 42.9% were male. This result is consistent with a study conducted in Yogyakarta, Indonesia, where 60% of registered CHD patients were female.[10] Another study conducted in a central hospital in Yogyakarta also found a higher proportion of female CHD patients (78.46%) than males, despite the sample consisting of adult CHD patients.[11] However, some studies in other countries reported a higher prevalence of CHD in males than in females.[12,13]

Congenital heart disease can be classified into acyanotic and cyanotic types. A previous study indicated that the acyanotic type has a higher prevalence than the cyanotic type.[14] This study also obtained the same data that most CHD patients were acyanotic (82.1%). In this study, acyanotic CHD patients mostly were ASD, both in females (46.2%) and males (40%). These results may differ from those of other studies conducted in Indonesia or other countries.[12,15]

The data in this study showed that all patient's mothers received additional folic acid supplements during pregnancy. Several studies have shown that folic acid supplementation could prevent low birth weight and the incidence of CHD. Interestingly, the data in this study showed that 89.3% of CHD patients had normal birth weight. This finding suggests that other factors may also be associated with the incidence of CHD, in addition to folic acid supplementation and birth weight. Similarly, this study found that 78.6% of patients had a history of term birth, although other studies have shown an increased incidence of CHD in preterm infants. [16,17]. This study also found that 3.6% of patients had Down Syndrome. Previous studies have shown that many children with Down Syndrome have CHD.[18]

In this study, 17.9% of mothers got pregnant due to hormonal contraception failure. The chance of exposure to contraceptive drugs in early pregnancy is possible in women who are unaware of their pregnancy. In an animal study, it was found that exposure to estradiol may cause growth retardation, small gestational age, low birth weight, and increased level of retinoic acid, which plays a role in cardiac

malformations.[19] However, further research is required as a Danish registry found that exposure to oral contraceptives before or during pregnancy did not increase the risk of congenital defects.[20]

An important aspect of this study is the risk of smoking. None of the mothers were active smokers, but it is important to consider that maternal active smoking may be under-reported or concealed due to social norms and acceptance in Indonesia. So, the actual number of active and passive smokers may be higher than this study found. Parental active or passive smoking has been closely associated with an increased incidence of CHD, but maternal passive smoking has a more dangerous impact than maternal active smoking.[21] Unfortunately, data on the frequency of cigarette smoke exposure during pregnancy were unavailable in this study.

This study found that both the duration and frequency of cigarette smoke exposure were associated with an increased incidence of CHD in infants.[22] Cigarette smoke contains over 4,000 harmful compounds, of which approximately 70 are carcinogenic. However, the mechanisms by which cigarette smoke causes abnormalities in fetuses are not fully understood. Some hypotheses suggest that nicotine and carbon monoxide, which are major components of cigarette smoke, can cross the placental barrier and cause vasoconstriction of placental vessels and fetal hypoxia. Animal studies have shown that chronic fetal hypoxia inhibits fetal heart maturation, while nicotine can block the expression of several genes that play a crucial role in fetal heart growth. Additionally, exposure to cigarette smoke can disturb the DNA in spermatozoa and oocytes, predisposing them to congenital anomalies.[23] Gene-environment interactions are also thought to be related to the occurrence of CHD. For example, polymorphisms in the gene coding for methylenetetrahydrofolate reductase are thought to influence the increased risk of CHD in females exposed to cigarette smoke.[24] Exposure to cigarette smoke, apart from being obtained from the father, can also be obtained from the environment such as school, workplace or other things known as environmental tobacco smoke (ETS). Maternal exposure to ETS during the first trimester may increase the risk of CHD in the offspring.[25-28].

The study acknowledges the possibility of recall bias and recommends conducting further research at higher cardiovascular service referral centers and over a longer period of time to obtain a larger sample size.

CONCLUSIONS

Based on this study, it is concluded that passive smoking might increase the risk of having CHD in the infant. It is recommended that pregnant women avoid contact with cigarette smoke, and smoking fathers should stop smoking. Public health promotion regarding the dangers of smoking to pregnancy and infants needs to be encouraged.

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CONFLICT OF INTEREST

The researchers state that there is no conflict of interest in this study.

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