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Prevalence and Associated Factors of Gestational Diabetes Mellitus

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Gestational diabetes; prevalence; risk factors.

Summary

Objective: A cross-sectional study was carried out to estimate the prevalence of gestational diabetes mellitus (GDM) in Mossoró/RN and to evaluate the correlation of associated risk factors. **Subjects and methods:** Pregnant women attended at Brazilian National Health Service between January 2016 and January 2017 were evaluated using a specific questionnaire with demographics and baseline caractheristics and first trimester fasting plasma glucose glycemic (FPG), followed by OGTT 75g schedule between 24 and 28 weeks of gestation. Diagnostic crite-

ria recommended by the IADPSG were used. **Results**: 166 pregnant women were recruited, with a mean age of 24.7 years, predominance of brown and white races, most with low schooling and low income, 38.5% presenting pre-gestational weight excess. Of the pregnant women with FPG collected in the first trimester, 13.8% had GDM, with a mean FPG 101.2 mg/dL; among 76 patients who completed the evaluation, 04 (5.3%) had a diagnosis of GDM with OGTT 75g, totaling 20 of 76 patients evaluated, with a total prevalence of 26.3%. Direct correlation between age and GDM was observed only in pregnant women diagnosed in the first trimester. No correlation was observed with the other factors evaluated: color, height, income, schooling, history of PCOS and gestational hypertension, family history of DM2, pre-gestational obesity and sedentary lifestyle. **Conclusion**: a high prevalence of GDM was identified, with a large percentage already identified in the first trimester. Additional studies are needed to better define risk factors in this population, as well as the impact of this early diagnosis on neonatal outcomes.

INTRODUCTION

Alterations in glycemia are the most common metabolic abnormalities in pregnancy, which occurs between 1 and 28% in most reports (Macaulay *et al*. 2014), and can reach up to 41.9% of pregnancies (Gopalakrishnan *et al*. 2015), depending on the diagnostic criteria used and the population studied. Gestational Diabetes Mellitus (GDM) is defined as hyperglycemia recognized for the first time during gestation and does not fills criteria for type 1 or 2 diabetes (WHO, 2013).

The worldwide increase in obesity, coupled with the advancement of maternal age, has led to an increase in the overall incidence of GDM. The importance of the diagnosis of GDM is that it has maternal and fetal implications, both in the gestational period and in the early and late post gestational period, in addition to the fact that its prevalence is increasing worldwide (Lavery *et al*. 2017). The main maternal complications

include: preeclampsia, polydramnio and increased risk of cesarean birth (Dodd *et al*., 2007), and of developing metabolic syndrome (Lauenborg *et al*., 2005) and type 2 diabetes mellitus (DM2) after childbirth (Bellamy *et al*. 2009). Fetal complications include macrosomia, neonatal hypoglycemia, jaundice, polycythemia, respiratory distress syndrome, shoulder dystocia and hypocalcemia, as well as potential long-term complications such as obesity (Spaight *et al*., 2016), metabolic syndrome (Vääräsmäki *et al*., 2009), and late DM2 (Dabelea *et al*., 2000).

There are still several controversies related to GDM, including the form of screening, as well as the diagnostic criteria to classify hyperglycemia that occurs before the 24th week of gestation and does not meet criteria for type 2 or type 1 diabetes mellitus, called early gestational diabetes (Sweeting *et al*., 2017). This lack of consensus makes it extremely difficult to determine the real world prevalence of GDM as well as to compare it across populations. The objective of this study was to estimate the prevalence of GDM in the city of Mossoró / RN, according to the International Association of the Diabetes and Pregnancy Study Groups (IADPSG) criteria, and also the associated risk factors.

MATERIAL AND METHOD

This is a cross-sectional study that evaluated pregnant women attended at the public prenatal health care system in the city of Mossoró / RN, in several basic health units and FACS outpatient clinic (Faculty of Health Sciences - UERN), after approval by the Committe on Research Ethics of the State University of Rio Grande do Norte (CEP-UERN).

To calculate the sample size, considering an average prevalence of 17.8% of GDM, a 95% confidence interval and a margin of error of 20%. Because it was a finite population, it was adopted to correct the sample calculation, considering N = 285 (pregnant women living in Mossoró accompanied by the SUS in a period of 4 months in the basic health units included in the research in the year 2016 (SISPRENATAL / DA-

TASUS), the margin of error of 20% and a non-response rate of 20%, coming to a sample of 208 pregnancies.

The recruitment of these patients was performed during the prenatal care appointment, following a schedule of the unit itself, concomitantly in 13 units basic health, selected for the convenience of prenatal care hours. Pregnant women until the 28th week of gestation were included. The criteria for exclusion used were: prior diagnostic of DM2 and history of comorbidities, except PCOS, and use of any medications that could interfere with glycemia.

Data collection was performed through the fulfillment of a specific questionnaire, after signing the informed consent term by the patient or legal guardian. The questionnaire included data regarding identification, age, color, schooling, pre-gestational weight, height, physical activity, recent use of medications, prior history of polycystic ovarian syndrome(PCOS), preeclampsia, gestational diabetes and macrosomia, family history of type 2 diabetes mellitus, as well as socioeconomic factors.

Data collection was performed in the first trimester of pregnancy chart or prenatal fasting glucose card. Patients who already had FPG compatible with diagnosis of GDM at the initial consultation were referred to a specialized outpatient clinic. The other patients were scheduled to oral glucose tolerance test 75g (OGTT 75g) with fasting collection, 60 and 120 minutes after ingestion of 75g of anhydrous glucose between the 24th and 28th week of gestation. Glucose dosing was performed on Siemens equipment, model ADVIA 1200, using a Siemens Bayer Advia 1200 kit. The criteria recommended by the IADPSG (International Association of Diabetes and Pregnancy Study Groups Consensus Panel, 2010; Blumer *et al*., 2013) were used for the diagnosis of gestational diabetes: FPG in the first trimester from 92 to 125 mg/dL and OGTT 75 g: FPG ≥ 92 mg / dL; 1 h after ≥ 180 mg / dL and 2 h after ≥ 153 mg / dL, with any of the three abnormal values

being sufficient to confirm diagnosis of GDM.

The database was built on the software platform SPSS® (Statistical Package for Social Sciences) version 22.0, with a subsequent verification of consistency of the typing. After the final structuring of the database, a descriptive analysis of all data regarding the independent variables was performed and the association between GDM and the independent variables was analyzed through the chi-square statistical test. To verify the magnitude of these associations, the prevalence ratios and their respective confidence intervals (95%) were used. A significance level of 5% was adopted.

RESULTS

A total of 166 pregnant women were recruited during prenatal care at the FACS outpatient clinic and at the 13 basic health units selected, between January 2016 and January 2017.

The recruited pregnant women had a mean age of 24.7 years (± 7.1 SD), mean height of 1.57m (± 0.09 SD), with predominance of brown (48.2%) and white (36.7% %). Most of them in a consensual marriage (68.1%) and with low level of schooling and low income. Most residing in own home, brick house, with electric power, piped water and septic tank (Table 1).

Table 1 - Social - demographic characteristics of the studied population - Mossoró/RN, 202

Evaluated factor	n	%
Race / Color		
Yellow	3	1,8
White	61	36,7
Indigenous	4	2,4
Brown	80	48,2
Black	18	10,8
Height		
<1,50 m	15	9,1
= 1,50m	150	90,9
Marital Status		
Single	51	30,7
Common-law marriage	113	68,1
Widow	2	1,2
Income		
Without income	4	2,4
Less than 1 minimum wage	20	12,0
01 minimum wage	71	42,8
More than 1 to 3 minimum wages	62	37,3
4 - 6 minimum wages	5	3,4
Did not know / did not answer	4	2,4
Education level		
= 11 years of study	104	62,7
12 or more years of study	62	37,3
House		
Rented	53	31,9
Granted	8	4,8
Home ownership	104	62,7
Did not know / did not answer	1	0,6
Construction type		
Brick masonry	159	95,8
Adobe and wood	3	1,8
Others	1	0,6
Did not know / did not answer	3	1,8
Number of residents in their houses		
1-3 people	65	39,2
4-6 people	70	42,2
7-10 people	23	13,9
More than 10 people	06	3,6
Did not know / did not answer	01	0,6
Number of rooms in the house		
Up to 03 rooms	16	9,6
4 to 5 rooms	79	47,6
6 and more rooms	71	42,8
Running water in the house		
Yes	158	95,2
No	08	4,8
Septic tank in the house		
Yes	161	97,6
No	4	2,4
Did not know / did not answer	1	0,6
Have electricity in the house	166	100
Bathrooms in the house		
Yes	165	99,4
No	01	0,6
Basic sanitation		
Yes	83	50,0
No	69	41,6
Did not know / did not answer	14	8,4

Regarding the pathological personal history researched, there was a report of previous diagnosis of PCOS in 26% of the patients. There was only one previous history of GDM, as well as report of only one macrosomic fetus. A previous gestational hypertension history was reported in 9.6% of the cases. Just over half of the population studied (53%) had a family history of type 2 diabetes mellitus (Table 2). The vast majority of the pregnant women evaluated (90.4%) were sedentary.

The mean pre-gestational body mass index (BMI) of the sample was 24.6 kg/m2 (SD ± 6.2), and it was observed that 7.9% of the patients presented low weight before gestation, 53.6% had a healhy weight and 22% were obese, in which were classified: mild - 11.5%, moderate - 3.7% and severe obesity - 1.2%.

Table 2 – Risk factors for GDM in 166 pregnant women living in the city of Mossoró/RN, 2020.

Variable	n	%
Polycystic ovary syndrome		
Yes	26	15,8
No	134	81,2
Did not know / did not answer	05	3,0
History of GDM		
Yes	01	0,6
No	145	97,6
Did not know / did not answer	03	1,8
History of macrosomic fetus		
Yes	01	0,6
No	161	97,6
Did not know / did not answer	03	1,8
History of previous gestational hypertension	16	9,6
Yes	148	89,2
No	03	1,8
Did not know / did not answer		
Physical activity		
None	150	90,4
01 to 2 times a week	06	3,6
03 or more times a week	10	6,0
Family history of Type 2 Diabetes mellitus	73	44
Yes	88	53
No	05	03
Did not know / did not answer		

FPG at the initial prenatal evaluation was obtained from 116 patients, mean of 80.5 mg/dL (SD ± 12.2). Of these 116 pregnant women, 16 (13.8%) already presented criteria for diagnosis of GDM in the first trimester of gestation (FPG ≥ 92 and ≤ 125 mg/dL). The mean FPG in the group of patients diagnosed with GDM at this stage was 101.2 mg/dL (SD ± 11.02) and median 96 md/dL. Among the pregnant women diagnosed in this phase, ten (62.5%) had FPG between 92 and 99 mg/dL and 06 (37.5%), FPG between 100 and

124 mg/dL. These patients were referred to a specialized outpatient clinic for treatment of GDM, and were not submitted to OGTT 75g. No patient with over diabetes was diagnosed.

All patients who were not diagnosed as having GDM in the first trimester were scheduled for collection of 75g OGTT between 24 and 28 weeks of gestation, but only 60 pregnant women were seen. The mean FPG in this test was 72.5 mg / dL (SD ± 7.2); 60 minutes after glucose overload, was 120.9 mg/dL (SD ± 23.4) and 120 minutes, 106.4 mg/dL (SD ± 23.1). Of the 60 patients submitted to the test, 04 pregnant women were diagnosed with GDM. The mean FPG in the first trimester of these 04 patients was 76.7 mg / dL (SD ± 10.9).

Of the 76 pregnant women who completed the evaluation, 20 presented criteria for GDM: 16 patients in the first trimester and another 04 between 24a and 28 weeks, resulting in a prevalence of 26.3% of GDM.

There was no correlation of GDM with the other factors evaluated, i.e., color, short stature, income, schooling, history of PCOS and gestational hypertension, family history of DM2, pre-gestational obesity and sedentary lifestyle. The bivariate analysis, performed through chi-square tests, showed direct correlation of age with the occurrence of GDM only in pregnant women diagnosed in the first trimester.

DISCUSSION

The prevalence of GDM, according to IADPSG criteria, in the 15 participating centers of the HAPO (Hyperglycemia and Adverse Pregnancy Outcome), involving about 24,000 pregnant women, identified a prevalence of 17.8% of GDM (Sacks *et al*., 2002), evaluating 75g OGTT between 24 and 28 weeks. In India, in 2015, using the same criteria, 332 pregnant women from low to medium socioeconomic level were found to have a prevalence of 41.9% (Gopalakrishnan *et al*., 2015), while the estimated prevalence in the United States was 9.2% (DeSisto *et al*., 2014).

In China, evaluating 18,589 women, a prevalence was 9.3%

considering the IADPSG criteria (Leng *et al*., 2015). In Yemen, using ADA criteria, a prevalence of 5.1% was found (Ali *et al*., 2016). A systematic review that evaluated 11% of the African territory showed variation in the prevalence of GDM from 0 to 13.9%, depending on the area studied (Macaulay *et al*., 2014).

In Brazil, the Brazilian Gestational Diabetes Study Group, when evaluating 4,977 pregnant women in 2001, found an average prevalence of 7.2% according to WHO criteria and 2.4% according to the ADA criteria (Schmidt *et al*., 2001). This same cohort was later reassessed using the IADPSG criteria, and a prevalence of DMG of 18% was found, possibly underestimated considering the probable changes in the population profile, with a higher prevalence of obesity and DM2 (Trujillo *et al*., 2015).

There is little recent data on the prevalence of GDM in Brazil. A study carried out in Pelotas - RS, in 2004, evaluated 4,243 women, and observed self-report of GDM in 2.95% (Dode & Santos, 2009). A retrospective study with analysis of medical records conducted in Vitória-ES, in 2011, evaluated 396 pregnant women, detecting a prevalence of 5.8% (Massucatti *et al*., 2012). In the Northeast of Brazil, in Bahia, the evaluation of the metabolic profile of pregnant women attended between 2007 and 2008 in public maternity, revealed a prevalence of 3.4% of GDM according to ADA criteria (Santos *et al*., 2012).

In the study population, a prevalence of GDM of 26.3% was found, slightly higher than in the HAPO Study, which varied from 9.3 to 25.5% between the different included centers (Sacks *et al*., 2012), evaluating pregnant women between 24a and 28th week with 75 g OGTT. However, in most cases of our sample, hyperglycemia was detected in the first trimester. A study in San Diego (USA) detected a prevalence of GDM with early screening in 9.4% of pregnant women; of these, 66.7%, had alteration only on fasting glycemia, with normal A1c glycated hemoglobin. Another study evaluating pregnant women in Oklahoma (USA) identified a total prevalence of 38% of dysglycemia, with 24% of GDM

detected in the first trimester, according to IADPSG criteria (Azar *et al*., 2015).

There is no consensus regarding the diagnostic criteria of early GDM, that is, that occurs before the 24th week of gestation. The American Diabetes Association considers GDM exclusively the hyperglycemia that occurs from the 24th week while the WHO and Endocrine Society consider FPG from 92 to 125 mg/dL sufficient as a diagnostic criterion in the first trimester. In China, a study identified that only 39.8% of pregnant women with FPG from 92 to 125 mg/dL at the first prenatal visit would develop GDM later in pregnancy when tested with 75 g OGTT between 24 and 28 weeks, suggesting that FPG value between 110 and 125 mg/dL should be used as a diagnostic criterion for early GDM (Zhu *et al*., 2013).

There are several risk factors for GDM, such as: age over 25 years, previous history of GDM and macrosomic fetus, family history of DM2, polycystic ovary syndrome, pre-gestational overweight / obesity, ethnicity (Zhu *et al*., 2013; Xiao *et al*., 2016). The Pelotas cohort (Dode *et al*., 2009) showed that the estimated risk of having GDM was associated with a non-white color, family history of DM2 and a direct effect on the estimated risk of GDM was observed in association with age, schooling and pre-gestational BMI.

In our sample, we observed a correlation of GDM with age only in the subgroup of patients diagnosed in the first trimester. However, it was not observed with the other risk factors evaluated. This fact can be attributed to the reduced size of the sample, possibly influenced by the recommendation of not getting pregnant given by the authorities in Health in that period, due to the outbreak of microcephaly due to infection by the Zika virus. In addition to the small number in the recruitment, there was still a very significant loss of follow-up, a probable reflection of the irregularity of this group in the prenatal care, as well as the fact that the collection was not performed in the basic health unit itself.

CONCLUSION

In conclusion, this study showed a high prevalence of GDM according to the IADPSG criteria in the population of Mossoró / RN, especially in the first trimester. Additional studies are needed to better define risk factors in this population, as well as the impact of this early diagnosis on neonatal outcomes.

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