Review Article

Gestational Diabetes Mellitus: A Narrative Review

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Abstract

Diabetes mellitus (DM) is a chronic disease that needs medical support and continuing patient education to avoid acute complications and decrease the long-term complications. The prevalence of diabetes is high in many areas, especially Asian. There are many risk factors for developing gestational diabetes, such as advanced gestational age, obesity, family history of DM, and previous delivery of large weight baby. There is higher perinatal morbidity and mortality in untreated cases, but this can be reduced with proper antepartum surveillance and adequate insulin treatment. This article consisted of an acceptable definition, pathogenesis, screening, risk factors, management of diabetes during pregnancy, maternal and fetal complication, and prevention.

Keywords: Diabetes mellitus, fetal surveillance, gestational diabetes, insulin therapy, screening

Introduction

Definition of pregestational diabetes mellitus is the occurrence of Type 1 and Type 2 diabetes before pregnancy, whereas gestational diabetes mellitus (GDM) defines as glucose intolerance for the first time during pregnancy.[1,2] During the last 30 years, the development of the treatment techniques enhances the prevention of diabetic complications during pregnancy, leading to a dramatic improvement in maternal and perinatal outcomes and that's need clinical efforts to maintain an excellent maternal glycemic control before conception and during pregnancy.[3,4] There is an increasing prevalence of diabetes mellitus (DM), and its major metabolic disorder caused by the insulin secretion defect or insulin action defect resulting from a defect in insulin secretion, insulin action, or both. As a result, it will lead to chronic hyperglycemia associated with carbohydrates, protein, and fat disturbance.[5,6]

Epidemiology

Impaired glucose tolerance and impaired fasting glucose play a role in the detection of prediabetes mellitus, which considered as a risk factor for the DM.[7]

The balance between insulin production and insulin sensitivity is responsible for the maintenance of standard glucose tolerance.[8] The ability of insulin to distribute carbohydrates is affected by the secretory response of B-cell of the pancreas; during pregnancy, there will be an adaptation to the alteration in the carbohydrate metabolism; therefore, there is no maternal and fetal effect.[9] Suppose there are any abnormalities in the response of the B-cells, in that case, it leads to an increase in the fetal risk, which occurs when the B-cells output does not meet the increase in the tissue's insulin demand due to insulin resistance.[10] The pregnancy is a diabetogenic state, the insulin resistance increases in the second trimester due to the release of anti-insulin hormones from the placenta like estrogen, progesterone, cortisol, human placental lactogen, and growth hormone.[11] There will be a glucose intolerance, and postprandial hyperglycemia causes increase in fetal nutrient consumption, leading to normal glucose metabolism with low fasting glucose in pregnant women.[12] The insulin sensitivity reduces about 50%–60% in normal pregnancy when the pancreas' function is normal; it can compensate for the physiological rise in the insulin resistance during pregnancy.[13] In contrast, in gestational diabetes, the pancreas cannot do this due to the B-cell function deficits[14] in which there is a

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Submitted: 12-Jan-2021 **Accepted:** 18-Apr-2021
Published: 29-Sept-2021

Access this article online

Quick Response Code:

Website: www.medjbabylon.org

DOI: 10.4103/MJBL.MJBL_1_21

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How to cite this article: Ali AI, Nori W. Gestational diabetes mellitus: A Narrative Review. Med J Babylon 2021;18:163-8.

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similarity in the pathophysiology between Type 2 diabetes and gestational diabetes.[15]

Inflammatory Mediators and their Role in Pregnancy and Diabetes

There is an increase in the circulating leukocytes in pregnancy. It regarded as a chronic low-grade inflammatory state triggered by prepregnancy obesity, which can be associated with increases in circulating interlukine-6 and C-reactive protein.[16,17] These factors can enhance insulin resistance, especially in obese women, and improve substrate availability, resulting in macrosomia development.[18,19] The most potent predictor in pregnancy for the insulin resistance is the tumor necrosis factor as it may promote insulin resistance by inhibition of insulin signaling through multiple mechanisms.[20,21]

Pederson hypothesis in 1920; Jorgen Pederson illustrated that maternal hyperglycemia leads to fetal hyperglycemia; therefore, it results in the fetus pancreatic islet cells' hypertrophy, causing the insulin hypersecretion.[22,23]

Screening of Gestational Diabetes

Gestational diabetes defined as any level of dysglycemia with onset or first acknowledgement during gestation, so it is essential to do screening for the DM; there are two ways for this screening.[24]

1. Universal screening: Means screening of all pregnant women[25]
2. Selective screening: Means screening for high-risk pregnant women when there are risk factors for gestational diabetes such as a family history of Type 2 DM, prior history of gestational diabetes, glycosuria, and impairment in the glucose metabolism.[25]

Screening should start at any time when hyperglycemia signs and symptoms appeared or at 24–28 weeks for all pregnant women.[26,27]

The oral glucose tolerance test (OGTT) included a 3-h 100 g diagnostic test performed after the 50 g screening test exceeded or met a predetermined blood glucose level.[28]

The diagnoses of gestational diabetes depend on finding of spontaneous blood glucose level >200 mg/dl, fasting plasma glucose >126 mg/dl, or hemoglobin A1c (HbA1c) >6.5% before 20 weeks of gestation.[29] Type 2 diabetes screening indicated at the first prenatal visit for pregnant women with a high risk of gestational diabetes, stillbirth, malformation, frequent mischarge, macrosomia babies, obesity, age >35 year old, symptoms of diabetes, and vascular diseases.[30,31] The international epidemiological study of 325 pregnant women in nine countries revealed the association between the adverse fetal outcome and glucose intolerance in pregnant with gestational diabetes during the third trimester;[32] they underwent a 75 g OGTT after a period of overnight fasting, measurement of blood glucose level at fasting, 1 h, and 2 h following the glucose intake found increasing in the rate of adverse pregnancy outcome[32,33] in comparison with the 2 steps approach, there is a higher rate of gestational diabetes diagnosis rather than macrosomia.[34,35]

There is a controversy about the best screening test for diabetes; several studies found that the one-step method could increase the number of pregnant diagnosed with gestational diabetes depending on one abnormal value.[36,37] However, there is inadequate data obtained from the randomized control trials for those diagnosed by the one-step approach.[38,39] A recent study included treating 958 pregnant women with mild GDM regardless of the diagnosis method, whatever treatment there was a similar decrease in cesarean incidence delivery, macrosomia, pregnancy-induced hypertension, and shoulder dystocia.[40] In contrast, other systematic review studies assessed the diagnostic thresholds for gestation diabetes on the fetal and maternal outcome and found that macrosomia was higher in those pregnant diagnosed with two-step approach two-step.[41]

The Risk Assessment of Gestational Diabetes

The patients classified into three groups

Low risk

They do not need routine blood glucose testing if the following are present; no DM history in first degree relatives; there is no abnormal prior obstetric outcome; the age of <25, average weight before pregnancy.[42]

Average risk

Assess the blood glucose at 24–28 weeks by performing one-step method; 100 g diagnostic OGTT for all patients, or by two steps method; glucose challenge test 50 g orally then 100 g diagnostic for patients meeting the threshold.[42]

High risk

If there is one of the following, then perform one of the above-described methods:

Previous history of GDM, Type 2 diabetes, strong family history of diabetes, prior history of glycosuria, and impaired glucose intolerance.[43]

Complications

Fetal complications

Unexplained stillbirth

It is usually associated with poor glycemic control, as hyperglycemia results in a chronic reduction in the level of oxygen; therefore, the fetal metabolites would be responsible for the unexplained stillbirth,[44] which is approved by the low mean umbilical venous pH in those diabetic mothers. Other causes of stillbirth include maternal ketoacidosis, placental insufficiency in overt diabetes with severe preeclampsia, and vascular complication.[45]

Spontaneous abortion

related to poor glycemic control, usually when the HbA1c concentrations are more than 12%.[46]

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Malformation

account 11% in diabetic pregnant the cardiac malformation is the most common anomaly for which the caudal regression associated with diabetes.[46]

Macrosomia

incidence is 25%–40%, in diabetic pregnant, and it is an estimated fetal weight >4–4.5 kg or more significant than 90th percentile at any gestational age.[47]

Altered fetal growth

It can be associated with a congenital malformation and advanced vascular complications.[47]

Neonatal complications

preterm birth is one of the severe complications of pregestational diabetes, as well as necrotizing enterocolitis, but the respiratory distress syndrome is mostly associated with gestational diabetes;[48] other complications such as low birth weight, especially those who delivered between 24 and 33 weeks, hypoglycemia of newborn as a result of hyperplasia of B-islet cells due to chronic hyperglycemia in the mother, polycythemia (related to hypoxia as a result of increased fetal oxygen consumption with high fetal erythropoietin), and hyperbilirubinemia.[49]

Maternal complications

Infection

There is a higher risk of infection in diabetic pregnancies such as vulvovaginal candidiasis, respiratory, urinary infections, and pelvic sepsis.[50]

Polyhydramnios

Polyhydramnios accounts 3%–30% among diabetic women, it occurs due to fetal glycemic load with polyuria, gastrointestinal obstruction, defect in the fetal swallowing, and high sugar in the amniotic membrane.[51]

Preterm delivery

Preterm delivery accounts for about 605 in diabetic pregnant, it regarded as a severe obstetrical complication.

Acute vascular complications

Acute vascular complications such as acute stroke and coronary artery disease.[52]

Preeclampsia

is an obstetric complication that leads to preterm delivery in diabetic pregnancies.[52]

Diabetic ketoacidosis

It is a severe medical complication and carries a risk for the fetus for both at time of the event and following it, incidence about 1% in diabetic pregnancies, usually seen among type 1 diabetic women.[52] There are several risk factors which are as follows: infection, noncompliance with insulin, severe hyperemesis gravidarum, B-memetic drugs used as tocolysis and corticosteroids;[53] it occurs as a result of insulin deficiency and increasing the regulatory hormone glucagon, unfortunately, leads to ketone body formation with the gluconeogenesis, and the serum B-hydroxybutyrate used to reflect the level of ketone bodies.[54]

The critical signs and symptoms of diabetic ketoacidosis (DK) are as follows: Abdominal pain, nausea or vomiting, polyuria, and polydipsia, muscular pain, blurred vision, lethargy, drowsiness, altered mental status, tachycardia, tachypnea, coma shock, and fetal distress by abnormal fetal heart.[55]

Management of Diabetic Ketoacidosis during Pregnancy

Investigation revealed the following

glucose hyperglycemia (≥11.0 mmol), positive serum/urine ketones, low serum bicarbonate, the elevated base deficit of ≥4 mEq/l, potassium level may be falsely normal/elevated, multidisciplinary approach should be available.[56]

Intravenous fluid therapy using isotonic saline 0.9% with electrolyte correction, bicarbonate administration if needed, treatment of the predisposing factor, maternal and fetal monitoring.[57]

Prevention of Diabetic Ketoacidosis in Pregnancy

We should outline a strategy for preventing DK from the preconception period until delivery; this can be obtained by pregnancy education, particularly the risk factors, with proper blood sugar control, and decreasing the pregnancy complication.[58]

Chronic complication

Neuropathy and nephropathy accounts for about 10%–50%.[58]

Management

The multidisciplinary team is needed to manage pregnant, seen in a special diabetic clinic with the specialized team included nutritionist, physician, obstetrician, neonatologist, and midwife.[59] The management aims are to optimize the diabetic control depending on the following rules: reasonable glycemic control, proper antepartum surveillance, dietary control, neonatal support, and preconception patient education.[59]

The essential management is glucose control in the first and second trimester to reduce the risks of early pregnancy loss,

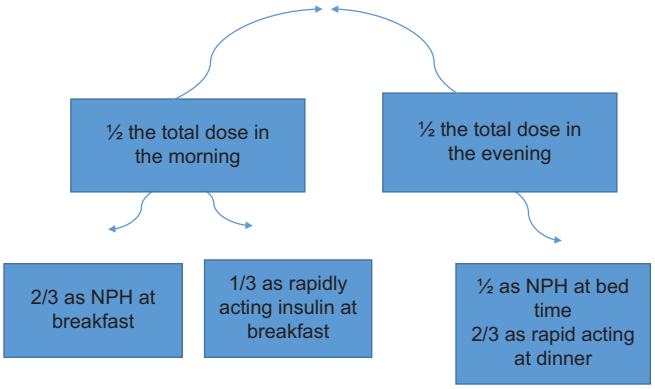

Figure 1: The American diabetes association showing the total insulin dose for the pregnant women

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congenital malformations in infants of diabetic mothers;[60] therefore, the fetal echo at 20–24 weeks advised to exclude structural anomalies, besides the lower serum level of alfa fetoprotein in diabetic pregnant.[61]

The third trimester needs strict glucose monitoring weekly with proper evaluation of preeclampsia, serial ultrasound monthly to detect inadequate fetal growth or excessive growth, fetal surveillance program, umbilical artery Doppler for assessing the uteroplacental circulation to see intrauterine growth retardation, hospitalization for those with uncontrolled glucose level depending on risk factors and the antepartum.[62]

Monitoring of glucose in gestational diabetes mellitus

Four times watching blood glucose level by daily measurement of fasting glucose, 1 or 2 h after each meal, several studies found the better outcome depending on the postprandial glucose control, diabetic pregnancies with reasonable diabetic control depending on the diet need less frequent monitoring.[63]

Hemoglobin A1c concentrations

It should be <6%–6.5% to get lower fetal complications, as it decreases due to rapid red blood cell turnover, so it does not have any benefit during pregnancy.[64]

Nutritional therapy is regarded as the cornerstone in the GDM management, as gestational diabetic women should have the dietary counseling; these are the following dietary approach: Regular small meals consist mainly of slowly absorbed carbohydrate to obtain good glycemic control, maintain the intake of moderate sugar-containing food as it does not relate to excessive weight gain nor hyperglycemia.[65]

In general, the caloric distribution should be 10% at breakfast, 30% at lunch, 30% at dinner, and 30% divided between the snakes, four to five portions of fruits and vegetables every day, eating fish, meat, poultry, milk, oily fish as two portions per day.[65]

Exercise

it will reduce insulin resistance peripherally, which can assist the dietary therapy for the GDM patients, advised to engage in activity for about 30 min every week.[66]

Medical treatment for the gestational diabetes mellitus

indicated when the fasting glucose >95 mg/dl or postprandial >120 mg/dl for 2 h and >140 mg/dl for 1 h, in general, the oral hypoglycemic drugs not recommended because they can pass through the placental barrier and lead to fetal hypoglycemia.[67] One of the safest oral hypoglycemic medication is the metformin; it causes improvement in the insulin sensitivity, the initial dose is 500 mg given at night for the 1st week then increases to 500 mg two times daily, until 2500–300 mg every day as a maximum dose; the side effects include diarrhea and abdominal pain.[68] Alternative drug for the metformin is the glyburide; it is a sulfonylurea which can promote the insulin secretion, the initial dose is 2.5–2 mg every day in dividing dose, can be given up to 30 mg.[11]

Insulin therapy

starting treatment in GDM when oral hypoglycemic drugs and dietary treatment is inadequate for glycemic control, we use regular and neutral protamine Hagedorn insulin and the short-acting insulin analogue.[69] The treatment depends on the maternal weight and it is illustrated in the Figure 1 seen above, which revealed the proper insulin doses in the morning and evening, the insulin therapy for the GDM women initiated as an outpatient treatment, and the starting dose is usually lower than the starting dose for the non-GDM diabetic women.[70]

Conclusion

The management of diabetic pregnant is a significant health problem that can burden society. Nonpharmacologic methods such as the diet and exercise could be adequate for many women to get reasonable glycemic control. However, others could not benefit and need additional treatment as pharmacological therapy such as insulin, the first-line treatment then metformin, and glyburide under strict glucose monitoring. It is essential that all pregnant women who have risk factors for diabetes be tested in the first trimester to rule out the presence of overt or preexisting diabetes.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Wood JR, Miller KM, Maahs DM, Beck RW, DiMeglio LA, Libman IM, *et al*. T1D Exchange Clinic Network. Most youths with type 1 diabetes in the T1D Exchange Clinic Registry do not meet American Diabetes Association or International Society for Pediatric and Adolescent Diabetes clinical guidelines. Diabetes Care. 2013 Jul 1;36:2035-7.
2. Mukhtar MH, El-Emshaty HM, Alamodi HS, Nasif WA. The Activity of Serum 8-Iso-Prostaglandin F2α as Oxidative Stress Marker in Patients with Diabetes Mellitus Type 2 and Associated Dyslipidemic Hyperglycemia. Journal of Diabetes Mellitus. 2016;6:318.
3. Westman EC, Yancy WS Jr., Humphreys M. Dietary treatment of diabetes mellitus in the pre-insulin era (1914-1922). Perspect Biol Med 2006;49:77-83.
4. Saravanan P; Diabetes in Pregnancy Working Group; Maternal Medicine Clinical Study Group; Royal College of Obstetricians and Gynaecologists, UK. Gestational diabetes: Opportunities for improving maternal and child health. Lancet Diabetes Endocrinol 2020;8:793-800.
5. Aynalem SB, Zeleke AJ. Prevalence of diabetes mellitus and its risk factors among individuals aged 15 years and above in mizan-aman town, Southwest Ethiopia, 2016: A cross sectional study. Int J Endocrinol 2018;2018 :9317987.
6. Lebovitz HE. Diagnosis, classification, and pathogenesis of diabetes mellitus. J Clin Psychiatry 2001;62 Suppl 27:5-9.
7. Mao T, Chen J, Guo H, Qu C, He C, Xu X, *et al*. The Efficacy of New Chinese Diabetes Risk Score in Screening Undiagnosed Type 2 Diabetes and Prediabetes: A Community-Based Cross-Sectional Study in Eastern China. Journal of diabetes research. 2020:29;2020.
8. Wang L, Gao P, Zhang M, Huang Z, Zhang D, Deng Q, *et al.* Prevalence and ethnic pattern of diabetes and prediabetes in China in 2013. JAMA 2017;317:2515-23.
9. Buchanan TA, Xiang A, Kjos SL. What is gestational diabetes? Diabetes Care 2007;30:S105-11.
10. Fonseca VA. Defining and characterizing the progression of

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type 2 diabetes. Diabetes Care 2009;32 Suppl 2:S151-6.
11. Hegerty CK. The new gestational diabetes: Treatment, evidence and consent. Aust N Z J Obstet Gynaecol 2020;60:482-5.
12. Dugan JA, Ma Crawford J. Managing gestational diabetes. JAAPA 2019;32:21-5.
13. American Diabetes Association. Management of diabetes in pregnancy. Stand Med Care Diabetes 2019:42;S165-72.
14. Catalano PM. Trying to understand gestational diabetes. Diabet Med 2014;31:273-81.
15. Johns EC, Denison FC, Norman JE, Reynolds RM. Gestational diabetes mellitus: Mechanisms, treatment, and complications. Trends Endocrinol Metab 2018;29:743-54.
16. Baz B, Riveline JP, Gautier JF. Endocrinology of pregnancy: Gestational diabetes mellitus: Definition, aetiological and clinical aspects. Eur J Endocrinol 2016;174:R43-51.
17. Li C, Zhou P, Cai Y, Peng B, Liu Y, Yang T, *et al.* Associations between gestational diabetes mellitus and the neurodevelopment of offspring from 1 month to 72 months: Study protocol for a cohort study. BMJ Open 2020;10:e040305.
18. Salmeri N, Villanacci R, Ottolina J, Bartiromo L, Cavoretto P, Dolci C, *et al.* Maternal arsenic exposure and gestational diabetes: A systematic review and meta-analysis. Nutrients 2020;12:3094.
19. Vesentini G, Barbosa AM, Damasceno DC, Marini G, Piculo F, Matheus SMM, *et al.* Alterations in the structural characteristics of rectus abdominis muscles caused by diabetes and pregnancy: A comparative study of the rat model and women. PLoS One 2020;15:e0231096.
20. Sánchez-Campillo M, Ruiz-Palacios M, Ruiz-Alcaraz AJ, Prieto-Sánchez MT, Blanco-Carnero JE, Zornoza M, *et al.* Child head circumference and placental MFSD2a expression are associated to the level of MFSD2a in maternal blood during pregnancy. Front Endocrinol (Lausanne) 2020;11:38.
21. Tieu J, Shepherd E, Middleton P, Crowther CA. Dietary advice interventions in pregnancy for preventing gestational diabetes mellitus. Cochrane Database Syst Rev 2017;1:CD006674.
22. Li S, Gan Y, Chen M, Wang M, Wang X, Santos HO, *et al*, Kathirgamathamby V. Effects of the Dietary Approaches to Stop Hypertension (DASH) on Pregnancy/Neonatal Outcomes and Maternal Glycemic Control: A Systematic Review and Meta-analysis of Randomized Clinical Trials. Complementary Therapies in Medicine. 2020:102551.
23. Yerlikaya-Schatten G, Trimmal L, Rosicky I, Husslein P, Schatten C, Eppel D, *et al.* Effects of gum chewing on glycaemic control in women with gestational diabetes mellitus: A randomized controlled trial. Impact of chewing on hyperglycaemia in women with GDM. Eur J Obstet Gynecol Reprod Biol 2020;247:61-5.
24. Polur H, Prasad KD, Bandela PV, Saheb SH. Diabetes in pregnancy Study group in India (DIPSI)–a novel criterion to diagnose GDM. International Journal of Biochemistry Research & Review. 2016:1-6.
25. López Stewart G. Diagnostic criteria and classification of hyperglycaemia first detected in pregnancy: a World Health Organization Guideline. 2014;103:341-63.
26. Kautzky-Willer A, Harreiter J, Winhofer-Stöckl Y, Bancher-Todesca D, Berger A, Repa A, *et al.* Gestational diabetes mellitus (Update 2019). Wien Klin Wochenschr 2019;131:91-102.
27. Chen ZG, Xu YT, Ji LL, Zhang XL, Chen XX, Liu R, *et al.* The combination of symphysis-fundal height and abdominal circumference as a novel predictor of macrosomia in GDM and normal pregnancy. BMC Pregnancy Childbirth 2020;20:461.
28. Ye Y, Xiong Y, Zhou Q, Wu J, Li X, Xiao X. Comparison of Machine Learning Methods and Conventional Logistic Regressions for Predicting Gestational Diabetes Using Routine Clinical Data: A Retrospective Cohort Study. Journal of Diabetes Research. 2020;2020. 4168340.
29. Wang J, Pan Y, Dai F, Wang F, Qiu H, Huang X. Serum miR-195-5p is upregulated in gestational diabetes mellitus. J Clin Lab Anal 2020;34:e23325.
30. Kautzky-Willer A, Harreiter J, Weitgasser R, Lechleitner M. Clinical practice recommendations for diabetes in pregnancy (Diabetes and Pregnancy Study Group of the Austrian Diabetes Association). Wien Klin Wochenschr 2016;128 Suppl 2:S113-8.
31. Sourij H, Edlinger R, Prischl F, Auinger M, Kautzky-Willer A, Säemann MD, *et al.* Diabetic kidney disease – Update 2016. Wien Klin Wochenschr 2016;128 Suppl 2:S85-96.
32. International Association of Diabetes and Pregnancy Study Groups Consensus Panel. International Association of Diabetes and Pregnancy Study Groups recommendations on the diagnosis and classification of hyperglycemia in pregnancy. Diabetes Care 2010;33:676-82.
33. Powe CE, Udler MS, Hsu S, Allard C, Kuang A, Manning AK, *et al.* Genetic loci and physiologic pathways involved in gestational diabetes mellitus implicated through clustering. Diabetes 2021;70:268-81.
34. American Diabetes Association. Diagnosis and classification of diabetesmellitus. Diabetes Care 2013;36:S67-74.
35. Kaestner KH, Powers AC, Naji A, HPAP Consortium, Atkinson MA. NIH initiative to improve understanding of the pancreas, islet, and autoimmunity in type 1 diabetes: The Human Pancreas Analysis Program (HPAP). Diabetes 2019;68:1394-402.
36. Tobias DK, Hu FB, Chavarro J, Rosner B, Mozaffarian D, Zhang C. Healthful dietary patterns and type 2 diabetes mellitus risk among women with a history of gestational diabetes mellitus. Arch Intern Med 2012;172:1566-72.
37. American Diabetes Association. Standards of medical care in diabetes – 2014. Diabetes Care 2014;37 Suppl 1:S14-80.
38. Sandu C, Bica C, Salmen T, Stoica R, Bohiltea R, Gherghiceanu F, *et al.* Gestational diabetes – Modern management and therapeutic approach (Review). Exp Ther Med 2021;21:81.
39. Ozbasli E, Takmaz O, Karabuk E, Gungor M. Comparison of factor XII levels in gestational diabetes, fetal macrosomia, and healthy pregnancies. BMC Pregnancy Childbirth 2020;20:752.
40. De Souza LR, Berger H, Retnakaran R, Maguire JL, Nathens AB, Connelly PW, *et al.* First-trimester maternal abdominal adiposity predicts dysglycemia and gestational diabetes mellitus in midpregnancy. Diabetes Care 2016;39:61-4.
41. Mpondo BC, Ernest A and Dee HE. Gestational diabetes mellitus. Challenges in diagnosis and management. J Diabetes Metab Disord 2015;14:42.
42. Polur H, Prasad KD, Bandela PV, Saheb SH. Diabetes in pregnancy Study group in India (DIPSI)–a novel criterion to diagnose GDM. International Journal of Biochemistry Research & Review. 2016:1-6.
43. López Stewart G. Diagnostic criteria and classification of hyperglycaemia first detected in pregnancy: a World Health Organization Guideline. 2014;103:341-63.
44. Wahabi H, Fayed A, Esmaeil S, Mamdouh H, Kotb R. Prevalence and complications of pregestational and gestational diabetes in Saudi women: analysis from Riyadh Mother and Baby cohort study (RAHMA). BioMed research international. 2017;2017. 6878263.
45. Jabak S, Hameed A. Continuous intrapartum fetal monitoring in gestational diabetes, where is the evidence?. The Journal of Maternal-Fetal & Neonatal Medicine. 2020:1-4.
46. Paulo HV, da Silva Araujo JR, Alícia Helena AS, Suyane de DM, Camila MS, Francisco H, *et al.* Clinical symptoms and manifestations of gestational diabetes. Int Res J Obstet Gynecol 2020;3:32.
47. Bricelj K, Tul N, Lucovnik M, Kronhauser-Cerar L, Steblovnik L, Verdenik I, *et al.* Neonatal respiratory morbidity in late-preterm births in pregnancies with and without gestational diabetes mellitus. J Matern Fetal Neonatal Med 2017;30:377-9.
48. Mitanchez D. Fetal and neonatal complications of gestational diabetes: Perinatal mortality, congenital malformations, macrosomia, shoulder dystocia, birth injuries, neonatal outcomes. J Gynecol Obstet Biol Reprod (Paris) 2010;39:S189-99.
49. Tabrizi R, Asemi Z, Lankarani KB, Akbari M, Khatibi SR, Naghibzadeh-Tahami A, *et al.* Gestational diabetes mellitus in association with macrosomia in Iran: A meta-analysis. J Diabetes Metab Disord 2019;18:41-50.
50. Zuckerman M, Kelly T, Heard K, Zosel A, Marlin M, Hoppe J. Physician attitudes on buprenorphine induction in the emergency department: Results from a multistate survey. Clin Toxicol (Phila) 2021;59:279-85.
51. Morrisom FJ, Maryam M, Ellen WS, Ashley C, Maria SH, Emma M, *et al*. Fetal outcomes after diabetic ketoacidosis during pregnancy. Diabetes Care 2017;40:e77-9.
52. Sibai BM, Viteri OA. Diabetic ketoacidosis in pregnancy. Obstet

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Gynecol 2014;123:167-78.
53. Stark J, Simma B, Blassnig-Ezeh A. Incidence of hypoglycemia in newborn infants identified as at risk. The Journal of Maternal-Fetal & Neonatal Medicine. 2020;33:3091-6.
54. Hua XG, Jiang W, Hu R, Hu CY, Huang K, Li FL, Zhang XJ. Large for gestational age and macrosomia in pregnancies without gestational diabetes mellitus. The Journal of Maternal-Fetal & Neonatal Medicine. 2020;33:3549-58.
55. Mathiesen ER, Ringholm L, Feldt-Rasmussen B, Clausen P, Damm P. Obstetric nephrology: Pregnancy in women with diabetic nephropathy – The role of antihypertensive treatment. Clin J Am Soc Nephrol 2012;7:2081-8.
56. Faza NN, Akeroyd JM, Ramsey DJ, Shah T, Nasir K, Deswal A, *et al.* Effectiveness of NPs and PAs in managing diabetes and cardiovascular disease. JAAPA 2018;31:39-45.
57. McIntyre HD, Sacks DA, Barbour LA, Feig DS, Catalano PM, Damm P, *et al.* Issues with the diagnosis and classification of hyperglycemia in early pregnancy. Diabetes Care 2016;39:53-4.
58. Marlow N, Bennett C, Draper ES, Hennessy EM, Morgan AS, Costeloe KL. Perinatal outcomes for extremely preterm babies in relation to place of birth in England: The EPICure 2 study. Arch Dis Child Fetal Neonatal Ed 2014;99:F181-8.
59. Bao W, Li S, Chavarro JE, Tobias DK, Zhu Y, Hu FB, *et al.* Low carbohydrate-diet scores and long-term risk of type 2 diabetes among women with a history of gestational diabetes mellitus: A prospective cohort study. Diabetes Care 2016;39:43-9.
60. Gilbert L, Nikolaou A, Quansah DY, Rossel JB, Horsch A, Puder JJ. Mental health and its associations with glucose-lowering medication in women with gestational diabetes mellitus. A prospective clinical cohort study. Psychoneuroendocrinology 2021;124.
61. Kapur A, Mahmood T, Hod M. The unmet need for universal testing for hyperglycaemia in pregnancy and the FIGO guideline. BJOG: An International Journal of Obstetrics & Gynaecology. 2018;125:529-31.
62. Magann EF, Chauhan SP, Doherty DA, Lutgendorf MA, Magann MI, Morrison JC. A review of idiopathic hydramnios and pregnancy outcomes. Obstetrical & gynecological survey. 2007;62:795-802.
63. Lawal SK, Adeniji AA, Sulaiman SO, Akajewole MM, Buhari MO, Osinubi AA. Comparative effects of glibenclamide, metformin and insulin on fetal pancreatic histology and maternal blood glucose in pregnant streptozotocin-induced diabetic rats. African health sciences. 2019;19:2491-504.
64. Pedersen ML. Diabetes care in the dispersed population of Greenland. A new model based on continued monitoring, analysis and adjustment of initiatives taken. Int J Circumpolar Health. 2019;78:1709257.
65. American Diabetes Association. Management of diabetes in pregnancy: Standards of medical care in diabetes-2019. Diabetes Care 2019;42:S165-72.
66. Carson LD, Henderson JN, King K, Kleszynski K, Thompson DM, Mayer P. American Indian Diabetes beliefs and practices: Anxiety, fear, and dread in pregnant women with diabetes. Diabetes Spectr 2015;28:258-63.
67. Brown J, Grzeskowiak L, Williamson K, Downie MR, Crowther CA. Insulin for the treatment of women with gestational diabetes. Cochrane Database Syst Rev 2017;11:CD012037.
68. Wei W, Zhang X. Expression of ADP and TNF-α in patients with gestational diabetes mellitus and its relationship with pregnancy outcomes. Exp Ther Med 2020;20:2184-90.
69. Pedersen ML. Diabetes care in the dispersed population of Greenland. A new model based on continued monitoring, analysis and adjustment of initiatives taken. International journal of circumpolar health 2019;78 (sup 1).
70. Fernández-Alba JJ, Soto Pazos E, Moreno Cortés R, Vilar Sánchez Á, González Macías C, Castillo Lara M, *et al.* INTERGROWTH21$_{st}$ vs customized fetal growth curves in the assessment of the neonatal nutritional status: A retrospective cohort study of gestational diabetes. BMC Pregnancy Childbirth 2020;20:139.