

MATERNAL CHARACTERISTICS AND PERINATAL OUTCOMES ASSOCIATED WITH SCREENING FOR GESTATIONAL DIABETES MELLITUS

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ABSTRACT

Introduction and objective: Gestational Diabetes Mellitus (GDM) can lead to various adverse maternal and fetal outcomes. Therefore, this study aims to describe the risk factors and outcomes of pregnant women associated with GDM screening. **Material and methods:** This retrospective study was conducted with 283 pregnant women at a Southern Brazilian University Hospital. Data on GDM screening, including fasting glucose tests and Oral Glucose Tolerance Test (OGTT), were collected from the prenatal booklets. Information related to maternal and perinatal outcomes, as well as the socioeconomic status of the pregnant women, was also collected. **Results:** The positive GDM screening rate in postpartum women was 25.2%, considering fasting glucose alone. However, it increased to 86.4% when considering fasting glucose and the presence of risk factors. There was no significant association between positive GDM screening and maternal and perinatal outcomes, or with socioeconomic status. Nevertheless, fasting glucose levels ≥ 85 mg/dL were associated with a higher risk of caesarean delivery and other fetal complications, such as hypoglycemia, inadequate newborn weight, and gestational age below 37 weeks at birth. Additionally, GDM screening was significantly associated with the outcome of pre-eclampsia. **Conclusion:** The study findings indicate that positive GDM screening is associated with a higher risk of caesarean delivery, pre-eclampsia, and other fetal complications.

Key words: Diabetes Gestational. Risk Factors. Prenatal Care. Maternal and Child Health.

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RESUMO

Características maternas e desfechos perinatais associados à triagem de diabetes gestacional

Introdução e objetivo: O Diabetes Gestacional (DG) pode levar a diversos resultados adversos para a mãe e o feto. Portanto, este estudo tem como objetivo descrever os fatores de risco e os resultados em gestantes associados à triagem de DG. **Materiais e métodos:** Este estudo retrospectivo foi conduzido com 283 gestantes em um Hospital Universitário do Sul do Brasil. Os dados da triagem de DG, incluindo testes de glicemia em jejum e Teste de Tolerância à Glicose Oral (TTGO), foram coletados da carteira da gestante. Informações relacionadas aos desfechos maternos e perinatais, bem como o status socioeconômico das gestantes, também foram coletadas. **Resultados:** A taxa de triagem positiva para DG em mulheres no pós-parto foi de 25,2%, considerando apenas a glicemia em jejum. No entanto, aumentou para 86,4% quando considerados a glicemia em jejum e a presença de fatores de risco. Não houve associação significativa entre triagem positiva para DG e desfechos maternos e perinatais, nem com o status socioeconômico. Entretanto, níveis de glicemia em jejum ≥ 85 mg/dL foram associados a um maior risco de parto cesárea e outras complicações fetais, como hipoglicemia, peso inadequado do recém-nascido e idade gestacional inferior a 37 semanas ao nascimento. Além disso, a triagem de DG foi significativamente associada ao desfecho de pré-eclâmpsia. **Conclusão:** Os resultados do estudo indicam que a triagem positiva para DG está associada a um maior risco de parto cesárea, pré-eclâmpsia e outras complicações fetais.

Palavras-chave: Diabetes Gestacional. Fatores de Risco. Cuidados Pré-natais. Saúde Materna-Infantil.

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INTRODUCTION

Maternal and perinatal morbidity and mortality rates still persist in Brazil.

As a result, Brazil has implemented public policies that seek to act directly on the determining factors to identify and intervene in situations of maternal-fetal risk, including prenatal care (Brazil, 2012).

Gestational Diabetes Mellitus (GDM) should be screened during prenatal care (Pan-American Health Organization, 2017).

While considered the most common metabolic disorder in pregnancy with a prevalence in Brazil of 7.4% among pregnant women (International Diabetes Federation, 2019), GDM may cause several negative maternal and fetal outcomes (Santos, collaborators 2020). In mothers, GDM has been associated with a higher incidence of gestational hypertension, preeclampsia, and emergency caesarean section; while in the fetus, GDM complications include an increased risk of macrosomia, shoulder dystocia, operative delivery, and respiratory complications.

Thus, the presence of GDM prompts higher rates of maternal and perinatal morbidity and mortality (Farahvar, Walfisch, and Sheiner 2019), and its screening, as well as the control of its risk factors, should be aimed for (Logakodie and collaborators 2017).

In Brazil, GDM is diagnosed through screening for clinical risk factors associated with fasting blood glucose in early pregnancy (before 20 weeks or as soon as possible).

If the serum glucose value exceeds a cut-point from 85mg/dL to 125 mg/dL or if a risk factor for GDM is present, pregnant women should undergo a 75-g oral glucose tolerance test (OGTT) (Brazilian Diabetes Society, 2019).

Although this is the universal criterion proposed by the Brazilian Ministry of Health, regional difficulties must be analyzed, and if there is an ideal economic condition, the criteria of the International Association of Diabetes and Pregnancy Study Group (IADPSG) [one-step approach using a single fasting 2-hour, 75 g OGTT] (Sacks and collaborators 2012), which were endorsed by the World Health Organization (WHO), must be used (Brazil, 2012).

As a result, it is important to adequately screen for GDM to avoid future maternal and fetal outcomes, especially in women treated

through the Brazilian Public Health Care System.

Thus, the aim of the present study was to describe risk factors and outcomes of pregnant women associated with screening for GDM.

MATERIALS AND METHODS

This is a retrospective study, carried out between January and April 2015, with postpartum women who underwent prenatal care in the Brazilian Unified Health System (UHS) and had their deliveries at the University Hospital of Santa Maria (HUSM)/RS, Brazil.

The study was based on an interview with postpartum women after delivery, a review of the prenatal booklet, and analysis of data from the medical records of postpartum women and newborns during hospitalization, in search of the association between sentinel events (screening for GDM) during prenatal care and maternal and perinatal outcomes.

HUSM (RS, Brazil) has the largest 100% UHS maternity hospital in the central region of Rio Grande do Sul and is located on the campus of the Federal University of Santa Maria (UFSM), in the city of Santa Maria-RS, Brazil.

According to data from the Statistics Service of the hospital, 661 births took place in the evaluated period.

For the sample calculation, we considered an average frequency of 140 births per month with a margin of error of 5% for a heterogeneous sample calculated at 80%. The risk of losses was considered, and to account for this, the number of cases to be analyzed was increased by 50%, resulting in a total of 283 postpartum women.

This study followed the guidelines of the Declaration of Helsinki, with approval from the Ethics Committee of the University of Santa Cruz do Sul (Protocol no. 091663/2014) and the Information System for Educators (SIE) at the Federal University of Santa Maria (no. 039174). To evaluate the screening for GDM, data related to fasting glucose tests and the Oral Glucose Tolerance Test (OGTT) were collected from the prenatal booklet, including values and the period of pregnancy in which such tests were performed. The parameters defined by the Ministry of Health in 2012 were used (Pan-American Health Organization 2017). Pregnant women with fasting plasma glucose levels equal to or higher than 85 mg/dL were considered

positive for GDM screening. As an integral part of the process of identifying GDM by the Ministry of Health in 2012, the recommendations of the International Association of Diabetes and Pregnancy Study Groups (Sacks and collaborators 2012) were considered for the diagnosis of GDM using the OGTT.

For this, data regarding 75-g OGTT of glucose records between 24-28 weeks of gestational age, at time 0 (fasting), 1, and 2 hours were evaluated, and positive values for GDM were considered as values above 92 mg/dL in the fasting state, 180 mg/dL in the first hour, and 153 mg/dL in the second hour. This last parameter (OGTT) is part of the updated diagnosis for screening GDM in pregnant women with financial viability and/or partial technical availability, provided by the guidelines of the Brazilian Diabetes Society (2019).

During the interview with postpartum women, we applied a questionnaire containing information on demographic (age), socioeconomic (socioeconomic level according to the Brazilian Association of Research Companies - ABEP (2013), behavioral characteristics (family history of diabetes mellitus in 1st-degree relatives), and comorbidities (such as polycystic ovary syndrome and systemic arterial hypertension). In addition, women were questioned about the use of hyperglycemic agents (corticosteroids and thiazides), unfavorable outcomes in previous pregnancies (macrosomia, malformations, and fetal demise), and current pregnancy data that constitute risk factors for GDM (nutritional status at the beginning of prenatal care and weight gain during pregnancy). Information referring to the healthcare professional that provided care during the prenatal period and the place where the service was performed were also obtained. For the assessment of socioeconomic level, women were classified into three categories: class B, class C, and class D/E. There were no women classified in class A in this sample.

Maternal complications during hospitalization (pre-eclampsia/eclampsia), postpartum height data, weight on hospital admission to classify pre-gestational nutritional status and weight gain during pregnancy (Institute of Medicine, 2009), data referring to childbirth [type of delivery, gestational age of the newborn (Capurro index (Capurro and collaborators 1978)), weight of the newborn (Battaglia and Lubchenco, 1967)], and also

maternal outcomes (preterm labor, premature amniorrhexis, birth trauma, lacerations/haemorrhages) and newborn outcomes (fetal and neonatal death, fractures, and hypoglycemia) were collected.

A preterm pregnancy was defined as a pregnancy that ended before 37 weeks, and a term pregnancy as one that lasted from 37 weeks to 41 weeks and 6 days (Spong, 2013).

The age of the newborn was defined at the time of delivery by the Capurro index (Capurro and collaborators 1978), in which newborns with birth weight greater than 4,000 g or 10% above the appropriate weight for gestational age were classified as macrosomia (Battaglia and Lubchenco, 1967).

The criterion for hypoglycemia was established according to the Brazilian Society of Pediatrics (2014), considering it as a glycemic level below 40-41 mg/dL from the 3rd hour of life up to 47 hours.

The classification of pre-gestational nutritional status followed the reference values recommended by the Institute of Medicine (2009), which considers the body mass index (BMI in kg/m²) and refers to low weight when BMI <18.5 kg/m², adequate weight when between 18.5 and 24.9 kg/m²; overweight when between 25 and 29.9 kg/m², and obesity when BMI ≥ 30 kg/m².

In this study, total weight gain (in kg) during pregnancy was used, according to the recommendation of the IOM, which classifies this gain according to the pre-gestational BMI. In pregnant women who are underweight by BMI, the total weight gain should be between 12.5 and 18 kg; in pregnant women with adequate BMI, the range of weight gain during pregnancy should be between 11.5 to 16 kg; in those who start prenatal care when overweight, the ideal gain is between 7 and 11.5 kg; and in pre-gestational obese women, the accepted gain is 7 kg during the entire pregnancy (Hu 2011).

The collected data were analyzed using the Statistical Package for Social Science (SPSS) version 20.0. A descriptive statistical analysis was performed by calculating the absolute frequency and the relative frequency, and a non-parametric Chi-Square test was also applied to analyze the association of the groups in relation to the categorical variables described. A significance level of p<0.05 was used.

RESULTS

The sample consisted of 283 postpartum women, with a mean age of 26.8 ±6.0 years, from the basic health network. The most prevalent risk factor among women was BMI, with more than 50% of the sample being overweight or obese. Specifically, 27.9% of the women were overweight ($25 \leq \text{IMC} < 30 \text{ kg/m}^2$), and 25.1% were obese ($\text{BMI} \geq 30 \text{ kg/m}^2$).

Excess weight gain during pregnancy, according to IOM criteria (Institute of Medicine, 2009), was observed in 35% of the women. A positive family history of diabetes mellitus was evidenced in almost 30% of the respondents, while 8.3% of multiparous women reported previous pregnancies with macrosomia (newborn weight $\geq 4,000 \text{ g}$).

The most frequent maternal outcomes included preterm labor (12.4%), birth trauma and lacerations (5.3%), pre-eclampsia in different degrees (3.9%), and premature amniorrhexis (2.1%).

Among the outcomes for newborns, three fetal deaths, one early neonatal death, and two cases of malformations were observed. Other newborn complications included prematurity (9.9%) and fetal distress (2.8%). Regarding prenatal appointments in the basic health network, 33.6% were performed by

doctors and nurses, 65.4% exclusively by doctors, and only 1.1% were exclusively performed by a nursing professional.

The distribution of postpartum women according to the screening criteria for diabetes mellitus during pregnancy, as defined by the Brazilian Ministry of Health (2012), is shown in Table 1. Among the observed postpartum women, 14.0% did not undergo screening for GDM by fasting glycaemia at any time during pregnancy. However, among the women who underwent fasting glucose testing, 25.2% had a positive GDM screening.

When analyzing only the criteria for risk factors presented by postpartum women, 80.6% of them had positive GDM screening, with the majority (62.2%) having up to two risk factors at the beginning of prenatal care.

Three risk factors were identified in 14.5% of the women, and four to six risk factors were observed in 3.9% of postpartum women. In this group, 8.3% did not undergo fasting blood glucose.

The association between fasting blood glucose and the presence of risk factors, according to the criteria recommended by the Brazilian Ministry of Health, showed that 86.4% of the postpartum women presented positive GDM screening.

Table 1 - Distribution of postpartum women receiving care at the University Hospital of Santa Maria (HUSM), Brazil, according to the screening criteria used for gestational diabetes mellitus (GDM).

Screening for GDM	n	%
Fasting glucose		
<85 mg/dL	181	74.8%
$\geq 85 \text{ mg/dL}$	61	25.2%
Risk factors		
Absent	55	19.4%
Present	228	80.6%
Positive blood glucose or risk factors (either one)		
Negative	33	13.6%
Positive	209	86.4%
75 g OGTT		
Negative	102	99.0%
Positive	1	1.0%

GDM: gestational diabetes mellitus, OGTT: oral glucose tolerance test.

Of the women evaluated, 36.4% underwent a 75g OGTT, and 24.3% had this test done exclusively. Out of the 29.1% postpartum women who performed the test according to the Brazilian Diabetes Society (2019), with a collection of three times (0, 1h,

and 2h), only in one case was the diagnosis of GDM confirmed by this criterion.

Table 2 shows the results of the association between screening glucose levels and maternal outcomes, perinatal outcomes, and the classification of the postpartum women by the ABEP socioeconomic questionnaire.

There was no association between screening for GDM exclusively by fasting glucose and the socioeconomic level of the postpartum women, as well as with maternal and perinatal outcomes. However, puerperal women with a blood glucose value equal to or

greater than 85 mg/dL had a higher risk of having a caesarean delivery and experiencing other fetal complications, such as hypoglycemia, inadequate weight for the newborn, and gestational age below 37 weeks.

Table 2 - Association between GDM screening through fasting blood glucose and maternal and perinatal outcomes, as well as the socioeconomic level of postpartum women receiving care at the University Hospital of Santa Maria (HUSM), Brazil.

Variables	All		GDM screening				p Value
	n	%	<85 mg/dL		≥85 mg/dL		n
			n	%	n	%	
Pre-eclampsia							
Yes	42	17.4	33	18.2	9	14.8	0.535
No	200	82.6	148	81.8	52	85.2	
Type of delivery							
Caesarean	154	63.6	114	63.0	40	65.6	0.716
Vaginal	88	36.4	67	37.0	21	34.4	
Maternal outcomes							
Yes	45	18.6	30	16.6	15	24.6	0.167
No	197	81.4	151	83.4	46	75.4	
Gestational age							
<37 weeks	53	21.9	37	20.4	16	26.2	0.345
≥37 weeks	189	78.1	144	79.6	45	73.8	
New-born weight							
Adequate	190	78.5	143	79.0	47	77.0	0.748
Inadequate	52	21.5	38	21.0	14	23.0	
Perinatal outcomes							
Yes	33	13.6	22	12.2	11	18.0	0.247
No	209	86.4	159	87.8	50	82.0	
New-born Hypoglycaemia*							
Yes	37	19.6	27	19.0	10	21.3	0.735
No	152	80.4	115	81.0	37	78.7	
ABEP socioeconomic class							
B1/B2	61	25.2	48	26.6	13	21.3	0.647
C1/C2	158	65.3	117	64.6	41	67.2	
D/E	23	9.5	16	8.8	7	11.5	

*New-borns in whom the glycaemic test was performed (n=189). GDM: gestational diabetes mellitus.

Analyzing the results presented in Table 3, it was found that only the outcome of pre-eclampsia was significantly associated with

positive GDM screening. For all other variables, no association was found with positive GDM screening.

Table 3 - Association between GDM screening by fasting blood glucose and risk factors, and maternal and perinatal outcomes, as well as the socioeconomic level, was examined in postpartum women receiving care at the University Hospital of Santa Maria (HUSM), Brazil.

Variables	All		GDM screening				p Value
			Negative		Positive		
	n	%	n	%	n	%	
Pre-eclampsia							
Yes	42	17.4	1	3.0	41	19.6	0.019
No	200	82.6	32	97.0	168	80.4	
Type of delivery							
Caesarean	154	63.6	17	51.5	137	65.6	0.119
Vaginal	88	36.4	16	48.5	72	34.4	
Maternal outcomes							
Yes	45	18.6	5	15.2	40	19.1	0.584
No	197	81.4	28	84.8	168	80.9	
Gestational age							
<37 weeks	53	21.9	9	27.3	44	21.1	0.422
≥37 weeks	189	78.1	24	72.7	165	78.9	
New-borns weight							
Adequate	190	78.5	27	81.8	163	78.0	0.619
Inadequate	52	21.5	6	18.2	46	22.0	
Perinatal outcomes							
Yes	33	13.6	3	9.1	30	14.4	0.413
No	209	86.4	30	90.9	179	85.6	
New-born hypoglycaemia*							
Yes	37	19.6	5	19.2	32	19.6	0.962
No	152	80.4	21	80.8	131	80.4	
ABEP socioeconomic class							
B1/B2	61	25.2	8	24.2	53	25.4	0.984
C1/C2	158	65.3	22	66.7	136	65.1	
D/E	23	9.5	3	9.1	20	9.6	

*New-borns in whom the glycaemic test was performed (n=189). GDM: gestational diabetes mellitus.

DISCUSSION

The current worldwide socioeconomic development, resulting from lifestyle changes and poor diet, has led to an increased number of individuals with diabetes (Hu 2011; Zhou and collaborators 2016; Ng and collaborators 2020).

A study by the Brazilian Ministry of Health (2020) reported a rise of approximately 2.0% in the Brazilian diabetic population (age >18 years) in the last 13 years.

Additionally, during the same period, the number of overweight and obese women increased by 15.4% and 8.9%, respectively (Brazil 2020). Many of these women are of reproductive age, and they are at risk of developing DM2 (Zhou and collaborators 2016), which often goes undiagnosed during the pre-pregnancy period. In this study, among the postpartum women evaluated in the basic health network, 53% had pre-gestational

overweight/obesity, which is the main risk factor associated with GDM in women.

Screening and diagnosing GDM are of critical importance to avoid adverse outcomes for both the mother and the fetus. However, the lack of consensus between different professional entities and a specific screening and diagnosis algorithm has impaired the adequate detection and treatment of GDM (World Health Organization 2016).

In this study, 14.5% of the postpartum women did not undergo any tests to screen for GDM during pregnancy. Prospective studies have shown favorable pregnancy outcomes with fasting blood glucose below 85 mg/dL and no risk factors (Yogev, Metzger, Hod 2009; Detsch and collaborators 2011).

Similarly, in our study, no significant association was observed between positive GDM screening based solely on fasting blood

glucose and unfavorable maternal and perinatal outcomes.

Similar results were found by Simon, Marques, and Farhat (2013) when assessing first-trimester fasting glycaemia and risk factors in pregnant women diagnosed with gestational diabetes mellitus.

In our study, in the presence of risk factors, there was an association between positive screening and a higher occurrence of pre-eclampsia.

This result suggests that insulin resistance plays a prominent role in the development of pre-eclampsia (Mahalakshmi and collaborators 2016; Farahvar, Walfisch, and Sheiner 2019).

Moreover, observing only the risk factors for GDM, the prevalence of positive screening was 80.4%. However, Farrar and collaborators (2017) found in their review that risk factor screening methods are poor diagnostic predictors for GDM.

To confirm the presence of GDM in pregnant women with positive screening, the Brazilian Ministry of Health recommends the 75 g OGTT (Pan-American Health Organization 2017).

In our study, only 37.3% of postpartum women with positive GDM screening underwent the test. Similar results were observed by dos Santos and collaborators (2020), who evaluated the screening of GDM in pregnant women attending prenatal follow-up visits and found that only 38.6% of medical records had OGTT information. This highlights the current fragility in the execution of official protocols established for prenatal care in Brazil.

Brazil is not the only country lacking consistency in following GDM screening protocols in the public health system. A study in Bangladesh, India, evaluated physicians' knowledge of GDM screening in public health services (Babu and collaborators 2015).

Although the authors found that screening by physicians was performed in almost all health centers (96%), only 12% of physicians could correctly provide all components of the flowchart for diagnosing GDM, and 46% of doctors diagnosed GDM solely through fasting blood glucose. Additionally, most physicians had poor knowledge about the cut-off values of blood glucose levels for each test (Babu and collaborators 2015).

In recent years, both the WHO and the Brazilian Ministry of Health have sought to

change the care paradigm of the pregnancy and neonatal cycle, so that care for pregnant women is not limited only to physician appointments but involves all health professionals who contribute to a healthy pregnancy (Menezes and Dias 2012).

In this study, prenatal care in the region covered by HUSM still follows the traditional model, with care centered on the physician in 98.9% of prenatal appointments, according to the women interviewed.

However, upon review of the records in the prenatal booklet, most consultations were registered by nursing professionals.

Another relevant aspect observed in this study was the absence of an established multidisciplinary health team focused on pregnant women in the basic health network.

The absence of a multidisciplinary health team often prevents the detection of target risk factors for GDM and, consequently, hinders the implementation of actions to address these risk factors.

This fact was also observed by Massucatti and collaborators (2012), who analyzed the medical records of pregnant women receiving prenatal care at Basic Health Units in Vitória, Brazil, and did not observe the follow-up of a nutritionist in that population.

In our study, the presence of other professionals from the multiprofessional team was rarely noted, with only three women having prenatal care exclusively performed by nurses.

This scenario does not comply with the guidelines instituted by the Brazilian Ministry of Health for the provision of care to maternal and child health (Pan-American Health Organization 2017).

CONCLUSION

In conclusion, our results showed that positive GDM screening was carried out in most of the women evaluated, and according to the criteria from the Brazilian Ministry of Health, more than 80% of pregnant women had a positive GDM screening.

Additionally, most pregnant women were overweight, with high BMI being the main risk factor for positive GDM screening.

Furthermore, the absence of a multidisciplinary team during prenatal care for the early detection of GDM was noted, offering better care to the health of pregnant women.

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