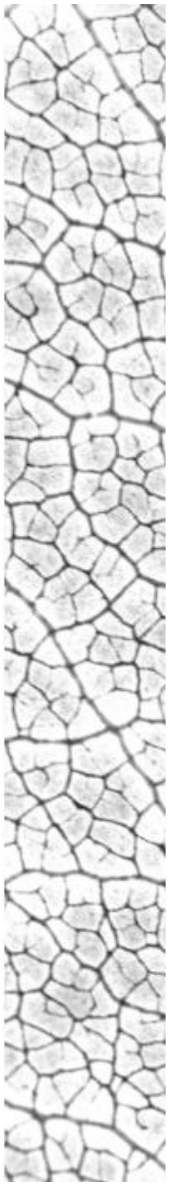

EurAsian Journal of BioSciences
Eurasia J Biosci 14, 1583-1588 (2020)

Maternal and infant outcomes of gestational diabetes mellitus and pregestational diabetes mellitus booked cases in maternity

Hermanto Tri Joewono [1*], Agus Sulistyono [1], Erliana [2], Aditiawarman [1]

[1] Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, Faculty of Medicine-Dr. Soetomo Teaching Hospital, Universitas Airlangga, Surabaya 60131, INDONESIA
[2] Department of Obstetrics and Gynecology, Faculty of Medicine-Dr. Soetomo Teaching Hospital, Universitas Airlangga, Surabaya 60131, INDONESIA
*Corresponding author: hermanto.tri@fk.unair.ac.id

Abstract
Gestational diabetes mellitus (GDM) and pregestational diabetes mellitus (PGDM) are closely related to an increased risk of morbidity and mortality in infants and mothers. The purpose of this study was to find out the trends, characteristics, and outcomes of mothers and infants in GDM and PDGM to the patients who gave birth. This was a cross-sectional descriptive-analytic research using secondary data from medical records of pregnant women with GDM and PGDM booked case who from 2013 to 2015. The prevalence of diabetes in pregnancy during the period 2013-2015 amounted to 6.97%. In patients with GDM and PGDM, outputs in the form of occurrence of eclampsia, sepsis, ruptured perineum grade III/IV, Diabetic Ketoacidosis (DKA), and maternal mortality were not obtained. The results showed that GDM with preeclampsia was in 9 patients with OR of 0.74. In PGDM outcomes, blood sugar was not controlled in 4 patients, while 13 patients obtained preeclampsia with OR of 3.76. With the blood sugar regulation and monitoring of fetal well-being, the complications and morbidity and mortality to the mother and the fetus can be avoided.

Keywords: gestational diabetes mellitus, pregestational diabetes mellitus, neonatal and maternal outcome

Joewono HT, Sulistyono A, Erliana, Aditiawarman (2020) Maternal and infant outcomes of gestational diabetes mellitus and pregestational diabetes mellitus booked cases in maternity. Eurasia J Biosci 14: 1583-1588.

INTRODUCTION

Diabetes mellitus (DM) is a metabolic disease characterized by chronic hyperglycemia and related to the dysfunction of pancreatic β-cells and oxidative stress (Pane et al. 2018). Over the coming year, the WHO expects a rise in the number of DM patients. It is also difficult to have a well-controlled DM condition because it requires lifestyle changes, such as improving dietary behaviors, maintaining optimum weight, exercising daily, and monitoring blood sugar independently (Firdiani et al. 2018). Type 2 diabetes mellitus (T2DM) increases morbidity and mortality of cardiovascular disease, including atherosclerotic complications (Roostarini et al. 2019; Tazhbenova et al., 2019).

Failure of long-term DM management may have significant negative health system consequences, such as a risk to health and serious economic impacts in time spent, incurable expenditures, and diseases. Indonesia predicted the number of patients 8.4 million in 2000 to 21.3 million in 2030 (Sweeting et al. 2016).

Pre-diabetes is an increasingly critical public health concern at present. Pre-diabetes prevalence is actually even higher than the prevalence of diabetes. The person who develops prediabetes, if he/she is not properly and appropriately treated, will become diabetic in several months or years (Soewondo et al. 2011).

Pregnant women are nutritionally vulnerable groups. Malnutrition in pregnant women causes complications for fetal growth, perinatal morbidity, and mortality. Fat metabolism during pregnancy is influenced by maternal hyperlipidemia and insulin resistance (Ernawati et al. 2018). Chronic hyperglycemia in diabetes is associated with long-term damage. The greatest impact on this condition is the increased morbidity and mortality of both mother and fetus. The biggest impact on this condition increases maternal and fetal morbidity and mortality (Albai et al. 2018). GDM causes hypertension in pregnancy by 28%, preterm birth by 28%, macrosomia by 45%, Intrauterine Growth Restriction (IUGR) by 5%, by 1%, and perinatal mortality by 1.7% (Cunningham

Received: September 2019
Accepted: March 2020
Printed: June 2020

F.Gary, Leveno Kenneth J., Bloom Steven L. 2010). The purpose of this study was to find out the trends, the characteristics and outcome for GDM and PGDM to the patients who delivered in Dr. Soetomo Surabaya, Indonesia from January 2013 to December 2015.

MATERIAL AND METHODS

This was a cross-sectional analytic descriptive study conducted at Dr. Soetomo Hospital, Surabaya, for pregnant women with GDM and PGDM who visited routinely in obstetric polyclinic and gave birth in the period of 2013 to 2015. There were 114 pregnant women diagnosed as GDM and 43 pregnant women diagnosed as PGDM who routinely visited obstetric polyclinic. Blood glucose levels were controlled by diet or by insulin. Fetal well-being was monitored by ultrasonography and cardiotocography.

The inclusion criteria of this study were all pregnant women who had booked case (visit >3 times) in Obstetric Polyclinic, Dr. Soetomo Hospital, Surabaya who was diagnosed as GDM and PGDM who gave birth in Dr. Soetomo Hospital from 2013 to 2015. GDM screening was carried out by a 2-step method for all pregnant women who visited at 24-28 weeks of gestation by performing an oral glucose challenge test (OGCT) with a load of 50 grams, and 1 hour afterward venous plasma glucose was measured. If a value of ≥135 mg% was obtained, a OGCT was performed with a load of 100 g, and fasting glucose was measured at hours 1, 2 and 3. If 2 numbers were exceeded, a diagnosis of gestational diabetes was established.

For pregnant women who had a high risk of developing GDM, screening was done early from the beginning of the visit. High risks include obesity, a history of GDM in a previous pregnancy, history of having a large baby, death or disability, the presence of cystic polyvarian syndrome, family history of DM, hypertension, and glucosuria.

PGDM is characterized as glucose intolerance, which is diagnosed by a physician before pregnancy. GDM is known as a physician's diagnosis of glucose intolerance during this pregnancy. In PGDM, the diagnosis is sufficient with history taking, i.e., a history of DM before pregnancy, the use of oral anti-diabetic (OAD) or insulin, so no screening is needed (Yang et al. 2019). In this study, women without the history of PGDM nor GDM were set as controls1. Dietary control was performed on all pregnant women with GDM. Total calories per day was calculated based on 35 calories/kgBB with the addition of 100 calories in the first trimester, 200 calories in the second trimester and 300 calories in the third trimester. The addition included 50-60% high carbohydrate fiber, 10-20% protein and 25-30% fat. Insulin therapy was started in pregnant women who were tested for GDP >105 mg/dl or blood glucose level 2 hours after eating >120 mg/dl with a target of fasting blood sugar levels of 60-90 mg/dl and 2 hours post-prandial <120 mg/dl. Diet B1 for GDM and KV Diet for PGDM (Cunningham F.Gary, Leveno Kenneth J., Bloom Steven L. 2010).

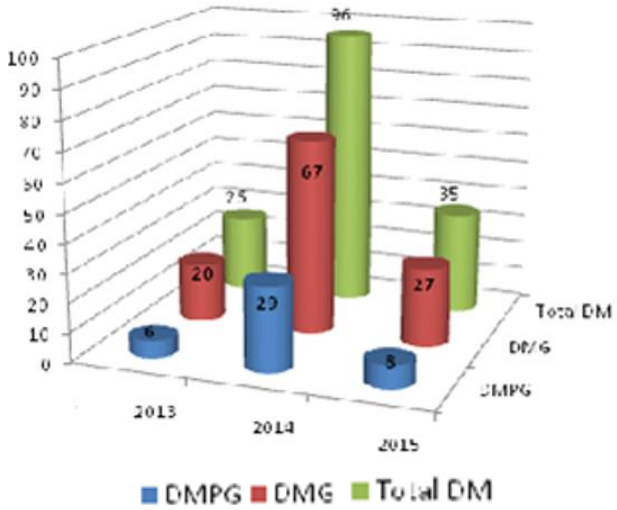

Fig. 1. Distribution of GDM and PGDM

Based on blood glucose levels, patients were managed in obstetric polyclinic and can also be hospitalized for blood sugar control. The insulin dose was adjusted according to the American Diabetes Association Criteria. Ultrasonography and monitoring of fetal well-being were carried out to determine abnormalities in the fetus. Basic laboratory tests were also carried out in the form of hemoglobin, leukocytes, platelets, HBsAg, complete urine, HIV screening. In theory, in the management of PGDM, we at HbA1C were examined for pregnancy, but because it was not covered by national health insurance, most HbA1C checks were not carried out. Every antenatal visit, which is carried out every 2 weeks or every week, checked for GDP and blood glucose level 2 hours after eating. Termination decisions were made at 39/40 mg of gestational age in GDM and 38/39 mg of PGDM in the mode of delivery (MOD) adjusted to obstetric indications (Sweeting et al. 2016).

RESULTS

Out of a total of 226 pregnant women with DM who had booked case and gave birth at Dr. Soetomo Hospital during the period 2013 to 2015, 69 patients did not give birth at Dr. Soetomo Hospital. The remaining 157 patients consisted of 114 GDM patients and 43 PGDM patients. Distribution by year was obtained consecutively since 2013-2015 in GDM 20-67-27 while PGDM 6-29-8 (**Fig. 1**).

Table 1 shows that the average age of women in GDM is 32.6 years and in PGDM is 34 years with the most groups age <35 years. Based on parity, the most multigravida was in GDM 75.4% and PGDM 76.7%.

Table 1. Characteristics of GDM and PGDM

Characteristics	GDM (n=114)	PGDM (n= 43)
Age (%)		
< 35	64 (56.1)	19 (46.2)
≥ 35	50 (43.8)	24 (55.8)
Mean	32.6 (6.22)	34 (8.43)
Parity (%)		
Primigravida	26 (22.8)	7 (1.63)
Multigravida	86 (75.4)	33 (76.7)
Grande Multi	2 (1.8)	3 (6.9)
BMI (%)		
Not Obese	95 (83.3)	27 (62.8)
Obesity grade I	12 (10.5)	7 (16.3)
Obesity grade II	2 (1.8)	5 (11.6)
Obesity grade III	5 (4.3)	5 (11.6)
Mode of Delivery (%):		
Abortion	2 (1.8)	2 (4.6)
Spontaneous Head	50 (43.8)	17 (39.5)
Extraction	0	0
Vacuum	0	0
Forceps Extraction	3 (2.6)	1 (2.3)
Spontaneous Bracht	0	0
Manual Aid CS	59 (51.8)	24 (55.8)
Termination Indication (%):		
Fetal	29 (55.4)	7 (16.3)
Mother	44 (38.6)	17 (39.5)
Time	23(20.2)	19 (44.2)
Spontaneous Birth (%)	18 (15.8)	1 (2.3)
Abnormal non-stress test (NST) (%)	10 (8.8)	2 (4.6)
BSC (%)	16 (14.0)	8 (18.6)
Chronic Hypertension (%)	1 (0.9)	1 (2.3)
Chronic Hypertension Severe Preeclampsia (%)	5 (4.38)	6 (13.9)
Mean of Childbirth Time (Weeks)	37.2	34.2
Mean of Weight Birth (gram)	2874.7	2596.3
Average of NICU Treatment (day)	2.28	2.87

Table 2. Maternal Outcomes in GDM and PGDM

Maternal Outcomes	GDM (n = 114)		PGDM (n = 43)	
	Σ	OR (p value)	Σ	OR (p value)
Uncontrolled Blood Sugar	0	-	4	-
Preeclampsia	9	0.74 (0.439)	13	3.76 (0.001)
Eclampsia	0	-	0	-
Urinary Tract Infection	1	3.67 (0.369)	2	20.24 (0.02)
Sepsis	0	-	0	-
Perineal Rupture	0	-	0	-
Regional Operating Infection	1	3.67 (0.369)	1	9.88 (0.18)
DKA	0	-	0	-
Mother's Death	0	-	0	-

Related to obesity, we obtained that GDM mothers were mostly obese grade I (10.5%) and non-obese (83.3%). Whereas, PGDM mothers were mostly obese grade I (16.3%) and non-obese (62.8%). The rate of Cesarean Section (CS) in GDM was 51.8% and in PGDM was 55.8%. The abnormal cases of NST was 8.8% in GDM and 4.6% in PGDM. GDM accompanied by chronic hypertension (HT), was 0.9% and by chronic HT severe preeclampsia was 4.38%, while PGDM accompanied by chronic HT was 2.3%, and by chronic HT severe preeclampsia was 13.9%. The termination time average in GDM was 37.2 weeks and in PGDM was 34.2 weeks. The mean weight of babies born was 2874 in GDM and 2596 in PGDM, with NICU length of stay of 2.28 days in GDM and 2.87 in PGDM.

GDM in **Table 2** does not show the incidence of uncontrolled blood sugar, eclampsia, sepsis, rupture of gr III/IV perineum, diabetic ketoacsurgery blood infectionsis (DKA), and maternal death. Nine cases of preeclampsia with OR of 0.74, 1 case of Urinary Track (UTI) with OR of 3.67, and 1 case of surgery blood infection with OR of 3.67 were obtained. In PGDM, there were no eclampsia, sepsis, gr III/IV perineal rupture, DKA, and maternal death. Four cases of uncontrolled blood, 13 cases of preeclampsia with OR of 3.76, 2 cases of UTI with OR of 19.76, 1 case of surgery blood infection with OR of 9.88 sugar were obtained.

Table 3. Infant Outcomes in GDM and PGDM

Infant Outcomes	GDM (n = 115)		PGDM (n = 45)	
	Σ	OR (p value)	Σ	OR (p value)
Severe Asphyxia	1	0.45 (0.46)	3	3.69 (0.06
Mild Asphyxia	6	1.88 (0.22)	2	1.58 (0.55)
Shoulder Dystocia	0	-	0	-
Macrosomia	6	3.26 (0.47	3	4.22 (0.04)
IUGR	0	-	2	0.89 (0.87)
Congenital Abnormalities	5	1.02 (0.97)	1	0.50 (0.52)
Abortion	2	1.84 (0.48)	2	4.84 (0.07)
IUFD	2	0.73 (0.68)	3	2.93 (0.11)
RDS	1	0.91 (0.94)	0	-
Hypoglycemia	1	0.25 (0.19)	3	2.07 (0.27)
Early Neonatal Death	1	0.28 (0.22)	1	0.71 (0.75)

Table 3 shows that infant outcomes GDM include severe asphyxia of 1 patient with OR of 0.45, moderate asphyxia 6 patients with OR of 1.08, macrosomia in 6 patients with OR of 3.26, congenital abnormalities in 5 patients with OR of 1.02, abortion and Intrauterine fetal Death (IUFD) in 2 patients and Respiratory Distress Syndrome (RDS), hypoglycemia and early neonatal death for 1 patient each. There were no events of shoulder dystocia and IUGR. In PGDM, infant outcomes included severe asphyxia in 3 patients with OR of 3.69, moderate asphyxi a in 2 patients with OR of 1.58, macrosomia, IUFD and hypoglycemia in 3 patients, IUGR and abortion in 2 patients, and congenital abnormalities and early neonatal death in 1 patient. There were no cases of shoulder dystocia and RDS.

DISCUSSION

Diabetes mellitus (DM) is a balance disorder between the transportation of sugar into cells, sugar stored in the liver, and sugar released from the liver. This results in increased blood sugar levels and will be excreted in urine, so urine contains lots of sugar. (Putri et al. 2020; Başaran et al.,) In our study, a characteristic was found in GDM with an average age of 32.6 years which is not much different from the average age in PGDM that was 34 years. Previous research in New Zealand in 2013 stated that the incidence of DM at the age of 25-34 years was 1.1%, and between 35-44 was 2%. With the distribution of Age <35 years more in GDM of 56.1% and Age>35 years more PGDM of 55.8%. Age is of particular concern because it determines the risk factor group, in which age <25 years is categorized as a low-risk group (Lawrence et al. 2017).

Regarding to parity, the highest number in 2 groups was multigravida, in GDM as many as 86 patients (75.4%) and in PGDM as many as33 patients (76.7). This is consistent with previous research by Schneider

in Germany which states that multiparous women increase the risk of hyperglycemia during pregnancy compared to nullipara, with an OR of 0.83 (95% CI 0.8–0.86, p <0.001) (Schneider et al. 2011). Based on BMI obtained by obese patients, as many as 19 patients in GDM and 17 patients in PGDM and 95 non-obese patients in GDM and 27 patients in PGDM. BMI measurement was done just before delivery or would be terminated. In our study, the highest percentage in the two groups was grade I obesity, whereas grade 3 obesity had percentage higher in PGDM which was 11.6%, while in GDM it was 4.3%. GDM and obesity are pathological conditions associated with insulin resistance and inflammation that are modulated by adipokines and cytokines. Obesity is associated with high adipocytes and hyperlipidemia and the inflammatory process is related to insulin resistance (Yessoufou et al. 2011).

Based on the MOD, it was found that the high number of SC in 2 groups, namely 51.8% in GDM and 55.8% in PGDM. This is consistent with previous research in 2013 comparing maternal outcomes in the form of SC events between DM and non-DM. In Non-DM, the incidence of SC was 19.7%, and in DM it was 28.0% in the group without risk factors. Whereas, the incidence in non-DM was 20.6%, and DM it was 27.4% in the group with risk factors (p-value <0.0001) (Cosson et al. 2013).

In our study, there were cases of uncontrolled blood sugar in 4 patients, all of whom were obtained in PGDM. The cause of uncontrolled blood sugar is due to adherence and discipline related to insulin treatment, diet and exercise. In another report, there was comparison of creatinine plasma levels in the primary care sector of Binjai in Northern Sumatera, Indonesia, in uncontrolled and controlled type 2 diabetes mellitus. There was a significant difference in creatinine plasma levels between uncontrolled type 2 diabetes mellitus and controlled type 2 diabetes mellitus subjects (Rusdiana et al. 2018).

In our study, 9 GDM mothers developed preeclampsia in 9 patients with OR of 0.74. Whereas, in PGDM as many as 13 patients were with OR of 3.76. This shows that PGDM outcomes that become preeclampsia are higher than GDM eclampsia was not found. In a previous study in Texas, it was mentioned that 20% of diabetic women would develop preeclampsia. Preeclampsia is a dangerous and potentially life-threatening disease for the mother and fetus which occurs uniquely in Indonesia, so the improvement of the standard diagnostic approach with complement is very important for this problem and development of future treatment strategies (Situmorang et al. 2018). High blood sugar levels during pregnancy cause changes in carbohydrate metabolism which ultimately results in arteriosclerosis and dysfunction of glomerular filtration which predisposes to preeclampsia (Uddin 2013).

In this study, we obtained a case of UTI in GDM as many as 1 patient with OR of 3.67 while in PGDM as many as 2 patients with OR of 19.76. There were no cases of other infections or sepsis in our study. This can be explained that the condition of hyperglycemia causes immunological dysfunction, including impaired neutrophil function and suppress the humoral immune system. Also, micro and macro-angiopathic neuropathy suppresses the antibacterial system in the urinary tract, gastrointestinal and urinary tract motility disorders (Alves et al. 2012). However, with good blood sugar control in patients with GDM and PGDM in Obstetric Polyclinic of Dr. Soetomo Hospital, the infection rate was only found in UTI cases in GDM (1 patient) and in PGDM (2 patients).

Regional operating infection is defined as an infection of the operating area that occurs within 30 days after surgery. Diabetes is a risk factor for regional operating infection, even in controlled hyperglycemic conditions. It was stated that, the regional operating infection number in DM reached 50% higher compared to non-DM. The relationship between diabetes and regional operating infection obtained an odds ratio of 1.53 (95% predictive interval [PI], 1.11-2.12, 57.2%) (Care et al. 2018).

In our study, there were no cases of DKA. DKA is a condition where insulin deficiency occurs both absolutely and relatively which is characterized by hyperglycemia, dehydration, and ketosis. If ketoacid surgery blood infections is not observed, it represents a severe metabolic disorder with high mortality. Diabetic ketoacidosis typically results from an increase in insulin resistance in the second and third trimesters. With increasing diabetes screening methods during antenatal testing, the incidence of diabetic ketoacidosis in pregnancy can be suppressed (Das 2016).

The rates are comparable in the offspring of women with type 1 or type 2 diabetes who are severe-related asphyxia due to neonatal morbidity (defined as neonatal seizures and/or HIE), and are significantly higher than those offspring of women without diabetes. The risk of morbidity related to asphyxia in the offspring of mothers with type 1 diabetes is more than three times higher and is only slightly reduced after confounders have been modified. Increased risk of birth asphyxia ranges from pregnancy in mothers with type 1 and type 2 diabetes and pathophysiological conditions. It should be remembered that a normal birth aspect does not automatically reflect normality for pregnancies in mothers with type 1 diabetes (Cnattingius et al. 2017).

In this study, we obtained 5 babies with congenital abnormalities from GDM mothers with OR of 1.02 and 1 baby from PGDM mother with OR of 0.50. The types of congenital abnormalities in GDM and PGDM are in the form of Trisomy 13, Trisomy 18, spina bifida + CTEV +

meningocele, diaphragmatic hernia, and multiple congenital. The most congenital abnormalities associated with PGDM are the involvement of the cardiovascular system and the central nervous system of the face and extremities. In GDM, there is an increase in congenital abnormalities as in typical type 1 DM embryopathy due to the presence of type 2 DM that is not detected before pregnancy (Allen et al. 2007).

In our study, 2 cases of abortion were obtained in both groups. IUFD infant outcomes were in 2 cases of GDM and 3 cases of PGDM. Congenital abnormalities involving the central nervous system and heart are lethal. Lethal congenital abnormalities are what will cause spontaneous abortion. The condition of hyperglycemia in trimester 2 causes impaired intellectual development, and unexplained IUFD can occur in trimester 3 which may be caused by hypoxia due to placental insufficiency (Boivin et al. 2002).

RDS babies' outcomes in our study only found as many as 1 case in GDM with OR of 0.91, whereas in PGDM we did not obtain any. Compared to another study, the incidence of RDS in GDM was 6 times higher compared to normal pregnancy. GDM that is not well controlled will disrupt the production of surfactants that cause hyaline membrane disease (Boivin et al. 2002).

According to another study, maternal hyperglycemia causes fetal hyperglycemia which in turn causes hyperplasia of the fetal pancreas and eventually causes fetal hyper insulin. The main protective factor that can prevent the occurrence of hypoglycemia in the fetus is optimal control of maternal hypoglycemia, especially in the third trimester and delivery. DM mothers with plasma glucose levels >6 mmol/L during the 4 hours following delivery will cause a high incidence of hypoglycemia in newborns (Boivin et al. 2002).

Early neonatal death (ENND), identified as a newborn's death, is 73 percent of all postnatal deaths worldwide between 0 and 7 days after birth In our study, there were cases of early neonatal death as many as 1 case in both groups which were both caused by congenital abnormalities. Another study mentioned that congenital abnormalities are the second leading cause of infant death in the United Kingdom. The cause of death in congenital abnormalities is a malformation of the circulatory system, found 44.3 deaths per 100,000 live births, followed by chromosome abnormalities 41.5 per 100,000 live births, and congenital abnormalities of the nervous system 26.3 per 100,000 live births (Lehtonen et al. 2017).

CONCLUSION

Screening for risk factors and routine and directed antenatal examinations are very important in the management of pregnant patients in general. Especially for GDM and PGDM patients, good and correct education related to diet, exercise, lifestyle and medication adherence greatly influence blood sugar regulation. With blood sugar regulation and good monitoring of fetal well-being, complications and morbidity and mortality for both mother and fetus can be avoided. Appropriate management of termination of pregnancy and examination and care of the mother until the puerperium are needed to get good maternal and neonatal outcomes.

REFERENCES

Albai A, Lupascu N, Popescu S, Timar B, Potre O, Potre C, Timar R, (2018) The Influence of Hyperglycemia on the Outcome of Diabetic Pregnancies. Romanian Journal of Diabetes, Nutrition and Metabolic Diseases 25(2): 215–221. https://doi.org/10.2478/rjdnmd-2018-0025

Allen VM, Armson BA, Wilson RD, Blight C, Gagnon A, Johnson JA, Langlois S, Summers A, Wyatt P, Farine D, Armson BA, Crane J, Delisle MF, Keenan-Lindsay L, Morin V, Schneider CE, Van Aerde J, (2007) Teratogenicity Associated With Pre-Existing and Gestational Diabete. Journal of Obstetrics and Gynaecology Canada 29(11): 927–934. https://doi.org/10.1016/S1701-2163(16)32653-6

Alves C, Casqueiro J, Casqueiro J, (2012) Infections in patients with diabetes mellitus: A review of pathogenesis. Indian Journal of Endocrinology and Metabolism 16(7): 27. https://doi.org/10.4103/2230-8210.94253

Başaran N, Evliyaoğlu O, Sucu V, Bulut L, Dikker O, Tezcan F, Vardar M (2016) Changing of Uric Acid Levels by Age and Sex in Patients with Diabetes Mellitus. Journal of Clinical and Experimental Investigations, 7(1): 1-6. https://doi.org/10.5799/jcei.328707

Boivin S, Derdour-Gury H, Perpetue J, Jeandidier N, Pinget M, (2002) Diabetes and pregnancy. Annales d'Endocrinologie 63(5): 480–487.

Care D, Suppl SS, (2018) Management of diabetes in pregnancy: Standards of medical care in Diabetesd2018. Diabetes Care 41(January): S137–S143. https://doi.org/10.2337/dc18-S013

Cnattingius S, Lindam A, Persson M, (2017) Risks of asphyxia-related neonatal complications in offspring of mothers with type 1 or type 2 diabetes: the impact of maternal overweight and obesity. Diabetologia 60(7): 1244–1251. https://doi.org/10.1007/s00125-017-4279-2

Cosson E, Benbara A, Pharisien I, Nguyen MT, Revaux A, Lormeau B, Sandre-Banon D, Assad N, Pillegand C, Valensi P, Carbillon L, (2013) Diagnostic and prognostic performances over 9 years of a selective screening strategy for gestational diabetes mellitus in a cohort of 18,775 subjects. Diabetes Care 36(3): 598–603. https://doi.org/10.2337/dc12-1428

Cunningham FG, Leveno Kenneth J, Bloom Steven L, HJC (2010) William Obstetrics 23Rd Edition. Ed. by Twickler Diane M., W. G. D. United States: Mc Graw Hill Medical.

Das V (2016) Diabetic ketoacidosis in pregnancy. Principles of Critical Care in Obstetrics 2: 95–100. https://doi.org/10.1007/978-81-322-2686-4_12

Ernawati R, Purwaka BT, Prasetyo B, (2018) Nutritional status of third trimester pregnant women correlates positively with birth weight. Majalah Obstetri & Ginekologi 25(2): 41. https://doi.org/10.20473/mog.v25i22017.41-47

Firdiani YF, Zulkifli A, Nyorong M, (2018) Influence factors on blood glucose level of diabetes mellitus patients in Makassar. ACM International Conference Proceeding Series 20–24. https://doi.org/10.1145/3242789.3242804

Lawrence H, Nathan Reynolds A, Joseph Venn B, (2017) Perceptions of the Healthfulness of Foods of New Zealand Adults Living With Prediabetes and Type 2 Diabetes: A Pilot Study. Journal of Nutrition Education and Behavior 49(4): 339-345.e1. https://doi.org/10.1016/j.jneb.2016.10.020

Lehtonen L, Gimeno A, Parra-Llorca A, Vento M, (2017) Early neonatal death: A challenge worldwide. Seminars in Fetal and Neonatal Medicine 22(3): 153–160. https://doi.org/10.1016/j.siny.2017.02.006

Pane YS, Ganie RA, Lindarto D, Lelo A, (2018) The effect of gambier extract on the levels of malondialdehyde, superoxide dismutase, and blood glucose in type 2 diabetes mellitus patients. Asian Journal of Pharmaceutical and Clinical Research 11(10): 121–124. https://doi.org/10.22159/ajpcr.2018.v11i10.26620

Putri NA, Notobroto HB, (2020) Viability Status of Diabetes Melitus Patients With Complications of Hyperglycemia, Cetoasidosis, and Gangrene. Jurnal Berkala Epidemiologi 8(1): 72. https://doi.org/10.20473/jbe.v8i12020.72-80

Roostarini JW, Soelistijo SA, Novida H, Sutjahjo A, Wibisono S, Prajitno JH, Susanto H, Miftahussurur M, Tjokroprawiro A, (2019) Lipoprotein (A) and arterial stiffness in patients with diabetes mellitus. New Armenian Medical Journal 13(1): 74–78.

Rusdiana, Savira M, Syahputra M, Santoso A, (2018) Creatinine plasma at uncontrolled type 2 diabetes mellitus and controlled type 2 diabetes mellitus patients at primary health care in Binjai city, Indonesia. IOP Conference Series: Earth and Environmental Science 125(1):. https://doi.org/10.1088/1755-1315/125/1/012168

Schneider S, Hoeft B, Freerksen N, Fischer B, Roehrig S, Yamamoto S, Maul H (2011) Neonatal complications and risk factors among women with gestational diabetes mellitus. Acta Obstetricia et Gynecologica Scandinavica 90(3): 231–237. https://doi.org/10.1111/j.1600-0412.2010.01040.x

Situmorang PC, Ilyas S (2018) Study of preeclampsia in placenta, kidney, and hepatic diseases. Asian Journal of Pharmaceutical and Clinical Research 11(11): 21–28. https://doi.org/10.22159/ajpcr.2018.v11i11.27540

Soewondo P, Pramono LA (2011) Prevalence, characteristics, and predictors of pre-diabetes in Indonesia. Medical Journal of Indonesia 20(4): 283–294. https://doi.org/10.13181/mji.v20i4.465

Sweeting AN, Ross GP, Hyett J, Molyneaux L, Constantino M, Harding AJ, Wong J (2016) Gestational Diabetes Mellitus in Early Pregnancy: Evidence for Poor Pregnancy Outcomes Despite Treatment. Diabetes Care 39(1): 75–81. https://doi.org/10.2337/dc15-0433

Tazhbenova ST, Millere I, Yermukhanova LS, Sultanova G, Turebaev M, Sultanova BP (2019) Effectiveness of diabetes mellitus management program at primary health care level. Electronic Journal of General Medicine, 16(6): em172. https://doi.org/10.29333/ejgm/115848

Uddin MN (2013) Diabetes Mellitus and Preeclampsia. Medical Journal of Obstetrics and Gynecology 1(3): 1016. Available at: https://www.jscimedcentral.com/Obstetrics/obstetrics-1-1016.php

Yang GR, Dye TD, Li D, (2019) Effects of pre-gestational diabetes mellitus and gestational diabetes mellitus on macrosomia and birth defects in Upstate New York. Diabetes Research and Clinical Practice 155(1): 107811. https://doi.org/10.1016/j.diabres.2019.107811

Yessoufou A, Moutairou K, (2011) Maternal diabetes in pregnancy: Early and long-term outcomes on the offspring and the concept of 'metabolic memory'. Experimental Diabetes Research 2011. https://doi.org/10.1155/2011/218598