



Journal Of Pharmacy And Experimental Medicine



A Review On Clinical and Therapeutic Management of Gestational Diabetes Mellitus (GDM)



Samidha Shelar^{1*}, Akanksha Lad¹, Pranjal Singh¹, Siddhi Said¹, Roopa Nair¹, Perna Sanas¹, Dr. Rupesh Pingale¹

¹NCRD's Sterling Institute of Pharmacy, Plot no.93, Sector-19 Nerul(E), Opposite To Seawood Railway Station, Navi Mumbai- 400706, Maharashtra India

ARTICLE INFO

Article history:

Received 02 June 2021

Revised 26 June 2021

Accepted 09 July 2021

Available online 12 July 2021

Keywords:

Gestational diabetes mellitus

Insulin therapy

Neonatal effects

Oral hypoglycaemic

Pregnancy

Self-management

ABSTRACT

Gestational diabetes is defined as any degree of glucose intolerance with onset or first recognition during pregnancy. Gestational Diabetes Mellitus (GDM) is one of the complications which happens during pregnancy and characterized by glucose intolerance in pregnant women. GDM has an increased risk of SC labor and can result in type 2 diabetes mellitus within 10 years after pregnancy. The aim of this study was to review the effect of insulin therapy and oral hypoglycaemic drugs like metformin, glyburide on the pregnant women with gestational diabetes. As well as to study what are the diagnostic criteria and self-management should be done to prevent and reduce the effects of GDM on pregnant women as well as on the infant. The study also includes what are GDM effects on neonatal and what care should be taken.

© 2021, . Samidha Shelar. This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

Highlights

1. Diagnosis and screening of gestational diabetes mellitus, diagnostic criteria for GDM
2. Gestational Diabetes Mellitus Self Management
3. Insulin therapy on GDM
4. Oral hypoglycemics for GDM
5. Postpartum management of GDM
6. Effects of GDM on neonatal

Introduction

- Gestational diabetes can be defined as a condition of glucose intolerance with onset during pregnancy. The condition may or may not continue after pregnancy.
- The definition says whether insulin or only diet modification is required for the treatment and whether the condition will continue after pregnancy or not [1].
- GDM is a condition in which placental hormones prevent the effective use of insulin by the body. Glucose is not absorbed by the cells instead its concentration in blood increases. It causes a condition called as insulin resistance.
- The placental hormone lactogen produced during pregnancy is the main reason behind GDM [2].

Diagnosis of Gestational Diabetes Mellitus [3-14]

Diagnosis of GDM is done by 2 tests

- I. Glucose Challenge test: 75gm of Glucose is given to the patients. The sample of the patient will be collected 2 hours after oral administration of glucose. Overnight fasting is NOT mandatory. A blood glucose level of 140 mg/dL (7.8 mmol/L) or higher might indicate gestational diabetes mellitus [3, 4].
- II. Oral Glucose Tolerance Test (OGTT): Overnight fasting is mandatory. A fasting blood sample is obtained. Gestational 2 hour test receive a 75gm glucose whereas Gestational 3 hour test receive a 100gm glucose dose. Blood sample of the patient is obtained for testing after 2 and 3 hours respectively [5,6].

Screening: Screening for GDM is usually done at 24 to 28 weeks of gestation. This occurs because insulin resistance increases during the second trimester of gestation. Due to this blood glucose levels rises in women who do not have the ability to produce enough insulin to adopt this resistance [7,8].

In general, there are two approaches for the evaluation of women with GDM: the onestep approach and the two-step approach.

- A. In the **one-step approach**, the diagnostic oral glucose tolerance test (OGTT) is performed. There is no prior serum or plasma glucose screening done before this test [9,10].
- B. In the **two-step approach**, initially the 50gm glucose challenge test is performed. Then, the diagnostic 100gm OGTT is performed only in the women who are positive to glucose challenge test [7,9,10].

* Corresponding author.

Samidha Shelar, NCRD's Sterling Institute of Pharmacy, Plot no.93, Sector-19 Nerul(E), Opposite To Seawood Railway Station, Navi Mumbai- 400706, Maharashtra, India.
E-mail address: samidhashelar435@gmail.com

Diagnostic Criteria for GDM

Diagnostic criteria	Fasting (mg/dl [mmol/l])	1-h (mg/dl [mmol/l])	2-h (mg/dl [mmol/l])	3-h (mg/dl [mmol/l])
100gm OGTT Carpenter/ Coustan [11]	95 (5.3)	180 (10.0)	155 (8.6)	140 (7.8)
100gm OGTT NDDG [11]	105 (5.8)	190 (10.6)	165 (9.2)	145 (8.1)
75gm OGTT WHO 1999 [12,13]	≥ 126 (7.0)	Not required	≥ 140 (7.8)	Not required
75gm OGTT IADPSG [11-13]	≥ 92 (5.1)	≥ 180(10.0)	≥ 153 (8.5)	Not required
100gm ACOG [12,13]	≥ 95(5.3)	≥ 180(10.0)	≥ 154 (8.6)	≥ 140(7.8)
75gm OGTT DIPSI [12]	Not required	Not required	≥ 140 (7.8)	Not required
75gm OGTT ADA [11,13]	95 (5.3)	180 (10.0)	155 (8.6)	Not required
100gm OGTT NDDG [11,14]	105	190	165	145

OGTT-Oral glucose tolerance test, NDDG-National Diabetes Data Group, WHO World Health Organization 2013, IADPSG- International Association of Diabetes and Pregnancy Study Groups, ACOG- American College of Obstetricians and Gynecologists, DIPSI- Diabetes In Pregnancy Study Group of India, ADA-American Diabetes Association, NDDG- National Diabetes Data Group

Gestational Diabetes Mellitus Self-Management [15-37]

GDM self-management refers to the activities and behaviours an individual woman should undertake to control and treat this condition. Women with GDM must monitor their health regularly. Diabetes self-management typically occurs in the home and includes [15]:

- Testing blood sugar (glucose)
- Consuming balanced meals and appropriate portion sizes
- Engaging in regular exercise
- Drinking water and avoiding dehydration
- Taking medications as prescribed
- Adjusting medications as needed
- Conducting self-foot checks

The process of self-management can be a challenge for mothers who undergo it because it requires learning and the application of self-management skills in a short time [16,17]. The serious impact of maternal and neonatal morbidity in the short and long term [18], it is important for DMG mothers to get attention in performing optimal self-management.

Self-management behavior in pregnant women with GDM [19,21,22,24-29]	Barrier to mothers with DMG in performing self-management behaviors [20,21,23,30,31]	Need of mothers with DMG [20,32-36]
Eat healthy food	Lack of knowledge	Information/ knowledge
Skills in health coping	Insulin is an easy choice	support
Have good problem solving skills	Physical health constraints	
Physical activity	Lack of support	
Monitoring blood sugar	Cultural factors s	
Take medication regularly		

Self-management behavior for diabetics is healthy eating, physically active, monitoring blood sugar, adhering to drugs, good problem solving skills, healthy coping skills, and risk reduction behavior. The self-management process involves a number of challenges and demands such as lack of knowledge, physical health constraints, lack of support, and cultural factors. In an effort to improve the achievement of self-management, health workers can consider effective counseling for patients. Diabetes counselors are needed to help DMG mothers understand the principle of self-management and the need for their health conditions. The need for support from families and health workers is able to change and improve the lifestyle of people with DMG and help reduce the psychological burden [37].

Insulin Therapy on Gestational Diabetes [38-61]

Gestational diabetes mellitus (GDM) defines to any degree of glucose intolerance developing during pregnancy with a prevalence 6–20% of pregnant women worldwide [38]. GDM shows with defective insulin secretion, insulin resistance, and abnormal fetoplacental vascular function [39,40]. Also, new borns of women with GDM present an adverse outcome and higher risk of developing obesity, impaired glucose tolerance, and type 2 diabetes mellitus (T2DM) later in adulthood [38,41].

Clinical management of women with GDM begins with a conscious controlled nutritional therapy, proper meditation, glucose monitoring, and moderate physical activity. Around 70–80% of these women achieve glycaemia suggested values, i.e., fasting: ≤95 mg/dL (5.3 mmol/L), 1 h postprandial: ≤140 mg/dL (7.8 mmol/L), 2 h postprandial: ≤120 mg/dL (6.7 mmol/L) [38,41,42]. when women under a strict diet suggested by the nutritionist do not attain the suggested glycaemia, insulin therapy are used [38,40,41]. Insulin therapy in pregnant women with GDM seems to be equally effective the nutritional diet given by doctor [41]. However, not clear results are open for these protocols in GDM since not sufficient evidence is still offered [41]. It is emphasized that some of the known studies embrace women with pre-gestational diabetes mellitus and those with GDM, do not clearly discriminate amongst pregnant women with GDM on a diet from those under insulin therapy [40,43].

Different Protocols of Insulin Therapy

The backbone of insulin therapy in pregnancy has been the use of neutral protamine Hagedorn (NPH) insulin for two to four times daily. Continuous insulin injection of lispro [44] whom frequently check their blood glucose level and use glucose monitoring devices [45]. However, several factors determine the decision of a protocol for treating the patients with insulin. These protocols are determinant when treating pregnant women with GDM. It is proposed that factors in addition to the clinical characteristics of the patients should be considered, including the high dependence of insulin treatment protocol on the characteristics of the studied population (v.g, ethnicity, socio-economic factors, physical activity, stress degree, feed quality), the use of a guideline based on the local sociocultural reality, the availability of proper technical facilities, and the actual benefits of different starting points for insulin treatment during the day, evening, or night [41,42,46]. In general, the existing perinatal guidelines indicate a low daily dose of insulin which also consider the characteristics of the woman and the frequency of self-monitoring [47]. It is emphasized that more than a general approach a specific insulin therapy planning dependent on factors as those mentioned above is applied worldwide [41,47]. Interestingly, The American Diabetes Association [48] recently suggested that the exclusive measurement of glycated haemoglobin A1c (HbA1c) level may show a lower compassion related with the classical oral glucose tolerance test (OGTT) approach in GDM. Also, other reports show no variances amongst the HbA1c level in women with GDM [49] contrasting with another study where the HbA1c level was recommended as the adaptable giving the finest measure of glycaemia control when dignified tested every 2 weeks.

Insulin therapy useful to women with GDM results in a better maternal and newborn outcome compared with women with GDM treated with diet, oral anti-diabetic drugs, or insulin analogues (Table 1). Valuable effects of insulin therapy include lesser rate of macrosomia [49,52,53], lower cranial-thoracic circumference ratio [54], or minor

incidence of caesarean sections [55]. Several other characteristics of the neonate are immune [50,56-60]. However, the use of long-acting versus short-acting insulin increased the incidence of macrosomia this case is however rare [61].

Oral Hypoglycemics [62-73]

The clinical and public health relevance of gestational diabetes mellitus (GDM) is widely debated because of its increasing incidence, the resulting negative economic impact, and therefore the potential for severe GDM-related pregnancy complications. Also, effective prevention strategies during this area are still lacking, and controversies exist regarding diagnosis and management of this manner of diabetes. Different diagnostic criteria are currently adopted worldwide, while recommendations for diet, physical activity, healthy weight, and use of oral hypoglycemic drugs don't seem to be always uniform [65,66].

The comparable efficacy, lower cost, easy administration and better patient adherence to oral hypoglycemic agents compared to insulin makes oral therapy attractive [71]. Women who begin insulin therapy require education to confirm the safe administration of insulin. Use of insulin is additionally related to hypoglycemia and weight gain. the utilization of safe and effective oral agents may offer advantages over insulin [63,64]. The foremost extensively studied oral hypoglycemic agents in pregnancy are glyburide (second generation sulfonylurea) and metformin (biguanide) [71]. Oral hypoglycemic agents are a beautiful choice to insulin thanks to their lower cost and easy administration, which increase patient compliance. Metformin works by increasing sensitivity to insulin [67,68].

Metformin vs Insulin

Oral metformin could be a logical option for women with gestational DM. It improves insulin sensitivity, probably by activating AMP kinase, and isn't related to weight gain or hypoglycemia. Reported outcomes of its use during pregnancy are favourable apart from one small, retrospective cohort study that showed increased rates of perinatal loss and preeclampsia as compared with insulin treatment. Metformin crosses the placenta and will affect foetal physiology directly [63,64].

Hyperglycemia is related to adverse outcomes of pregnancy in women with gestational or pre-existing diabetes. The principal approach to glycemic control in pregnant women with diabetes is dietary therapy, with the addition of insulin when diet alone isn't sufficient. Insulin therapy is effective in achieving the acceptable levels of glycemia, but it's inconvenient and expensive [62].

Glyburide vs Metformin

Several authoritative bodies recommend that sulfonylurea drugs not be during pregnancy thanks to their potential to cause neonatal hypoglycemia and foetal anomalies. This recommendation relies mainly on studies done before the supply of medicine like glyburide and glipizide, which are in common use today. It's demonstrated in laboratory studies that glyburide doesn't cross the human placenta in appreciable quantities, in contrast to older sulfonylurea drugs and metformin. On the idea of those findings and also the relatively mild hyperglycemia in most pregnant women with gestational diabetes, it's hypothesized that glyburide may well be another to insulin therapy in such women [72,73].

Glyburide and metformin are comparable oral treatments for GDM regarding glucose control and adverse effects. Their combination demonstrates a high efficacy rate with a significantly reduced need for insulin, with a possible advantage for metformin over glyburide as first-line therapy [67,68].

Metformin is fastest in glucose control, with a more favourable pregnancy outcomes—would be an improved option, but its rate of glucose control is that the lowest. However, glyburide is that the optimum treatment regarding the speed of glucose control, but with more adverse outcomes [69,70].

Postpartum Management of GDM [74-91]

GDM is a common condition experienced during pregnancy that is

associated with long term maternal risk for the development of type 2 diabetes following the index pregnancy. The pathogenesis of GDM and insulin resistance, risk factors, links to diabetes following the pregnancy and clinical practice recommendations for this population reviewed [74].

Diabetes prevalence has increased dramatically with 1.3million cases diagnosed annually. Women with GDM are at increased risk for developing overt diabetes later in life. The article reviews the roles of medical nutrition therapy, physical activity, and pharmacotherapy in preventing type 2 diabetes in women with a GDM history [75]. GDM affects approximately 4% of all pregnant women in the US and represents of all cases of diabetes mellitus diagnosed during pregnancy. Opportunities to diagnose and prevent type 2 diabetes mellitus in women with a history of GDM include early diagnosis by postpartum screening and implementation of diabetes prevention measures [76]. Monitoring of glucose, fetal stress, and fetal weight through ultrasound combined with maternal weight management, medical nutritional therapy, physical activity, and pharmacotherapy can decrease comorbidities associated with GDM [77].

It is estimated that 6% to 9% of pregnancies are complicated by diabetes; approximately 90% of which are GDM. GDM is carbohydrate intolerance during pregnancy leading to hyperglycemia [78].

Incidence of type 2 diabetes is high after GDM. Despite the high attendance rate of 6 weeks postpartum visit and glucose testing, low rates of longer term follow-up regarding postpartum glucose testing was observed [79].

GDM is common but controversial disorder. While no large randomized controlled trials show that screening for and treating gestational diabetes affect perinatal outcomes, multiple studies have documented an increase in adverse pregnancy outcomes in patients with the disorder [80].

The majority of women with GDM are not tested for glucose intolerance after delivery. Post partum visit attendance is the only identified factor strongly associated with testing [81]. There was insufficient evidence to determine the effectiveness of alternatives of insulin for gestational diabetes, but use of such alternatives was unlikely to result in maternal or foetal adverse events [82].

Women with recent GDM report multiple barriers and facilitators of postpartum. The results will inform the development of interventions to improve care for these women to reduce subsequent diabetes risk [83]. GDM- a transitory form of diabetes first recognised during pregnancy complicates between <1% and 28% of all pregnancies [84]. Diet is the mainstay of treatment in GDM, but physical activity is a helpful adjunctive therapy when euglycemia is not achieved by diet alone [85]. Once a women is diagnosed with GDM, two strategies are considered for management; lifestyle modifications and pharmacological therapy [86]. Based on the hyperglycemia and adverse pregnancy outcome study, new universal screening recommendations and cut offs for GDM have been proposed. In addition to the intermediate perinatal risk, GDM carries an increased risk of metabolic disease in the mother and child [87].

Newly proposed diagnostic criteria will, if adopted universally, further increase the prevalence of this condition. Much controversy surrounds the diagnosis and management of gestational diabetes [88]. Exploring the health behaviours of women with recent gestational diabetes mellitus in the first year postpartum [89]. Worldwide there are many guidelines with recommendations for appropriate management strategies for GDM once lifestyle modifications have been instituted and failed to achieve control [90].

Determining whether antepartum variables can predict postpartum glucose intolerance. Postpartum glucose screening is not warranted for women at low risk who do not require insulin during pregnancy. The incidence of postpartum glucose intolerance in this group is very low [91].

Effects of GDM on Neonatal [92-109]

Foetal exposure to GDM is said to alter foetal growth and increase the risk of macrosomia [92]. The higher risk of foetal malformations

wit GDM suggests that many of these women may have high glucose levels even during the first trimester [93]. The initial colonization of the human microbiota and the impact of maternal health on neonatal microbiota at birth remain largely unknown [94].

Specific maternal, neonatal and offspring benefits of lifestyle interventions during pregnancy to prevent or improve GDM control or to limit GWG still require clarification [95]. Age and BMI before pregnancy where the predominant mediators of the increased risk of GDM, whereas a higher income and educational level were protective [96]. Foetal growth in GDM is directly linked to maternal glycaemic control [97]. Glucose monitoring during pregnancy is indispensable for improving glycaemic control and reducing the risk of perinatal outcomes [98]. Suboptimal glycaemic control in women with GDM is associated with adverse neonatal outcome [99]. The effect of maternal glucose concentrations on neonatal anthropometry is continuous and extends into the normal glycaemic range [100]. Women with GDM still have increased incidence of obstetric and neonatal complications, which could imply that treatment of women with GDM should be tightened [101]. In twin pregnancies, gestational diabetes was associated with a higher risk of gestational hypertension and preeclampsia [102].

Gestational diabetes is associated with hypothyroidism, obesity, and lipid abnormalities, majority of women require insulin for treatment [103]. Increased maternal prepregnancy weight, weight gain in pregnancy and glycaemia in pregnancy all place IGDM at increased risk of macrosomia and adiposity [104].

When added to usual care, habits- GDM resulted in better maternal glycaemic control and composite neonatal outcomes [105]. GDM affects lipid metabolism of neonates. As a consequence of GDM foetal HDL composition is altered [106]. A deep investigation on the factors associated with adverse neonatal outcomes requires a risk stratification [107]. The risk of composite neonatal morbidity is significantly increased in GDM offspring [108]. Neonatal hypoglycaemia and hyperbilirubinaemia largely occur in different pregnancies. Both are associated with earlier GDM diagnosis [109].

Conclusion

The incidence of GDM is increasing nowadays and, if not diagnosed, managed and treated adequately, it can have unfavourable maternal and fetal outcomes. Glycaemic control can be achieved with a combination of nutritional, lifestyle and pharmaceutical therapies. Lifestyle changes, exercise and following diet prescribed by physician remain the mainstay of GDM management. If these changes do not help in managing the blood glucose levels, then hypoglycaemic drugs are used. Insulin analogues are used for improving metabolic control by reducing postprandial hyperglycemia. Various research studies have found glyburide and metformin safe and as effective as insulin in GDM management. GDM patients have got the higher risk of developing Type 2 diabetes in their later life hence they should remain under long term follow up with the doctors. New methods for diagnosis and management of GDM are being studied, but further research is required for their routine use.

Acknowledgements

None

Conflict of Interest

None

References

- Metzger BE, Coustan DR (Eds.): Proceedings of the Fourth International Workshop Conference on Gestational Diabetes Mellitus. Diabetes Care 21 (Suppl. 2):B1– B167, 1998
- <https://www.hopkinsmedicine.org/health/conditions-and-diseases/diabetes/gestational-diabetes/> 12/03/2021 ; 20:13pm)
- <https://www.lalpathlabs.com/pathology-test/glucose-challenge-test-gct-pregnancy75g-glucose> (09/03/21; 10:17am)
- <https://www.fogsi.org/screening-for-gestational-diabetes/> (09/03/21; 11:09am)
- <https://www.rmlonline.com/site/sections/53> (09/03/21; 10:07am)
- <https://www.webmd.com/diabetes/guide/oral-glucose-tolerance-test> (09/03/21;10:23am)

- Andrew Garrison, MD, Central City Community Health Center and the University of Utah, Salt Lake City, Utah. Screening, Diagnosis, and Management of Gestational Diabetes Mellitus. American Family Physician. 2015 Apr 1.91(7): 460-467.
- Berger H1, Crane J, Farine D, Armson A, De La Ronde S, Keenan-Lindsay L, Leduc L, Reid G, Van Aerde J, Maternal-Fetal Medicine Committee, Executive and Council of the Society of Obstetricians and Gynaecologists of Canada. Screening for gestational diabetes mellitus. Journal of Obstetrics and Gynaecology Canada. 01 Nov 2002, 24(11):894-912
- Hillier TA, Vesco KK, Whitlock EP, et al. Screening for Gestational Diabetes Mellitus. Agency for Healthcare Research and Quality (US). 2008 May; Evidence Syntheses, No. 60.
- V Seshiah1, V Balaji 2, Madhuri S Balaji 2, Aruna Sekar 2, C B Sanjeevi 3, Anders Green 4. One step screening procedure for screening and diagnosis of gestational diabetes mellitus. The Journal of Obstetrics and Gynecology of India November/December 2005, Vol. 55, No. 6: Pg 525-529
- Bonaventura C. T. Mpondo, Alex Ernest and Hannah E. Dee. Gestational diabetes mellitus: challenges in diagnosis and management. Journal of Diabetes & Metabolic Disorders. 2015 May. Volume 14; Article no 42.
- P. Reddi Rani1 and Jasmina Begum2. Screening and Diagnosis of Gestational Diabetes Mellitus, Where Do We Stand. Journal of Clinical & Diagnostic Research. Volume : 10; Issue : 04; QE01–QE04
- T Karagiannis,1 E Bekiari,1 K Manolopoulos,2 K Paletas,1 and A Tsapas 1,3. Gestational diabetes mellitus: why screen and how to diagnose. Hippokratia. 2010 Jul-Sep; 14(3): 151–154.
- Kyu Yeon Hur 1,2. New Diagnostic Criteria for Gestational Diabetes Mellitus and Pregnancy Outcomes in Korea. Diabetes & Metabolism Journal. 2019 Dec; 43(6): 763–765.
- Rural Health Information Hub ,Self Mangement Model <https://www.ruralhealthinfo.org/toolkits/diabetes/2/selfmanagement#:~:text=Diabetes%20self%2Dmanagement%20typically%20occurs,Engaging%20in%20regular%20exercise>
- C. Hurst et al., "Investigating the Perceived Benefits, Barriers and Beliefs towards Physical Activity in Pregnancy among Women with Gestational Diabetes Mellitus," Ir. Med. J., vol. 110, no. 7, p. 617, Aug. 2017. 1st International Respati Health Conference (IRHC) [Juli 2019]
- R. Martis, J. Brown, J. McCra-Couper, and C. A. Crowther, "Enablers and barriers for women with gestational diabetes mellitus to achieve optimal glycaemic control - a qualitative study using the theoretical domains framework," BMC Pregnancy Childbirth, vol. 18, no. 1, p. 91, 11 2018.
- F. Ghaffari, M. Salsali, Z. Rahnavard, and S. Parvizy, "Compliance with treatment regimen in women with gestational diabetes: Living with fear," Iran. J. Nurs. Midwifery Res., vol. 19, no. 7 Suppl1, pp. S103–S111, Feb. 2014.
- L. Yuen and V. W. Wong, "Gestational diabetes mellitus: Challenges for different ethnic groups," World J. Diabetes, vol. 6, no. 8, pp. 1024–1032, Jul. 2015.
- T. Emamgoli Khooshehchin, Z. Keshavarz, M. Afrakhteh, E. Shakibazadeh, and S. Faghihzadeh, "Perceived needs in women with gestational diabetes: A qualitative study," Electron. Physician, vol. 8, no. 12, pp. 3412–3420, Dec. 2016.
- Y. Y. E. Wah, M. McGill, J. Wong, G. P. Ross, A.-J. Harding, and I. Krass, "Selfmanagement of gestational diabetes among Chinese migrants: A qualitative study," Women Birth, Nov. 2018.
- M. Carolan, G. K. Gill, and C. Steele, "Women's experiences of factors that facilitate or inhibit gestational diabetes self-management," BMC Pregnancy Childbirth, vol. 12, p. 99, Sep. 2012.
- J. Parsons, K. Sparrow, K. Ismail, K. Hunt, H. Rogers, and A. Forbes, "Experiences of gestational diabetes and gestational diabetes care:

- a focus group and interview study," BMC Pregnancy Childbirth, vol. 18, no. 1, p. 25, 11 2018.
24. M. Carolan, "Women's experiences of gestational diabetes self-management: a qualitative study," Midwifery, vol. 29, no. 6, pp. 637-645, Jun. 2013.
 25. H. T. Neufeld, "Food perceptions and concerns of aboriginal women coping with gestational diabetes in Winnipeg, Manitoba," J. Nutr. Educ. Behav., vol. 43, no. 6, pp. 482-491, Dec. 2011.
 26. A. Kubo et al., "Perceived psychosocial stress and gestational weight gain among women with gestational diabetes," PLoS ONE, vol. 12, no. 3, Mar. 2017.
 27. E. S. Miller, M. R. Peri, and D. R. Gossett, "The association between diabetes and postpartum depression," Arch. Womens Ment. Health, vol. 19, no. 1, pp. 183-186, Feb. 2016.
 28. S. Barakat, D. Martinez, M. Thomas, and M. A. Handley, "What do we know about Gestational Diabetes Mellitus and Risk for Postpartum Depression among Ethnically Diverse Low-Income Women in the United States?," Arch. Womens Ment. Health, vol. 17, no. 6, pp. 587-592, Dec. 2014.
 29. F. M. Javid, M. Simbar, M. Dolatian, and H. A. Majd, "Comparison of Lifestyles of Women With Gestational Diabetes and Healthy Pregnant Women," Glob. J. Health Sci., vol. 7, no. 2, pp. 162-169, Mar. 2015.
 30. S. Youngwanichsetha and S. Phumdoung, "Lived experience of blood glucose selfmonitoring among pregnant women with gestational diabetes mellitus: a phenomenological research," J. Clin. Nurs., vol. 26, no. 19-20, pp. 2915-2921, 2017.
 31. A. L. Hui, G. Sevenhuysen, D. Harvey, and E. Salamon, "Stress and anxiety in women with gestational diabetes during dietary management," Diabetes Educ., vol. 40, no. 5, pp. 668-677, Oct. 2014.
 32. S. Benavides-Vaello and S. A. Brown, "Sociocultural construction of food ways in lowincome Mexican-American women with diabetes: a qualitative study," J. Clin. Nurs., vol. 25, no. 15-16, pp. 2367-2377, Aug. 2016.
 33. D. Marchetti, D. Carrozzino, F. Fraticelli, M. Fulcheri, and E. Vitacolonna, "Quality of Life in Women with Gestational Diabetes Mellitus: A Systematic Review," J. Diabetes Res., vol. 2017, 2017.
 34. B. U. Devsam, F. E. Bogossian, and A. S. Peacock, "An interpretive review of women's experiences of gestational diabetes mellitus: Proposing a framework to enhance midwifery assessment," Women Birth, vol. 26, no. 2, pp. e69-e76, Jun. 2013.
 35. A. Vas et al., "Effectiveness of self-management programmes in diabetes management: A systematic review," Int. J. Nurs. Pract., vol. 23, no. 5, Oct. 2017. 1st International Respati Health Conference (IRHC) [Juli 2019]
 36. P. Soewondo, A. Ferrario, and D. L. Tahapary, "Challenges in diabetes management in Indonesia: a literature review," Glob. Health, vol. 9, p. 63, Dec. 2013.
 37. SELF-MANAGEMENT ON GESTATIONAL DIABETES MELLITUS: a scientific LITERATURE REVIEW 231 American Diabetes Association Standards of medical care in diabetes-2017: summary of revisions Diabetes Care, 40 (2017), pp. 4-5, 10.2337/dc17-S005
 39. R. Wagner, L. Fritsche, M. Heni, E. Fehrlert, N. Stefan, H. Staiger, H.U. Häring, A. Fritsche A novel insulin sensitivity index particularly suitable to measure insulin sensitivity during gestation Acta Diabetol., 53 (2016), pp. 1037-1044, 10.1007/s00592-016-0930-5
 40. L. Sobrevia, R. Salsoso, T. Sáez, C. Sanhueza, F. Pardo, A. Leiva Insulin therapy and fetoplacental vascular function in gestational diabetes mellitus Exp. Physiol., 100 (2015), pp. 231-238, 10.1113/expphysiol.2014.082743
 41. J. Brown, L. Grzeskowiak, K. Williamson, M.R. Downie, C.A. Crowthe Insulin for the treatment of women with gestational diabetes Cochrane Database Syst. Rev., 2017 (2017), Article CD012037, 10.1002/14651858.CD012037.pub2
 42. K. Mayo, N. Melamed, H. Vandenberghe, H. Berger. The impact of adoption of the International Association of Diabetes in pregnancy study group criteria for the screening and diagnosis of gestational diabetes Am. J. Obstet. Gynecol., 212 (2015), p. 224
 43. M. Subiabre, L. Silva, R. Villalobos-Labra, F. Toledo, M. Paublo, M.A. López, R. Salsoso, F. Pardo, A. Leiva, L. Sobrevia Maternal insulin therapy does not restore foetoplacental endothelial dysfunction in gestational diabetes mellitus Biochim. Biophys. Acta Mol. basis Dis., 1863 (2017), pp. 2987-2998, 10.1016/j.bbadis.2017.07.022
 44. A. Bhattacharyya, S. Brown, S. Hughes, P.A. Vice Insulin lispro and regular insulin in pregnancy Q. J. Med., 94 (2001), pp. 255-260, 10.1093/qjmed/94.5.255
 45. I.B. Hirsch Insulin analogues N. Engl. J. Med., 352 (2005), pp. 174-183, 10.1056/NEJMr040832
 46. C. Kim Gestational diabetes: risks, management, and treatment options Int. J. Womens Health, 2 (2010), pp. 339-351, 10.2147/IJWH.S13333
 47. Committee on Practice Bulletins—Obstetrics Practice bulletin no. 180 Obstet. Gynecol., 130 (2017), pp. 17-37, 10.1097/AOG.0000000000002159
 48. American Diabetes Association Classification and diagnosis of diabetes Diabetes Care, 40 (2017), pp. S11-S24, 10.2337/dc17-S005
 49. O. Langer, D.L. Conway, M.D. Berkus, E.M.-J. Xenakis, O. Gonzales A comparison of glyburide and insulin in women with gestational diabetes mellitus N. Engl. J. Med., 343 (2000), pp. 1134-1138, 10.1056/NEJM200010193431601
 50. P.R. Olmos, G.R. Borzone, R.I. Olmos, C.N. Valencia, F.A. Bravo, M.I. Hodgson, C.G. Belmar, J.A. Poblete, M.O. Escalona, B. Gómez Gestational diabetes and pre-pregnancy overweight: possible factors involved in newborn macrosomia J. Obstet. Gynaecol. Res., 38 (2012), pp. 208-214
 51. O. Vèrier-Mine Outcomes in women with a history of gestational diabetes. Screening and prevention of type 2 diabetes. Literature review Diabete Metab., 36 (2010), pp. 595-616, 10.1016/j.diabet.2010.11.011
 52. T. Sáez, P. de Vos, L. Sobrevia, M.M. Faas Is there a role for exosomes in foetoplacental endothelial dysfunction in gestational diabetes mellitus? Placenta, 61 (2018), pp. 48-54, 10.1016/j.placenta.2017.11.007
 53. D.R. Coustan, S.B. Lewis, L.S.B. Insulin therapy for gestational diabetes Obstet. Gynecol., 51 (1978), pp. 306-310, 10.1097/00006250-197803000-00010
 54. D.J. Thompson, K.B. Porter, D.J. Gunnells, P.C. Wagner, J.A. Spinato Prophylactic insulin in the management of gestational diabetes Obstet. Gynecol., 75 (1990), pp. 960-964, 10.1016/0020-7292(91)90240-6
 55. H. Ijäs, M. Vääräsmäki, L. Morin-Papunen, R. Keravuo, T. Ebeling, T. Saarela, T. Raudaskoski Metformin should be considered in the treatment of gestational diabetes: a prospective randomised study Br. J. Obstet. Gynaecol., 118 (2011), pp. 880-885, 10.1111/j.1471-0528.2010.02763.x
 56. Y. Min, C. Lowy, K. Ghebremeskel, B. Thomas, D. Bitsanis, M.A. Crawford Fetal erythrocyte membrane lipids modification: preliminary observation of an early sign of compromised insulin sensitivity in offspring of gestational diabetic women Diabet. Med., 22 (2005), pp. 914-920, 10.1111/j.1464-5491.2005.01556.x
 57. G. Di Cianni, L. Volpe, A. Ghio, C. Lencioni, I. Cuccuru, L. Benzi, S. Del Prato Maternal metabolic control and perinatal outcome in women with gestational diabetes mellitus treated with lispro or aspart insulin: comparison with regular insulin Diabetes Care, 30 (2007), p. e11, 10.2337/dc06-2586
 58. L. Jovanovic, S. Ilic, D.J. Pettitt, K. Hugo, M. Gutierrez, R.R. Bowsher, E.J. Bastyr Metabolic and immunologic effects of insulin lispro in gestational diabetes Diabetes Care, 22 (1999), pp. 1422-1427, 10.2337/diacare.22.9.1422
 59. C.P. Spaulonci, L.S. Bernardes, T.C. Trindade, M. Zugaib, R.P.V. Fran-

- cisco Randomized trial of metformin vs insulin in the management of gestational diabetes. *Am. J. Obstet. Gynecol.*, 209 (2013), pp. 34.e1-34.e7, 10.1016/j.ajog.2013.03.022
60. M.A. Hickman, R. McBride, K.A. Boggess, R. Strauss Metformin compared with insulin in the treatment of pregnant women with overt diabetes: a randomized controlled trial. *Am. J. Perinatol.*, 30 (2013), pp. 483-489, 10.1055/s-0032-1326994
 61. M. Pöyhönen-Alho, K. Teramo, R. Kaaja Treatment of gestational diabetes with short- or long-acting insulin and neonatal outcome: a pilot study. *Acta Obstet. Gynecol. Scand.*, 81 (2002), pp. 258-259,
 62. Langer O, Conway DL, Berkus MD, Xenakis EM, Gonzales O. A comparison of glyburide and insulin in women with gestational diabetes mellitus. *N Engl J Med.* 10.1056/NEJM200010193431601.
 63. Rowan JA, Hague WM, Gao W, Battin MR, Moore MP, Mi GTI. Metformin versus insulin for the treatment of gestational diabetes. *N Engl J Med.* 2008;358(19):2003–15. doi: 10.1056/NEJMoa0707193.
 64. Rowan JA, Mi GI. A trial in progress: gestational diabetes. Treatment with metformin compared with insulin (the metformin in gestational diabetes [MiG] trial). *Diabetes Care.* 2007;30(Suppl 2):S214–9. doi: 10.2337/dc07-s219.
 65. Gestational diabetes mellitus: an updated overview
 66. E. Chiefari, B. Arcidiacono, D. Foti & A. Brunetti
 67. Glyburide versus metformin and their combination for the treatment of gestational diabetes mellitus: a randomized controlled study
 68. Z Nachum, N Zafran, R Salim, N Hissin
 69. Comparative efficacy and safety of oral antidiabetic drugs and insulin in treating gestational diabetes mellitus: an updated PRIS-MA-compliant network meta ...
 70. H Liang, S Ma, Y Xiao, H Tan - *Medicine*, 2017 - ncbi.nlm.nih.gov
 71. Oral hypoglycemic agents for gestational diabetes mellitus
 72. AC Maymone, JP Baillargeon, J Menard... - Expert opinion on ..., 2011 - Taylor & Francis
 73. Scholarly articles for oral hypoglycemic agents for gestational diabetes mellitus
 74. Jane Faith Kapustine. *J Am Acad Nurse Pract.* 2008 Nov.
 75. Meena Khandelwal. *Curr Diab Rep.* 2008 Aug.
 76. Rhonda Bentley Lewis et al. *Nat Clin Pract Endocrinol Metab.* 2008 Oct.
 77. Catherine Kim, MD, MPH
 78. Killion, Molly M. MS, RN, CNS July/ August 2018
 79. Sarah H Koning, *Journal of diabetes and metabolic disorders* 15(1), 1-9, 2016
 80. David K Turok, *American family physician* 68(9), 1767-1772, 2003
 81. Michelle A Russell, *Obstetrics & Gynecology* 108 (6), 1456-1462, 2006
 82. Nicholson WK, Wilson LM, Wiktop CT, et al.
 83. Wendy L Bennett, *Journal of womens health* 20 (2), 239-245, 2011
 84. Karoline Kragelund Nielsen, *BMC pregnancy and childbirth* 14 (1), 1-18, 2014
 85. Guido Menato, *Expert Review of Obstetrics & Gynecology* 3 (1), 73-91, 2008
 86. Z Asli Oskovi-Kalpan , *Diabetes: from research to clinical practice: Volume 4*, 257-272, 2021
 87. Caroline Spaight, *Novalties in Diabetes* 31, 163-178, 2016
 88. Donald R Coustan , *Clinical chemistry* 59 (9), 1310-1321, 2013
 89. Marilyn K Evans, *Candian journal of diabetes* 34 (3), 227-232, 2010
 90. Kristi W Kelley, *Drugs in context* 4, 2015
 91. Laurie R Greenberg, *Obstetrics & Gynecology* 86 (1), 97-101, 1995
 92. S Macaulay, *Diabetic Medicine* 35 (10), 1425- 1433, 2018
 93. Sven Schneider, *Acta Obstetrica et gynecologica Scandinavica* 90 (3), 231-237, 2011
 94. Jinfeng Wang, *Gut* 67(9), 1614-1625, 2018
 95. Delphine Mitanchez, *Nutrients* 12 (2), 353, 2020
 96. Grzegorz Domanski, *BMC pregnancy and childbirth* 18 (1), 1-11, 2018
 97. Jane L Tarry-Adkins, *PLoS medicine* 17 (5), e1003126, 2020
 98. Qiong WEI, Zilin SUN, Article number 19920 (2016)
 99. Victor Hugo Gonzalez- Quintero, *Diabetes care* 30 (3), 467-470, 2007
 100. Jacqueline C Hill, *Acta Obstetrica et gynecologica Scandinavica* 84 (2), 159-165, 2005
 101. Per Glud Ovesen, *The Journal of Maternal-Fetal & Neonatal Medicine* 28 (14), 1720 1724, 2015
 102. MA Guillen, *Diabetic medicine* 31(12), 1651-1656, 2014
 103. G Thiruvikrama Prakash, *Indian Journal of endocrinology and metabolism* 21 (6), 854, 2017
 104. Betty R Vohr, *Diabetes care* 18 (4), 467-475, 1995
 105. Tong Wei Yew, *Diabetes care* 44 (2), 456-463, 2021
 106. Ivana Sreckovc a, I... Christian Wadsack.
 107. Basilio Pintaui, *Acta diabetologica* 55 (12), 1261-1273, 2018
 108. Martina Persson, *Diabetes care* 36 (11), 3543-3548, 2013
 109. A Thevarajah, D Simmons, 10 april 2019



Submit your manuscript to Boston science publishing journal and benefit from:

- ▶ Convenient online submission
- ▶ Rigorous peer review
- ▶ Immediate publication on acceptance
- ▶ Open access: articles freely available online
- ▶ High visibility within the field
- ▶ Retaining the copyright to your article

Submit your manuscript at [bostonsciencepublishing.us](https://www.bostonsciencepublishing.us)