

# Comparison of Congenital Heart Disease between Neonates Born to Diabetic and Non-diabetic Mothers

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## Abstract:

**Background:** Congenital heart disease (CHD) contributes about one-third of all major congenital anomalies in the world among the neonates, most common in infants of diabetic mothers but incidence is increasing all over the world due to establishing cardiac investigation facilities especially neonatal echocardiogram.

**Materials & Methods:** A hospital-based cross-sectional study was done in two private hospitals in Dhaka from July '19 to June '20. A total of 90 neonates were included from nursery and neonatal intensive care units of both hospitals who were requested for echocardiography as suspected CHD.

**Results:** In our study 52% mothers had diabetes mellitus (DM) during this conception and remains were normoglycemic. CHD present in 41.11% non-DM & DM

mother's offspring, there was no significant statistical difference among the groups ( $p=0.535$ ). Gestational age and maternal coexisting diseases caused little impact on CHD in neonates ( $p < 0.1$ ). Regarding neonatal conditions only respiratory distress was significantly associated with CHD at  $p < 0.05$  level.

**Conclusions:** Researcher according to our study diabetes mellitus does not contribute to CHD in neonates. Researcher can focus on other maternal comorbidities and other factors like respiratory distress and cyanosis after birth, which may contribute to CHD in neonates.

**Key words:** congenital heart disease, diabetic mother, gestational diabetes, echocardiogram.

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## Introduction:

Congenital heart disease (CHD) is the most frequent type of neonatal birth defect in the world which is often discovered later in life.<sup>1</sup> It contributes about one-third of all major congenital anomalies<sup>2</sup>. The incidence of CHD varies from 4 to 50 per thousand live births. It is a relatively crucial form of CHD that causes stillbirth, spontaneous abortion and prematurity<sup>3-5</sup>. Nowadays CHD is one of the major causes of infant mortality in developing countries<sup>2</sup>. CHD incidence is increasing all

over the world due to establishing cardiac investigation facilities specifically upgraded by neonatal echocardiogram over the last fifty years<sup>6,7</sup>. There is no nationwide survey on congenital heart disease in the neonatal age group in Bangladesh. According to different studies, the incidence of CHD is around 18 per thousand in Bangladesh, 15% in India, and 10% in Sri Lanka<sup>7-9</sup>. There are 80% lesions contribute due to ventricular septal defect (36%), atrial septal defect (5%), patent arterial duct (9%), pulmonary stenosis (9%), aortic stenosis (5%), coarctation of aorta (5%), transposition of great arteries (4%), and Tetralogy of Fallot (4%)<sup>6,7</sup>.

CHD is a multifactorial disease having a group of genetic and environmental predisposition<sup>10</sup>. The incidence of congenital heart disease is most common in Down's syndrome, infants of diabetic mother, maternal history of rubella infection, drug abuse or alcohol consumption, maternal obesity and some environmental issues like pollution, use of pesticides in fields or preservatives in foods<sup>1</sup>. Diabetic mother's offspring have fivefold more incidence of congenital malformation in comparison to nondiabetic mothers<sup>11</sup>. Prevalence of gestational diabetes mellitus increases in recent studies about 10 to 100% irrespective of race and ethnic status<sup>11</sup>. There is

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no definite information regarding CHD and identification of associated factors regarding diabetic and nondiabetic mothers. In this study, we investigate whether the neonates of diabetic mothers have higher frequency of CHD in comparison to neonates of non-diabetic mothers.

#### **Method:**

This is a cross sectional prospective study, done in two hospitals (Bangladesh Institute of health science, BIHS and Universal Medical College Hospital, UMCH) in Dhaka, Bangladesh. A total of 90 neonates were included from nursery and NICU of both hospitals with clinical suspicion of CHD. Echocardiography was done by a pediatric cardiologist after delivery irrespective of diabetic and nondiabetic mothers. Mothers of these neonates were included in this study and their glycemic status was recorded.

Neonates with other congenital anomalies were excluded from the study like cleft lip & palate, Down's syndrome, mothers had history of suffering from TORCH infection where heart disease is an associated condition.

Selection of study subjects was done by convenient sampling and inclusion criteria was dependent on the neonates with prolonged oxygen requirement, need resuscitation during deliveries, precordial murmurs, having cyanosis, or history of maternal diabetes or GDM who were going for echocardiogram.

The study was carried out from July 2019 to June 2020. Data was collected by structured questionnaire from interviewing mother and medical records of neonates. Data were summarized in table, bar diagrams, categorical data were presented by frequency (percentage), continuous data were presented as mean  $\pm$  standard deviation and chi square test. Logistic regression analysis was done to determine potential factors associated with isolated congenital heart disease. SPSS version 16 was used for statistical analysis and  $p$ -value  $< 0.05$  was considered as statistically significant.

Ethical clearance was obtained from the Ethical Committee at American International University Bangladesh, and permission was taken from both the hospitals. Informed consent was taken from parents or caregivers of the enrolled neonates.

#### **Results:**

Socio demographic characteristics of both diabetic and nondiabetic mothers are nearly similar in our study, there is no significant difference among the groups. Confounding factors like foetal loss/abortion/previous neonatal death or complicated labor were similar in both groups. Regarding maternal occupation, service holder means sedentary workers were more prone to develop diabetes, but others had no such difference. Maternal occupational status also reflects the alertness, social conditions, and economic background of enrolled mothers. Among them 98% came for antenatal checkup before delivery, number of checkups were variable but similar in both groups.

In our study, mothers of enrolled neonates were suffering from different types of associated conditions during the pregnancy period. 40% mothers were suffering urinary tract infection (UTI), 24.44% mothers had anemia, 4.44% heart disease, 3.33% chronic disease (asthma, liver disease, epilepsy) or hypothyroidism and 2.22% mothers had renal disease like CKD or AKI (Figure 1).

Regarding glycemic status during the current pregnancy, 52% mothers were suffering from diabetes mellitus including gestational diabetes and the rest were free from this type of illness. In both groups 41.11% offspring had congenital heart disease (CHD) according to echocardiography findings. According to Pearson's chi-square test  $p$ -value is 1.251 which is not significant at 0.05 level (0.535) (Figure 2,3). So, CHD in neonates was not only associated with maternal diabetes.

In our study, both diabetic & non-diabetic mothers' neonates suffered from different types of congenital heart disease. But CHD in the form of PDA with PPHN & ASD, PDA with PPHN was higher in diabetic mothers' neonates (Figure 4).

According to logistic regression analysis, our study population showed that maternal age, weight, number of pregnancies had no significance on CHD detection. Gestational age and maternal coexisting diseases caused little impact on CHD in neonates ( $p < 0.1$ ) (table 2). Regarding neonatal conditions, respiratory distress was significantly associated with CHD at  $p < 0.05$  level (Table 3).

**Table-I***Characteristics of the mothers of the enrolled neonates (n=90)*

Maternal variables	Mean $\pm$ SD	
	DM	Non-DM
Maternal age (years)	30.26 $\pm$ 5.47	26.44 $\pm$ 6.25
Weight in recent pregnancy (kg)	56.11 $\pm$ 8.8	52.12 $\pm$ 9.35
Number of pregnancies	2.32 $\pm$ 1.13	1.84 $\pm$ 0.99
No of antenatal checkup in current pregnancy	4.89 $\pm$ 1.9	4.21 $\pm$ 2.7
gestational age at birth (weeks)	35.06 $\pm$ 2.8	35.7 $\pm$ 3.7
Hypertension in current pregnancy	1.5 $\pm$ 0.5	1.8 $\pm$ 0.4
Events in previous pregnancy	1.7 $\pm$ 0.97	1.7 $\pm$ 0.97
Foetal loss/ abortion/ neonatal death		
Hypertension in pregnancy		
Other problem like complicated labor		
<b>Maternal occupation</b>		
Service (office)	24%	14%
Housewife	36%	42%
Teacher	23%	28%
Doctor	10%	6%
Others	7%	10%

**Table-II***logistic regression analysis regarding CHD and maternal characteristics*

Variables	Odds ratio	p-value	SE	95% CI	
				Upper	Lower
Maternal age at the time of delivery	1.016	.895	.121	.80	1.28
Maternal weight at the time of delivery	1.012	.870	.071	.88	1.16
Number of pregnancies /paras	1.443	.597	.694	.37	5.62
Events in previous pregnancy(Foetal loss, abortion)	1.869	.290	.591	.59	5.95
Gestational age during delivery	2.544	.062	.500	.95	6.78
Coexisting diseases of mother (UTI, anemia, hypertension, hypothyroidism, renal disease)	1.728	.071	.303	.95	3.12

**Table-III***logistic regression analysis regarding CHD and neonatal presentations*

Variables	Odds ratio	p-value	SE	95% CI	
				Upper	Lower
Presence of neonatal respiratory distress	44.81	.044*	1.89	1.10	16.6
Presence of cyanosis after birth	.311	.179	.869	.06	1.71
Need of resuscitation during delivery	4.358	.377	1.66	.17	114.34

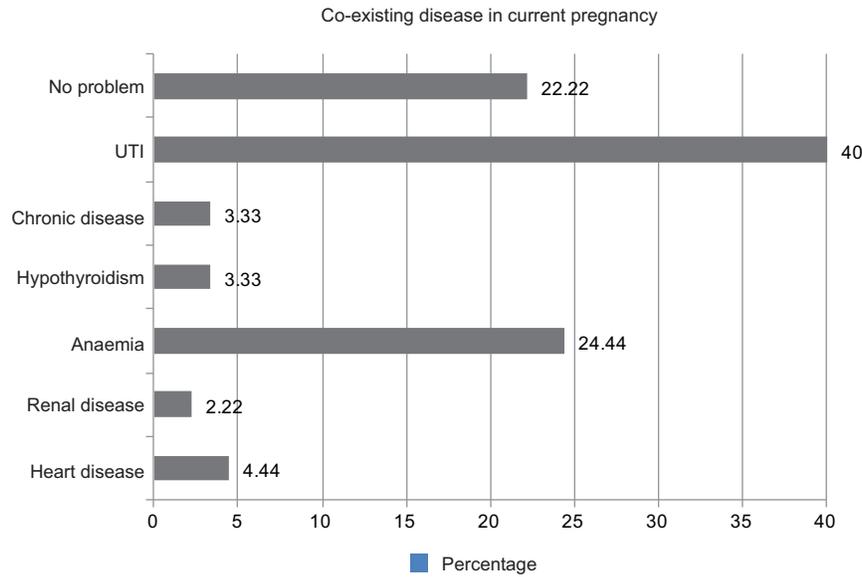


Fig.-1: Maternal co-existing diseases in current pregnancy

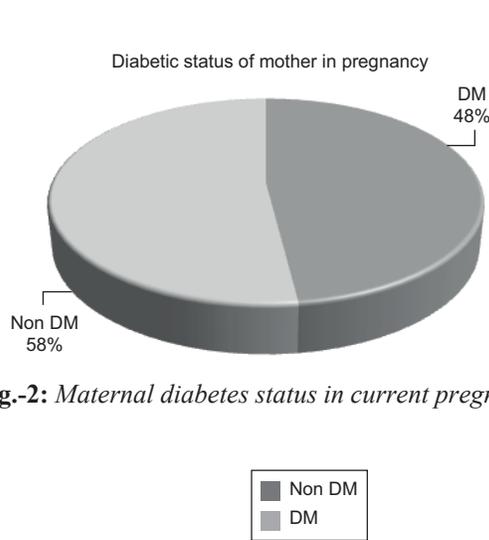


Fig.-2: Maternal diabetes status in current pregnancy

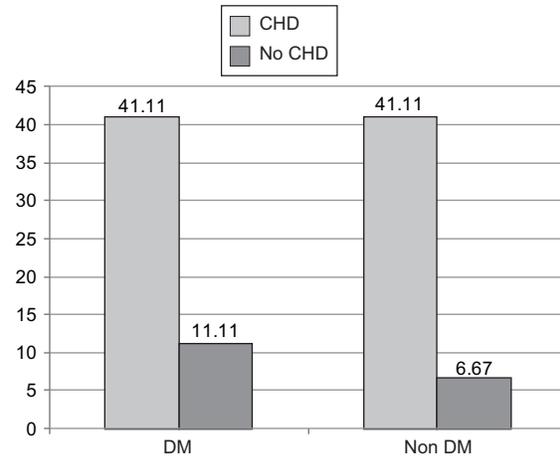


Fig.-3: Relationship between CHD & Diabetes status of mothers in current pregnancy

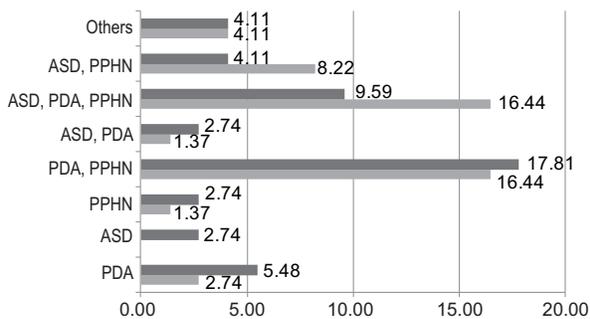


Fig.-4: Pattern of congenital heart disease in relation to diabetes status of mothers

**Discussion:**

Congenital heart disease is a major cause of morbidity and mortality in the infant period. Progression of disease condition affects the quality of life during childhood. In Western Europe, 45% of infant death were due to CHD<sup>1</sup>. Echocardiogram is a screening tool for early detection of CHD in the asymptomatic period after birth<sup>1</sup>.

Many studies showed maternal diabetes, hypertension had an impact on CHD<sup>3,12,13</sup> but according to our study neonatal CHD was not dependent upon maternal glycaemic status. Previous study shows high prevalence

of CHD below 20 years of maternal age (42.6%) & above 35 years (40.5%)<sup>2</sup>. Studies carried out in Ethiopia and Pakistan noticed no association between presence of CHD and maternal diseases<sup>2</sup>.

Nowadays, gestational diabetes is detected by prenatal checkup. Most pregnant women visit health care personnel as availability of community clinics in rural levels. Awareness, care & control of blood sugar reduces incidence of CHD<sup>14</sup>. Literally, hyperglycemic mothers are more conscious than non diabetic mothers and they come in regular antenatal checkup several times. Maternal occupation plays another big role in awareness and coming for repeated follow-up, early detection of complications & taking treatment.<sup>14</sup> A little bit large percentage of mothers (24%) who were service holder in office are prone to develop diabetes as sedentary workers.

A study in Sudan was reported, common congenital heart disease was VSD (33.4%)<sup>2</sup>. Similar findings were seen in China (29.9%)<sup>2</sup> and Ethiopia (30.9%)<sup>2</sup>. But in our study, we found higher percentage of PDA with PPHN (34.25%, 16.44% in infant of diabetic mothers & 17.81% among nondiabetic mothers). Recently Nazneen & Halima found 82% PPHN & 70% PDA in neonates which supported our study findings<sup>14</sup>. But discrepancy from Nazneen's study is probably due to premature baby or many neonates had multiple lesions like ASD, VSD, PDA. Gestational age at delivery was an issue of presence of CHD in form of PDA, ASD and different grade of PPHN.<sup>11,15</sup>

In our study, we found CHD was more common in neonates who had respiratory distress during or after delivery. Cyanosis and presence of respiratory distress after birth were strong suspicion for CHD in a previous study also<sup>15</sup>.

In the infant period, one of the major causes of morbidity and mortality is congenital heart disease which is diagnosed incidentally by echocardiogram during respiratory problem or heart failure.<sup>1</sup> Echocardiogram confirmed the type and existence of CHD in neonates. For early detection of CHD in the asymptomatic period after birth, echocardiogram is a best screening tool<sup>1</sup>.

Due to the small study population, only hospital delivered children were included in our study which does not represent our whole population. For further

comments it needs to do large scale study to detect association of CHD among neonates of both diabetic and nondiabetic mothers.

### Conclusions:

Maternal diabetes mellitus is an important factor of many neonatal conditions. But according to our study this does not contribute to CHD in neonates. Therefore, we can focus on other maternal comorbidities and search for other factors like respiratory distress and cyanosis after birth, which may contribute to CHD in neonates.

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