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# Prevalence of Congenital Heart Disease in Infants of Diabetic Mothers in Children Welfare Teaching Hospital

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**Abstract**
**Background:** Women with diabetes in pregnancy (type 1, type 2 and gestational) are at increased risk for adverse pregnancy outcomes which also include infant development of congenital heart disease and even fetal death. Adequate glycemic control before and during pregnancy is crucial to improve outcome.
**Aim of the study:** to observe the significance of the cardiac complication seen in new born of diabetic mother and its relation to glycemic control.
**Patients and methods:** This prospective study was conducted in the nursery care unit in children welfare teaching hospital from the period 1st of July 2014 till 30th of June 2015 where one hundred newborns of diabetic mother were collected and screened by echocardiography for congenital heart disease. Those mothers were classified according to White classification, and the babies were classified according to their maturity to (full term, pre term and post term), in reference to their mode of delivery (Spontaneous vaginal delivery or caesarian section) and to their body weight.
**Results:** One hundred newborns where collected, 61 male and 39 female. Male to female ratio was 1.5:1; 60% were normal with no cardiac complication, 40% had congenital heart disease, hypertrophic cardiomyopathy 23%, atrial septal defect 7 %, patent ductus arteriosus 3% and ventricular septal defect 2%, 1% Transposition of great arteries, 1% Trancus arteriosus, 1% Double outlet right ventricle, 1% Tricuspid atrasia and 1% coartication of aorta, it was found that there is a significant relationship between the type of diabetes of the mother and the development of congenital heart disease in infants (p value 0.02); the degree of glycemic control according to HBA1c of the mother and development of congenital heart disease in infants (p value 0.005); birth weight of the infants and the congenital heart disease (p value 0.023), death was reported in only 2%.
**Conclusions:** Hypertrophic cardiomyopathy was the most common type of congenital heart disease in infants of diabetic mothers. Most of infants of diabetic mothers were full term, delivered by caesarian section and their birth weights were more than 4 kg; Congenital heart disease in infants were more common in mothers with uncontrolled diabetes during pregnancy. Pregestational diabetes mellitus mothers are more liable to deliver babies with congenital heart disease than those with gestational diabetes mellitus.
**Keywords:** Congenital heart disease, Hypertrophic cardiomyopathy, Type 1 diabetes, Type 2 diabetes, Gestational diabetes.

## INTRODUCTION

Women with diabetes in pregnancy (type 1, type 2 and gestational) are at increased risk for adverse pregnancy outcomes. Adequate glycemic control before and during pregnancy is crucial to improving outcome (KLIGEMAN *et al.* 2016). Diabetic mothers have a high incidence of polyhydramnios, preeclampsia, pyelonephritis, preterm labor, and chronic hypertension; their fetal mortality rate is greater than that of non- diabetic mothers, especially after 32 weeks of gestation (ALSWEILER *et al.* 2012). Fetal loss throughout pregnancy is associated with poorly controlled maternal diabetes (especially ketoacidosis) and congenital anomalies. Most infants born to diabetic mothers are large for gestational age (KLIGEMAN *et al.* 2016). If the diabetes is complicated by vascular disease, infants may be growth restricted, especially those born after 37 week of gestation. The neonatal mortality rate is >5 times that of infants of non- diabetic mothers and is higher at all gestational ages and in every birth weight for gestational age category (ALSWEILER *et al.* 2012). Also the related pathologic findings are hypertrophy and hyperplasia of the pancreatic islet β cells, increased weight of the placenta and infant organs except for the brain, myocardial hypertrophy, increased amount of cytoplasm in liver cells, and extramedullary hematopoiesis (CROWTHER *et al.* 2005; KLIGEMAN *et al.* 2016). The fetal heart is threatened in a double fashion. First, at the beginning of gestation, the disease has a teratogenic effect, cardiogenesis is impaired in the correct expression of genes coding for the cardiac development. Early prenatal cardiac screening between 12 and 16 weeks gestation is generally advised to detect these pathologies. The incidence of cardiac malformations is 3–6% of the offspring, five times higher than in normal pregnancies and frequently includes complex lesions. Second, starting at the end of the second or beginning of the third trimester, the fetus may be affected by pathological ventricular hypertrophy (PVH), commonly referred as hypertrophic cardiomyopathy. Additional echographic investigation is required at the third trimester of gestation. PVH is characterized by an enlargement of heart; more precisely, a

 

disproportionate hypertrophy of septum and/or ventricular free walls (RAYBURN 1997; ULLMO *et al.* 2007). The cardiomegaly is common (30%), and heart failure occurs in 5-10% of infants of diabetic mothers. Asymmetric septal hypertrophy may occur and may manifest like transient idiopathic hypertrophic subaortic stenosis. Congenital heart disease is more common in infants of diabetic mothers (WAY *et al.* 1979). The aims of the current study were to study the presence of congenital heart disease in infants of diabetic mother and use echocardiography for screening and to identify the relationship between the type of maternal D.M and its glycemic control with the development of CHD in her infant.

**PATIENTS AND METHODS:**

This cross sectional prospective study was conducted in the Nursery Care Unit in Children Welfare Teaching Hospital from the period of 1st of July 2014 till 30th of June 2015 where one hundred newborns of diabetic mother were collected and screened by echocardiography for congenital heart disease, the mothers were classified to its diabetes according to white classification, type of diabetes whether gestational diabetes mellitus (GDM) or pre gestational diabetes mellitus (PGDM), type of treatment (no treatment, diet, oral hypoglycemic agents or insulin) and glycemic control of the mothers according to HBA1c (controlled, fair control or poorly controlled), the babies were grouped according to their maturity to full term (gestational age 37 – 42 weeks ) pre term (less than 37 weeks ) and post term ( more than 42 weeks), and in reference to their mode of delivery (Spontaneous vaginal delivery or caesarian section ) and to their body weight into less than 2.5 kg, 2.5 – 4 kg and more than 4 kg.

**Electrocardiography:**

Echocardiography was done to all newborns irrespective to their clinical symptoms by experienced pediatric cardiology specialist using M-mode and two dimensional echocardiography that performed with mechanical sector scanner of 3 & 5 MHz .on Echo septal hypertrophy was diagnosed according to chart of pediatric Echo dimension.

**Statistical analysis:**

Statistical analysis was done using IBM SPSS programs version 22. Chi square test was used for categorization variables; t test and ANOVA for continues variables, P value less or equal to 0.05 considered as significant.

**RESULTS:**

Among 100 newborns of diabetic mothers there were 61 male and 39 female with a male to female as shown in figure 1 and table 1

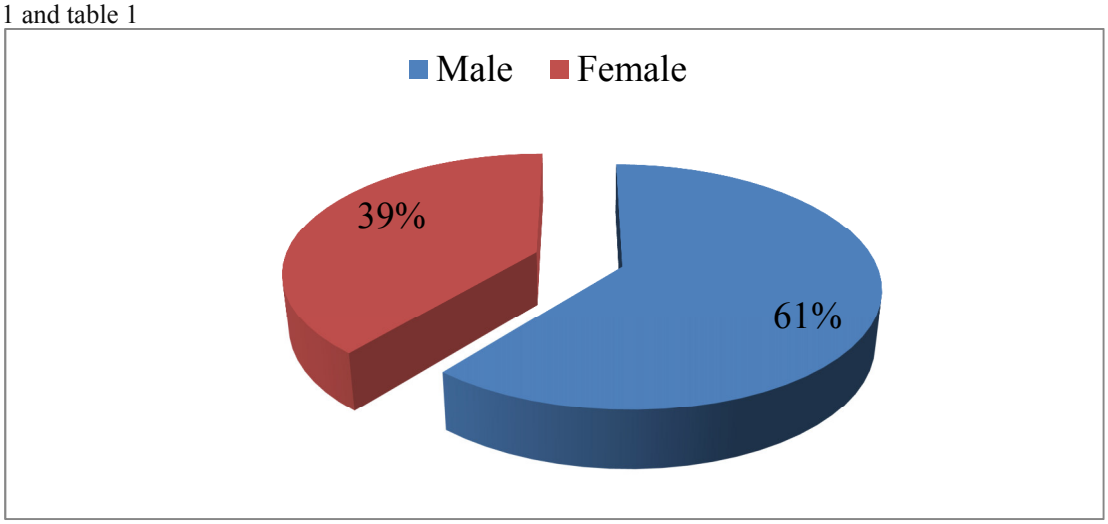


Figure 1: Distribution of infants according to gender

The most common mode of delivery in this study was elective cesarean section 49 mother while the emergency cesarean section was 38 mother and there were only 13 mother with spontaneous vaginal delivery as shown in figure 2 and table 1.

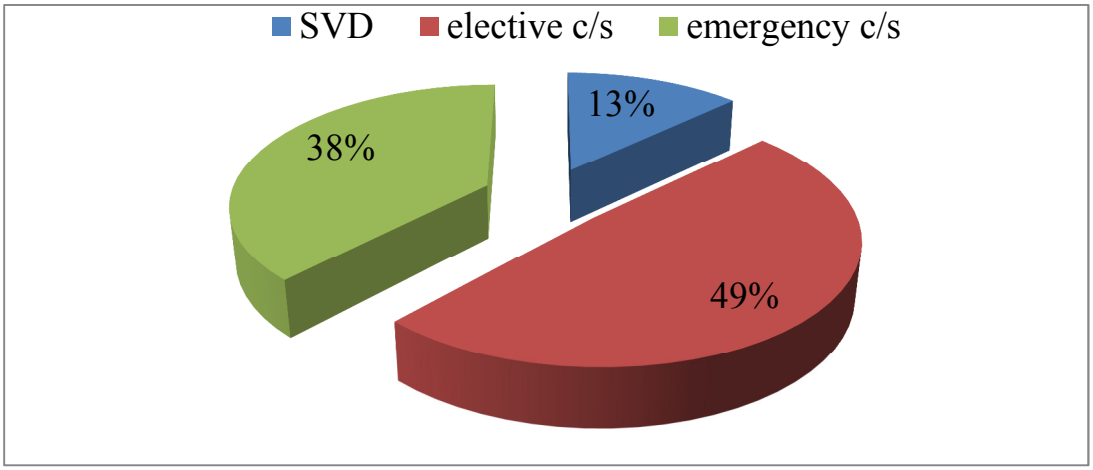


Figure 2: distribution of infants according to mode of delivery

In the current study 60 infants were macrocosmic > 4 kg and 32 infants their weight between 2.5 – 4 kg, and there were 8 infants that their weight below 2.5 kg. as shown in figure 3 and table 1.

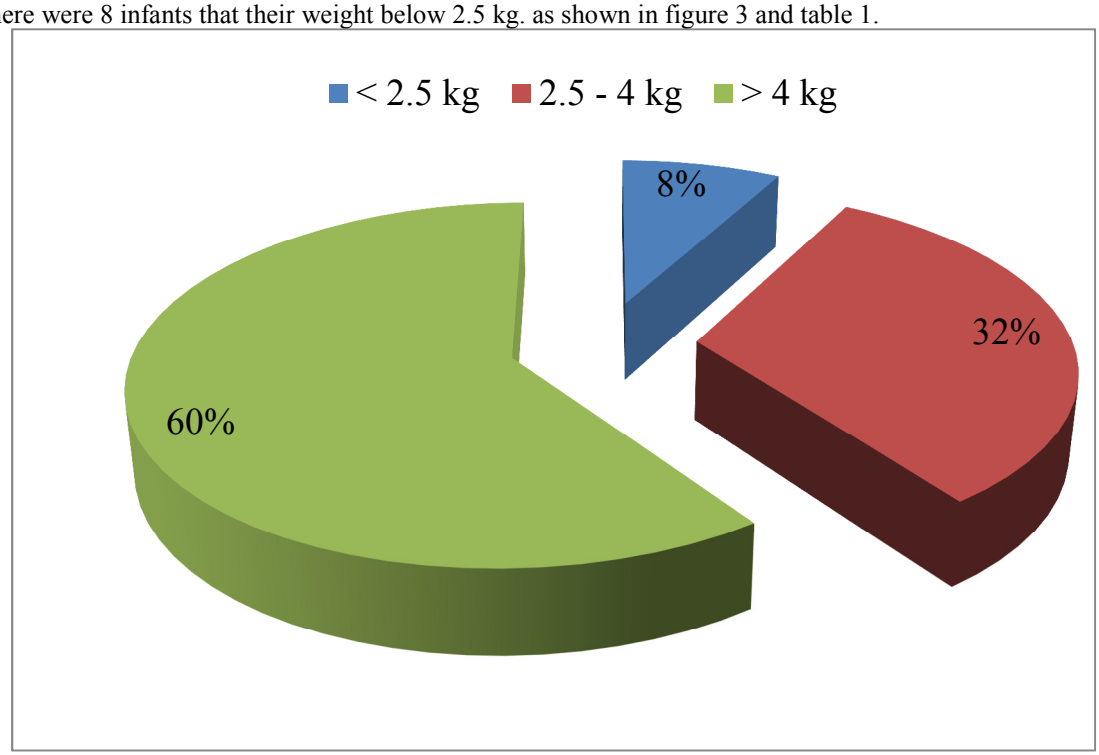


Figure 3: Distribution of infants according to birth weight

In the current study, 80 infants were full terms, 18 infants were pre-term and only 2 infants were post-term as shown in figure 4 and table 1.

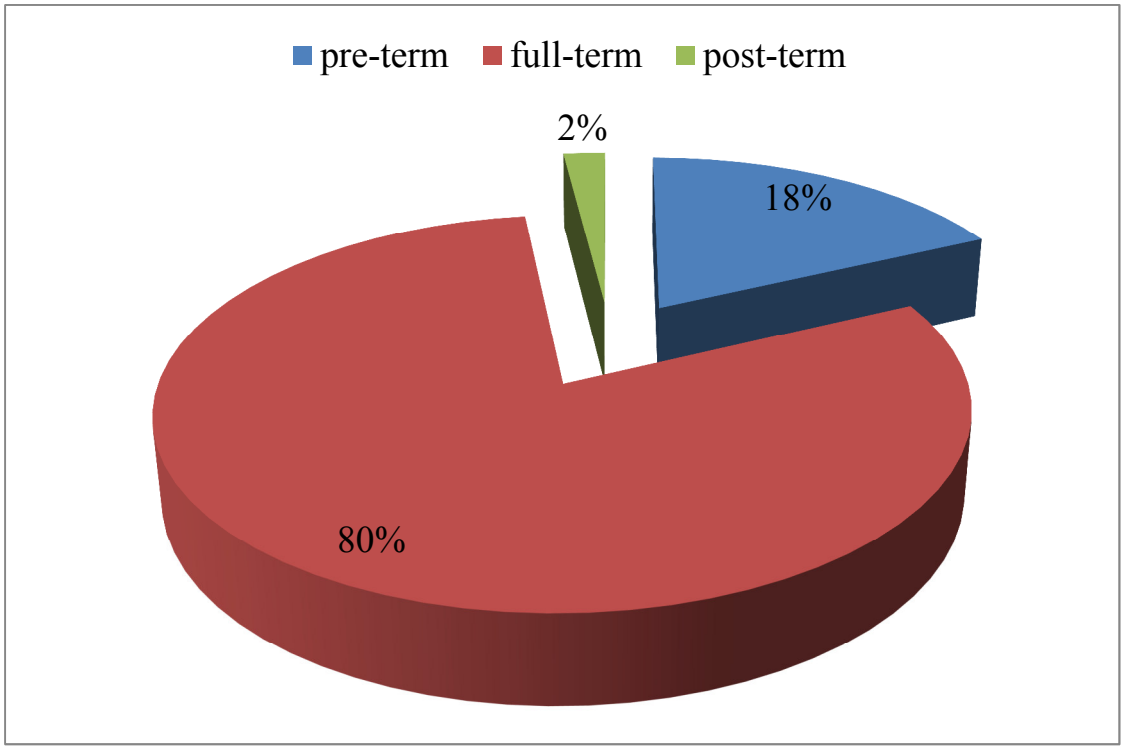


Figure 4: Distribution of infants according to birth maturity

**Table 1 characteristic of 100 infants of diabetes mother**

| | Criteria | no.(%) | Total |
|---|---|---|---|
| Sex | Male | 61 (61%) | 100 |
| | Female | 39 (39%) | |
| Mode of delivery | SVD | 13 (13%) | 100 |
| | elective c/s | 49 (49%) | |
| | emergency c/s | 38 (38%) | |
| Birth weight | < 2.5 kg | 8 (8%) | 100 |
| | 2.5 - 4 kg | 32 (32%) | |
| | > 4 kg | 60 (60%) | |
| Birth maturity | pre-term | 18 (18%) | 100 |
| | full-term | 80 (80%) | |
| | post-term | 2 (2%) | |

Among the mothers, 49 mothers were treated by insulin, 32 mothers with no treatment, 18 mothers with diet control and only 1 mother on oral hypoglycemic agents as shown in table 2**.**

**Table 2: Distribution of the study sample according to type of treatment**

| Type of treatment | No. | PERCENTAGE |
|---|---|---|
| Insulin | 49 | 49% |
| no treatment | 32 | 32% |
| diet control | 18 | 18% |
| oral hypoglycemic agent | 1 | 1% |
| Total | 100 | 100% |

In the current study about 60 infants were normal and 40 infants had congenital heart disease as shown in figure 5.

 

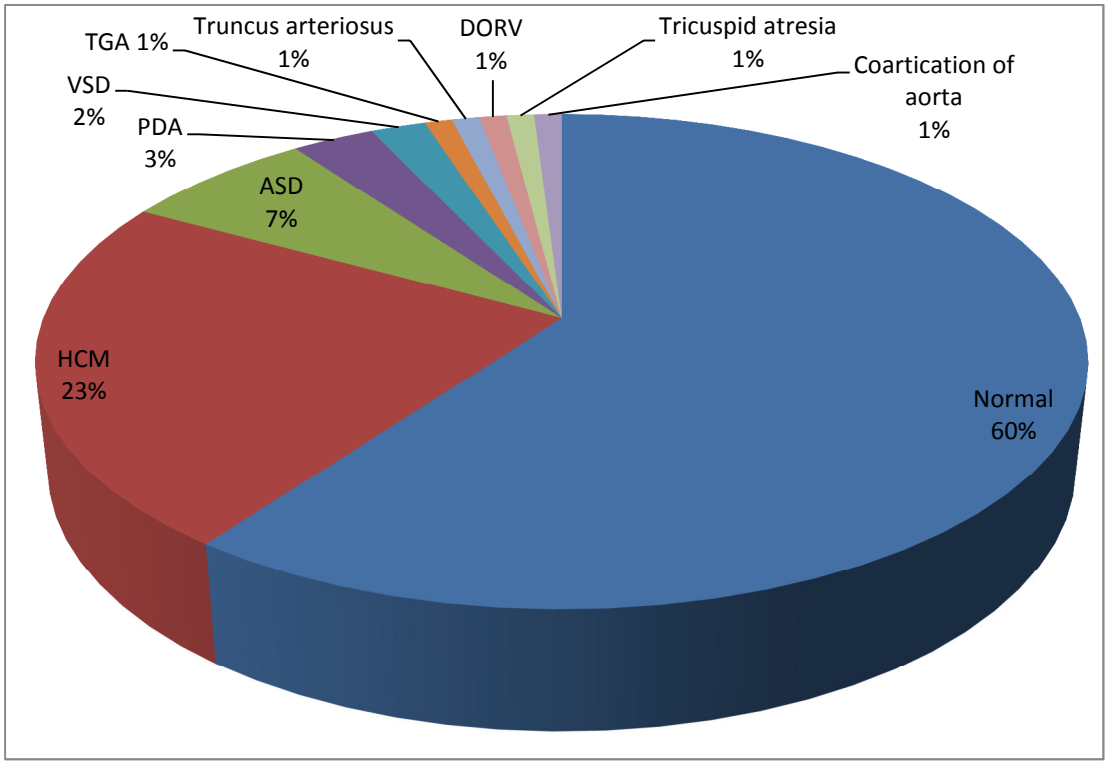


Figure 5: Distribution of the study sample according to Echocardiography

The most common type of diabetes mellitus in the mothers was GDM 66 mothers while the PGDM accounted for 34 mothers as shown in table 3. Out of 60 patients who returned with HbA1c result: 25 (42%) were good controlled (HbA1c 6%-7.5%), 35 (58%) were uncontrolled: 10 (16.6%) fairly controlled (HbA1c 7.6% – 9.9%) and 25 (41.4%) poorly controlled (HbA1c ≥ 10 %) as shown in table 3. It was found that there is a significant relationship between the incidence of congenital heart disease and the uncontrolled DM (p value 0.005) as shown in the table 3. Also it was found an increase in the incidence of CHD in the PGDM compared with GDM (P value 0.020) as shown in table 3. There was a significant relationship between the increase in the birth weight and the incidence of CHD (P value 0.023) as shown in the table 3.

**Table 3: Association between congenital heart disease and risk factor in IDM**

| | variable | CHD | Normal | Total | | | p value |
|---|---|---|---|---|---|---|---|
| Control | controlled | 6 (24%) | 19 (76%) | 25 (42%) | | 60 | 0.005 |
| | uncontrolled | 21 (60%) | 14 (40%) | 35 (58%) | Fair 10 (16.6%) | | |
| | | | | | Poor 25 (41.4%) | | |
| Type | GDM | 21 (31%) | 45 (68%) | 66 (66%) | | 100 | 0.020 |
| | PGDM | 19 (55%) | 15 (44%) | 34 (34%) | | | |
| birth weight | < 2.5 kg | 0 (0%) | 8 (100%) | 8 (8%) | | 100 | 0.023 |
| | 2.5 - 4 kg | 11 (34%) | 21 (65%) | 32 (32%) | | | |
| | > 4 kg | 29 (48%) | 31 (51%) | 60 (60%) | | | |

Significance at <0.05

**DISCUSSION:**

Type 1 diabetes was generally thought to be prevalent in 0.5% of pregnancies, but recent publications indicate that this percentage is increasing during the last two decades, mainly because of an expanding number of young patients developing type 2 diabetes (ULLMO *et al.* 2007).

In the current study 60 % of infant of diabetic mother were normal, while 40% of infants were found with CHD, which is seems to be agree with *Haider Shirazi et al* (HAIDER SHIRAZI *et al.* 2010), that showed infants with CHD was 32% ,but it is seems to be disagree with *Ullmo et al* (ULLMO *et al.* 2007), that showed infants with CHD was18%, *M. Mayer et al* (MEYER-WITTKOPF *et al.* 1996), that showed infants with CHD was 3.1% and *G Haider et al* (HAIDER G *et al.* 2009), that showed infants with CHD was 1.8%.

The most common type of congenital heart disease was hypertrophic cardiomyopathy (HCM) 23% while , ASD 7%, PDA 3%, VSD 2% and 1% for each of TGA, Trancus arteriosus, double outlet right ventricle, Tricuspid atrasia and Coarctation of the aorta. Which is seems to be agree with *Ullmo et a,l* that showed HCM

 

13% and 1% for each of DORV, VSD,TOF and ASD (ULLMO *et al.* 2007). Regarding the type of D.M. in mothers , it was observed that the most common type was GDM 66% while PGDM 34% which similar finding of *Haider Shirazi et al* (HAIDER SHIRAZI *et al.* 2010) in which GDM was 84% PGDM was 16%, *Ullmo et al* (ULLMO *et al.* 2007) in which GDM was 62% PGDM was 38% .

The high risk for CHD was present for newborns of mothers with PGDM as compared with GDM; this shows the offspring of mothers with a PGDM are at a significantly increased risk to develop CHD (p value 0.020).

The glycemic control during pregnancy depending on HbA1C found to be uncontrolled diabetes mellitus 58% and good controlled diabetes mellitus 42% which agree with *Haider Shirazi et al* (HAIDER SHIRAZI *et al.* 2010) in which uncontrolled D.M. was 58% and controlled D.M was 42%, and disagree with *Ullmo et al* (ULLMO *et al.* 2007) in which uncontrolled D.M. was 20% and controlled D.M. was 80%.

The degree of diabetic control during pregnancy (by measuring HbA1c level) shows a significant relationship with the incidence of CHD (P value = 0.005), CHD in uncontrolled DM (HbA1c above 7.5%) is significantly higher than that in good controlled DM (HbA1c 6%-7.5%). Despite of some diabetic mothers attending regularly the ante natal care, 58% of patients (that returned with result) had an HbA1c above the normal limit (7.5%), which emphasizes the difficulty of realizing good glycemic control—a fact that may be explained by technical difficulties to control diabetes, bad attendance in the follow-up during pregnancy, late discovery of GDM, non-compliance with diet and insulin treatment, and the late referral by gynecologist or endocrinologist for a specific high-risk multidisciplinary consultation, also the different socio-economical status and ethnicity may play a role (KLIGEMAN *et al.* 2016).

High birth weight (more than 4 kg) found to be 60% which disagree with *Haider Shirazi et al* (HAIDER SHIRAZI *et al.* 2010), that show high birth weight 15%; *Haider G et al* (HAIDER G *et al.* 2009), show high birth weight 41% ; *Ullmo et al* (ULLMO *et al.* 2007), show high birth weight 27% , this high incidence of high birth weight was due to poor glycemic control.

There was a significant relationship between the increase in the birth weight and the incidence of CHD (p value 0.023). About the sex distribution in this study , male 61% infants while female were 39% infants giving a ratio of about 1.5:1 which agree with *Haider Shirazi et al* (HAIDER SHIRAZI *et al.* 2010), that show a ratio of (1.3:1) and showed to be disagree with *Abu-Sulaiman et al* (ABU-SULAIMAN and SUBAIH 2004), that show a ratio of (1:1.1).

Regarding to the birth maturity; in this study there were 80% infants were full term and 18% infants were pre term and 2 % infants were post-term which agree with *Abu-Sulaiman et al* (ABU-SULAIMAN and SUBAIH 2004), that shows full term infants were 90% and 10 % infants were pre term, and *Haider Shirazi et al* (HAIDER SHIRAZI *et al.* 2010), that shows full term infants were 81 % and 19 % infants were pre term , and there were no post term infants in both studies.

The most common mode of delivery was caesarian section 87% , which is agree with *Ullomo et al* (ULLMO *et al.* 2007), that shows 61% caesarian section and *G.Haider et al* (HAIDER G *et al.* 2009), that shows 66% caesarian section but it is disagree with *Haider Shirazi et al* (HAIDER SHIRAZI *et al.* 2010), that shows 31% caesarian section, and these high incidence of caesarian section reflect the complicated pregnancy.

About the treatment of diabetic mothers the most common type of treatment was the insulin 49% while no treatment 32%, diet control 18% and oral hypoglycemic agent 1% and this result was agree with *Ullmo et al* (ULLMO *et al.* 2007) in which insulin treatment 81%, diet control 19% and agree with *Haider Shirazi et al* (HAIDER SHIRAZI *et al.* 2010) in which insulin treatment was 19 % and diet control was 81%, the high proportion of diabetic mother with no treatment in our study due to poor ante natal care and noncompliance of the therapy.

In conclusion, we conclude that the HCM was the most common type of CHD in infants of diabetic mothers, also the CHD was found to be more common in full term infants, delivered by caesarian section, macrosomic (weighing more than 4 kg), infant of mothers with uncontrolled D.M and with PGDM.

**REFERENCES:**

ABU-SULAIMAN, R. M., and B. SUBAIH, 2004 Congenital heart disease in infants of diabetic mothers: echocardiographic study. Pediatr Cardiol **25:** 137-140.

ALSWEILER, J. M., J. E. HARDING and F. H. BLOOMFIELD, 2012 Tight glycemic control with insulin in hyperglycemic preterm babies: a randomized controlled trial. Pediatrics **129:** 639-647.

CROWTHER, C. A., J. E. HILLER, J. R. MOSS, A. J. MCPHEE, W. S. JEFFRIES *et al.*, 2005 Effect of treatment of gestational diabetes mellitus on pregnancy outcomes. N Engl J Med.2486-2477 :352

HAIDER G, ZEHRA N and A. F, 2009 perinatal outcome in diabetic mothers at ISRA university hospital. Isra Med j **1:** 8-12.

HAIDER SHIRAZI, SADIA RIAZ and IQBAL MAHMOOD, 2010 Neonatal outcome of diabetic pregnancy. Ann. Pak. Inst. Med. Sci **6**.112-107 :

 

KLIGEMAN, SANTON and S. G. SCHOR, 2016 *Nelson textbook of pediatrics*.

MEYER-WITTKOPF, M., J. M. SIMPSON and G. K. SHARLAND, 1996 Incidence of congenital heart defects in fetuses of diabetic mothers: a retrospective study of 326 cases. Ultrasound Obstet Gynecol **8:** 8-10.

RAYBURN, W. F., 1997 Diagnosis and classification of diabetes mellitus: highlights from the American Diabetes Association. J Reprod Med **42:** 585-586.

ULLMO, S., Y. VIAL, S. DI BERNARDO, M. ROTH-KLEINER, Y. MIVELAZ *et al.*, 2007 Pathologic ventricular hypertrophy in the offspring of diabetic mothers: a retrospective study. Eur Heart J **28:** 1319-1325.

WAY, G. L., R. R. WOLFE, E. ESHAGHPOUR, R. L. BENDER, R. B. JAFFE *et al.*, 1979 The natural history of hypertrophic cardiomyopathy in infants of diabetic mothers. J Pediatr **95:** 1020-1025.