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Original Research Article

Screening and diagnosis of gestational diabetes: a hybrid method

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ABSTRACT

Background: In Mexico the gestational diabetes prevalence varies between 4 and 13%. The main purpose of this study is to determine the prevalence of gestational diabetes, the relevance of its risk factors, and its repercussions in pregnancy with a hybrid diagnostic method.
Methods: This prospective, longitudinal, and observational study includes 347 pregnant women. Screening for gestational diabetes was performed with the O'Sullivan test, with a cut-off point of 140 mg/dL of glucose, followed by a 75-gram oral glucose tolerance test in patients with an abnormal screening test. The diagnosis was made with one or more abnormal results. Different variables were evaluated in these patients; from risk factors, to complications of gestational diabetes.
Results: Of the 347 patients studied, 77 (22.2%) had a positive screen and 34 patients were confirmed with gestational diabetes (9.8%). A body mass index greater than or equal to 25 increased the relative risk by 2.52, the history of macrosomia by 4.10, a maternal age greater than or equal to 36 years by 2.54, and the presence of a twin pregnancy by 6.94. Regarding complications, there was an increase in prevalence of macrosomia (RR=4.09).
Conclusions: The prevalence of gestational diabetes, using the combination of the two existing classical methods, is similar to that reported in other national and international studies, while also avoiding overdiagnosis, over-monitoring, and reducing typical discomforts that may come by using the one-step method.

Keywords: Diabetes, Gestational, Curve, Complications, Screening, Diagnosis

INTRODUCTION

Gestational diabetes' global prevalence corresponds to 17% with regional variations according to race, maternal age, and body mass index. In Mexico, the gestational diabetes prevalence varies between 4 and 13%.[1-3] This disease has been associated with increased short-term risks, such as: hypertensive disorders of pregnancy, increased incidence of cesarean delivery, obstetric trauma, fetal macrosomia, perinatal mortality, neonatal respiratory and metabolic complications, and hydramnios; as well as, an increased long-term risk in mothers of developing type 2 diabetes and cardiovascular disease.[4] It also increases the risk of obesity, abnormal glucose tolerance, hypertension, metabolic syndrome, as well as autism and other neurodevelopmental disorders in adolescents and adults exposed during their gestation.[5] All pregnant women should be screened for gestational diabetes using laboratory tests for serum glucose.[6,7] Screening is usually effected between the 24th and 28th week of gestation, because insulin resistance increases significantly from the 24th week of pregnancy, leading to hyperglycemia in those patients with insufficient secretory capacity to maintain euglycemia.[8,9] Diagnosis can be made with either one-step or two-step tests. The two-step test, used since 1973 consists of a first screening based on the administration of 50 grams of oral glucose followed by a venous glucose measurement one hour after loading (O'Sullivan's test); patients who reach or exceed the reference limit are subjected to a 3-hour glucose tolerance curve with the administration of a load of 100 grams of oral glucose.[10]

The glucose tolerance curve uses the values from Carpenter and Coustan as the most accepted reference: basal glucose 95 mg/dl, one hour post load 180 mg/dl, two hours post load 155 mg/dl and 3 hours post load 140 mg/dl; Gestational diabetes is diagnosed when the patient has two or more abnormal values on the oral glucose tolerance curve.[9] The one-step test, promoted since 2010 by the International Association of Diabetes and Pregnancy Study Group (IADPSG), consists of universally implementing a glucose tolerance curve with 75 grams of oral glucose and 3 glucose determinations: fasting , one hour and two hours postload, with reference values less than 92 mg/dl fasting, 180 mg/dl one hour postload and 153 mg/dl two hours postload, requiring only a value greater than or equal to the reference to establish the diagnosis.[11] Using a one-step diagnostic method significantly increases the prevalence of gestational diabetes, but this population includes women with an already low risk for adverse outcomes and who do not seem to gain similar benefits from diagnosis and treatment compared to women who are diagnosed with gestational diabetes by traditional methods.[12] In 2017, the American Diabetes Association (ADA) recognized that there is no clear evidence to support the recommendation of the one-step approach over the traditional two-step approach.[13] On the other hand, the oral glucose tolerance curve with 100 grams and 4 measurements has been shown to be associated with increased maternal stress and dissatisfaction with the diagnostic process in addition to gastric irritation, delayed emptying, and gastrointestinal osmotic imbalance causing nausea and vomiting secondary to the highly concentrated hyperosmolar glucose solution.[14,15] While the 100 gram curve is typically run as the second step in the two-step test and the 75-gram curve is run as the only step in the one-step test, this is arbitrary. In fact, the Canadian Diabetes Association Guidelines suggest the 75-gram oral glucose tolerance curve as the second step of the two-step approach.[16] The American College of Obstetricians and Gynecologists (ACOG) mentions in its practice bulletin number 190 (February 2018) that patients with only one high value of glucose after the 100 grams test, have an increased risk of adverse results.[9] The main objective of this study is to determine the prevalence of gestational diabetes, the relevance of its risk factors, and its repercussions in pregnancy with a hybrid diagnostic method.

METHODS

Based on the STARD 2015 checklist, a prospective, longitudinal, descriptive, and observational study was carried out from January 1st 2019 to December 31st 2021, including 347 pregnant women from the Fray Juan de San Miguel Hospital in Uruapan, Michoacán, México.[17] The inclusion criterion was that the patient had a basal glucose in the first trimester less than or equal to 100 mg/dl. The exclusion criterion included all patients with a basal glucose level greater than 100 mg/dl and patients with previous diabetes. All patients were screened for gestational diabetes between the 24th to 28th week of gestation with an O'Sullivan's test (serum venous glucose one hour after administration of a 50 gram load of oral glucose), taking 139 mg/dl as the maximum normal reference limit. If this value was greater than or equal to 140 mg/dl, an oral glucose tolerance curve was performed with a load of 75 grams. In accordance with the IADPSG (International Association of the Diabetes and Pregnancy Study Groups) and ADA (American Diabetes Association) criteria, the maximum reference value in fasting is 92 mg/dl, in one hour post load it's 180 mg/dl, and in two hours post load it's 153 mg/dl. To establish the diagnosis of gestational diabetes, one or more of these values must be above the reference ranges. Certain variables were analyzed such as: age, number of pregnancies, history of macrosomic infants, family history of diabetes, body mass index (BMI) (classifying the patient as low weight with a BMI less than 18.5, normal weight with a BMI of 18.5 to 24.9, overweight with a BMI of 25 to 29.9, type I obesity with a BMI of 30 to 34.9, type II obesity with a BMI of 35 to 39.9, and type III obesity with a BMI greater than 40), and weight gain from the first to the second trimester (taking 0-4.99% of the initial weight as a normal increase). When gestational diabetes was diagnosed, management was based on a specific diet according to the hospital´s nutrition service and the response was assessed a week after it began, with a basal glucose goal less than or equal to 95 mg/dl and two hours postprandial less than 125 mg/dl. When these objectives were not achieved, medical management with metformin or insulin was started, according to the characteristics of each patient. Data was collected in google sheets spreadsheet and the results were analyzed and converted to tables with IBM SPSS Statics 29. Gestational diabetes relative risk was obtained in relation to the mother's age, family history of diabetes, previous macrosomic infants, initial BMI, weight gain during pregnancy, multiparity, and twin pregnancy. The relative risk of obstetric outcomes was also determined, including the new born´s weight, weeks of gestation of the product at birth, weeks of gestation, route of birth, Apgar score at 5 minutes, and incidence of preeclampsia.

RESULTS

Total 347 patients were screened with the 50 grams-oral glucose load, of which, 77 had values greater than or equal to 140 mg/dl, corresponding to 22.19% of the total. These patients underwent an oral glucose tolerance curve with 75 grams, of which 34 had one or more abnormal values, corresponding to 44.1% of the curves performed and a diagnosis of gestational diabetes in 9.8% of the total screened population. Of the 34 patients diagnosed with gestational diabetes, 23 had a single abnormal value, 9 had two abnormal values, and the remaining 2 had all 3 abnormal values. Based on age, from the 347 patients, 25 were classified in the range of 15 to 20 years, of which, only one patient had gestational diabetes (4.0%); 75 patients corresponded to the group of 21 to 25 years, of which, 4 had gestational diabetes (5.33%); 91 patients were classified in the range of 26 to 30 years, of which, 7 had gestational diabetes (7.69%); 113 in the range of 31 to

35 years, of which, 13 had gestational diabetes (11.5%), 35 in the range of 36 to 40 years, of which, 7 had gestational diabetes (20%), and 8 in the range of 41 years or more, of which, 2 had gestational diabetes (25%).

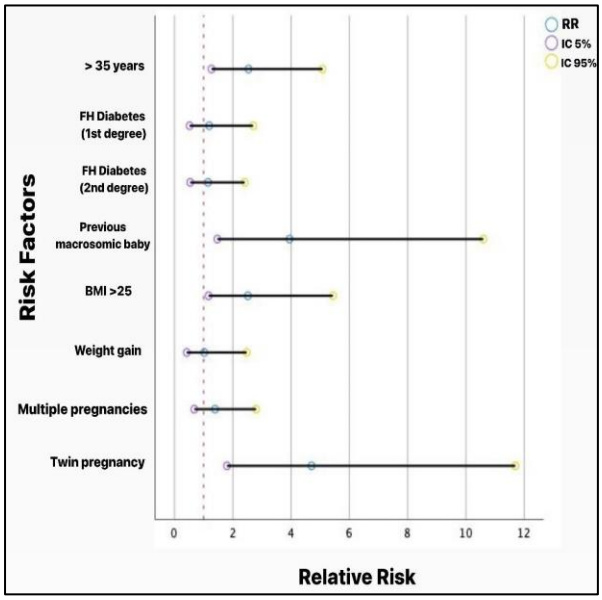

Figure 1: Gestational diabetes-risk factors.

The relative risk (RR) of developing gestational diabetes for patients 36 years or older compared to the group of 35 years or younger was 2.54 (95% confidence interval (CI) 1.27 to 5.08) (Figure 1). From the 347 patients, 135 (38.9%) had no family history of diabetes, 85 patients (24.49%) had first-degree family history, and 127 patients (36.59%) had second-degree family history. 12 of the 135 patients without family history of diabetes developed gestational diabetes (35.29% of the patients with gestational diabetes). 9 of the 85 patients with a first-degree family history developed gestational diabetes (26.47% of the patients with gestational diabetes) and 13 of the 127 patients with a second-degree family history developed gestational diabetes (38% of the patients with gestational diabetes). The RR for gestational diabetes in patients with a first-degree family history was 1.19 (95% CI 0.52 to 2.7) and for second-degree family history, it was 1.15 (95% CI 0.54 to 2.41) (Figure 1). Previous macrosomic infants were reported in 8 patients, of which, 3 developed gestational diabetes in their current pregnancy (37.5% of patients with a history of previous macrosomic babies), which is a relative risk for gestational diabetes of 3.95 (95% CI 1.47 -10.6) (Figure 1). According to the body mass index, 7 patients (2.01% of the total) had a low weight at the beginning of pregnancy, 1 developed gestational diabetes (16.6%); 152 patients had a normal weight (43.8% of the total), 8 of them developed gestational diabetes (5.26%); 140 patients were overweight (40.3% of the total), 19 developed gestational diabetes (13.57%); 33 patients had grade I obesity (9.51% of the total), 3 of them developed gestational diabetes (9.09%); 11 patients had grade II obesity (3.17% of the total), 3 of them developed gestational diabetes (27.27%), and 4 patients had grade III obesity (1.15% of the total), from which none of them developed gestational diabetes. 188 patients (54.17% of the total) with a body mass index greater than or equal to 25 were reported, of which 25 patients (13.29%) developed gestational diabetes.

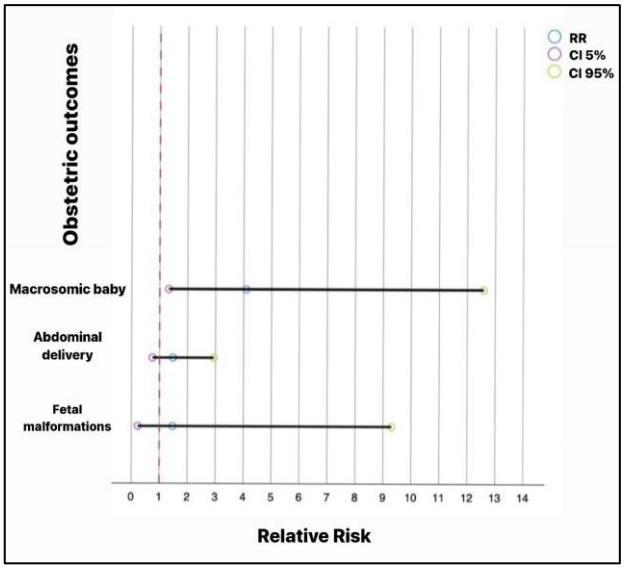

Figure 2: Gestational diabetes-obstetric outcomes.

The relative risk of gestational diabetes in patients with a low weight was 2.71 (95% CI 0.39 to 18.8); 0.91 in those with a normal weight (95% CI 0.84 to 0.98); 2.57 in overweight patients (95% CI 1.16 to 5.7); 1.72 in those with grade I obesity (95% CI 0.48-6.16); 5.18 in those with grade II obesity (95% CI 1.59 to 16.81); and finally in patients with grade III obesity, it was 0; with an overall relative risk for patients with a body mass index greater than or equal to 25 of 2.52 (95% CI 1.17 to 5.44) (Figure 1). The weight variations from the first to the second trimester were measured in percentages. From the 347 patients, 12 were reported with weight loss (3.46%), 56 patients (16.14%) with an increase of 0 to 4.9% of their initial body weight (considered normal), 133 patients (38%) with a gain of 5 to 9.9% and 146 patients (42%) with a gain of 10% or more. The relative risk for developing gestational diabetes of patients with weight loss was 0.77 (95% CI 0.1-5.88), for patients with weight gain of 5% to 9.9%, it was 0.77 (95% CI 0.3-1.98), and for patients with a gain of 10% or more, it was 1.02 (95% CI 0.42 to 2.48) (Table 1). Regarding the number of previous pregnancies, 127 patients were primiparous (36.6%) (considered normal), of which, 10 developed gestational diabetes, while, 220 patients had a history of at least one previous pregnancy (63.4%), of which, 24 developed gestational diabetes, with a RR of 1.39 (95% CI 0.68 to 2.80) (Figure 1). There were 7 twin pregnancies reported (2.01%), 3 of them in patients with gestational diabetes (42.8%) with a relative risk of 4.7 (95% CI 1.8 to 11.7) (Figure 1).

Pregnancy delivery was abdominal in 203 patients (58.50% of the total) and vaginal in 144 patients (41.50%

of the total). Of the 34 patients with gestational diabetes, 23 had undergone cesarean delivery and 11 had a vaginal delivery. The relative risk of cesarean section in the gestational diabetes sample was of 1.48 (95% CI 0.74 to 2.94) (Figure 2). A total of 13 macrosomic infants (3.74% of the total) were reported, of which, 4 (30.7%) had mothers with gestational diabetes and 9 (69.2%) in normoglycemic mothers. There was an increased relative risk for macrosomia of 4.09 (95% CI 1.33-12.5) in patients with gestational diabetes (Figure 2). There was no incidence of preeclampsia in our sample, although it should be noted that all patients underwent screening between weeks 11 and 13.6 using the patient's medical records and uterine artery Doppler measurements. Prophylactic aspirin was administered in high-risk patients.[19] 7 newborns with fetal malformations (2.01% of the total) were reported. Only one of them is a patient from a mother with gestational diabetes (14.29% of the total fetal malformations). The relative risk for fetal malformations in pregnancies with gestational diabetes was 1.43 (95% CI 0.17 to 11.53) (Figure 2).

There was only one fetal death (0.28%) at 34.5 weeks of gestation in a patient without gestational diabetes, but with intrahepatic cholestasis of pregnancy. There were no 5 minute-APGAR scores lower than 8 registered. In our study the cut-off point for the screening of gestational diabetes was 140 mg/dl, but this is set arbitrarily between 130 mg/dl to 140 mg/dl according to the population studied and the institution that performed the study.[9] We made a comparative analysis in the subgroup of patients with an O'Sullivan's test lower than 140 mg/dl (N=263), between patients with glucose lower than 130 mg/dl (N=243) and patients with values between 130 and 139 mg/dl (N=20). It was reported that in this group, a total of 154 cesarean sections, 109 vaginal deliveries, and a total of 8 macrosomic babies were found. From the patients that underwent a c-section, 140 were mothers with glycemia lower than 130 mg/dl and 14 were mothers with glycemia between 130-139 mg/dl. On the other hand, 103 of the vaginal deliveries were in mothers with glycemia lower than 130 mg/dl and 6 corresponded to mothers with glycemia of 130-139 mg/dl. From the total of macrosomic babies in this group of patients, 7 were from mothers with glycemia less than 130 mg/dl and 1 from a mother with glycemia between 130-139 mg/dl.[8] The relative risk of cesarean section for the patients with a glucose between 130 to 139 mg/dl was of 1.22 (95% CI 0.89-1.65) and the RR for macrosomia was of 1.73 (95% CI 0.22-13.41). The IADPSG recommends that a fasting glucose greater than or equal to 92 mg/dl in the first trimester be classified as gestational diabetes, so we compared a subgroup of patients with glucose in the first trimester between 92 mg/dl to 100 mg/dl (N=38) with another subgroup of patients with glucose less than 92 mg/dl (N=309).[11] In the subgroup of 38 patients with glucose between 92-100 mg/dl, 8 patients (21%) developed gestational diabetes in the second trimester. The RR for developing gestational diabetes with these levels of glucose was 2.5 (95% CI 1.22 to 5.1). An analysis of the risk of obstetric complications was also performed in this subgroup of patients with a RR for macrosomia of 0.46 (CI 0.06 to 3.4) and for cesarean section of 1.03 (95% CI 0.79 to 1.34). During the follow-up of the patients with gestational diabetes, 27 (79.4%) were only managed with diet and 7 (20.5%) required medical management; 4 (11.7%) with metformin and 3 (8.8%) with insulin.

DISCUSSION

We did not find any studies for screening and diagnosis of gestational diabetes using the same technique as we used. The prevalence of gestational diabetes found in our population was 9.79%, within the ranges reported in the universal literature.[1-3,18] We had a positive screening of 22.19%, below the screening incidence reported in Ramírez. Torres M.´s article.[18] His study had a 8,074 pregnant women sample at the National Institute of Perinatology. They reported a positive screening of 37.2%, using a cut-off point for the O'Sullivan test of 130 mg/dl, compared to our study, that was 140 mg/dl. In that study, it is difficult to assess the benefit of their cut-off point, since they do not report the differences in the rate of cesarean sections, perinatal morbidity and mortality, birth weight, and the 5 minute-APGAR score in their sample. In our study, we registered a slight increase in the relative risk of cesarean section (RR 1.2, 95% CI 0.89 to 1.65) and macrosomia (RR 1.73, 95% CI 0.22 to 13.41) between the cut-off points of 130 mgs/dl and 139 mgs/dl, without being statistically significant. The HAPO study, which used the one-step glucose tolerance curve for diagnosis with a 75-gram oral glucose load, [4] studied 25,000 patients and found a gestational diabetes incidence of 17.8%, with a RR of 2 for macrosomia and a 45% increase for cesarean section, compared to our study with a RR of 4.09 for macrosomia (statistically significant) and 1.48 for cesarean section (not statistically significant), with a 10% increase in the number of c-sections. If we had diagnosed gestational diabetes patients with first-trimester glucose equal to or greater than 92 mg/dl (n=38) as suggested by the HAPO study, we would have a total of 72 patients with gestational diabetes with an incidence of 20.7%, without a significant increase in the risk of macrosomia or cesarean section, which would have meant greater obstetric surveillance of our patients without improving their outcome. The greatest incidence of gestational diabetes corresponds to the age group of 36 years and older, with a statistically significant RR of 2.54; proving age over 35 years as a risk factor for gestational diabetes. Gestational diabetes incidence varied minimally between patients without a family history of diabetes, with a first-degree or second-degree family history (RR 1.19 and 1.15, respectively) without statistical significance, which proves the need for universal screening. More than half of our sample (54.17%) had a BMI equal to or greater than 25 at the beginning of their pregnancy, with a statistically significant increase in the RR for developing gestational diabetes of 2.52. Having previous macrosomic babies increased the RR by 4.10 times (statistically significant) for developing gestational diabetes in the current pregnancy. Weight gain during

pregnancy did not show a risk for developing gestational diabetes, which leads us to conclude that it is not possible to modify the development of this disease by trying to limit weight gain during pregnancy. The relevant risk factors for the development of the disease were a previous macrosomic baby, BMI greater than or equal to 25, maternal age greater than or equal to 36 years, and the presence of a twin pregnancy (Table 1). The cut-off point of 140 mg/dl in the first step was adequate since there was no statistically significant difference in the risk of cesarean section and macrosomia between patients with values of 130 to 139 mg/dl or those of 140 mg/dl or higher. Regarding obstetric outcomes the presence of the disease adversely influenced the weight of the product at birth (Table 2). This study mainly focuses on the Canadian diabetes association suggestion of the 75-gram oral glucose tolerance curve as the second step of the two-step approach. The limitation of this study is the lack of results comparison with other studies, because there aren´t any with the same methodology.

CONCLUSION

The gestational diabetes prevalence reported in our study with the hybrid diagnostic method (50 gram post-load glucose as the initial screening and, if abnormal, continue with the 75 gram-oral glucose tolerance test with 3 glucose measurements as a second step, instead of the traditional curve of 100 grams with 4 glucose measurements) is comparable to the one reported in studies with the two-step method, avoiding overdiagnosis and over-vigilance brought by the one-step method and the typical discomfort of the 100 grams-oral glucose tolerance curve and 4 measurements with a reduction in waiting times, the hyperosmolar solution load, the number of venipunctures, and the economic cost.

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REFERENCES

1. Guariguata L, Linnenkamp U, Beagley J. Global estimates of the prevalence of hyperglycemia in pregnancy. Diabetes Res Clin Pract. 2014;103:176.
2. Ramirez T. Diabetes Gestacional. Experiencia en una institución de tercer nivel de atención. Ginecol Obstet Mex. 2005;73:484-91.
3. Hinojosa M, Hernandez F. Prevalencia de diabetes mellitus gestacional en el Hospital Juárez de México. Rev Hosp Jua Mex. 2010;77(2):123-8.
4. HAPO Study Cooperative Research Group, Metzger BE, Lowe LP. Hyperglycemia and adverse pregnancy outcomes. N Engl J Med. 2007;358:1991.
5. Scholtens DM, Kuang A, Lowe LE. Hyperglycemia and adverse pregnancy outcome follow-up study (HAPO FUS): maternal glycemia and childhood glucose metabolism. Diab Care. 2019;42:381.
6. Moyer VA. Screening for gestational diabetes mellitus: U.S. preventive services task force recommendation statement. U.S. Preventive Services Task Force. Ann Intern Med. 2014;160:414-20.
7. Danilenko-Dixon DR, Van Winter JT. Universal versus selective gestational diabetes screening: application of 1997 american diabetes association recommendations. Am J Obstet Gynecol. 1999;181: 798.
8. Lowe LE. Classification and diagnosis of diabetes: standard of medical care in diabetes-2012. Diab Care. 2021;44:S15.
9. Hernandez F. Gestational diabetes mellitus. Obstet Gynecol 2018:131:e49.
10. O'Sullivan JB, Mahan CM, Charles D,m Dandrow RV. Screening criteria for high-risk gestational diabetic patients. Am J Obstet Gynecol. 1973;116:8905-9.
11. Metzger BE, Gabbe SG, Persson B, Buchanan TA, Catalano PA, Damm P. International association of diabetes and pregnancy study groups recommendations of the diagnosis and classification of hyperglycemia in pregnancy. Diab Care. 2010;33:676-82.
12. Horvath K, Koch K, Jeitler K, Matuas E, Bender R, Bastian H, et al. Effects of treatment in Women with gestational diabetes mellitus: systematic review and meta-analysis. BMJ. 2010;340:c1395.
13. Van Winter JT. Classification and diagnosis of diabetes. Diab Care. 2017;40:114-9.
14. Rumbold AR, Crowther CA. Women's experiences of being screened for gestational diabetes mellitus. Aus N Z J Obstet Gynaecol. 2002;42:131-7.
15. Agarwal MM, Punnose J, Dhatt GS. Gestational diabetes: problems associated with the oral glucose tolerance test. Diabetes Res Clin Pract. 2004;63:73.
16. Thompson D, Berger H, Feig D, et al. Diabetes and pregnancy. Can J Diab. 2013;37:S1-9.
17. Reporting guideline checklist. Available at: https://www.equator-network.org/wp-content/uploads/2015/03/STARD-2015-checklist.pdf. Accessed on 20 November 2022.
18. Ramirez TM. Diabetes mellitus gestacional. Experiencia en una institución de tercer nivel de atención. Ginecol Obstet Mex. 2005;73:484-91.
19. Rolnik DL, Wright D, Poon LCY, Syngelaki A, O'Gorman N, de Paco Matallana C, et al. ASPRE trial: performance of screening for preterm pre-eclampsia. Ultrasound Obstet Gynecol. 2017;50(4):492-5.

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