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Neonatal adverse outcomes and associated factors among pregnant women with gestational and usual risk of diabetes mellitus

Desfechos neonatais adversos e fatores associados entre gestantes com diabetes *mellitus* gestacional e de risco habitual

Abstract

Objective: To assess adverse neonatal outcomes and associated factors between pregnant women with gestational diabetes mellitus and usual gestational risk. Methods: Cross-sectional, nationwide, hospital-based study, conducted from February 2011 to October 2012. Women with multiple pregnancies or stillbirths were excluded. Information was collected using a standardized questionnaire, prenatal card and/or medical records. Results: Out of a total of 12,712 postpartum women evaluated, 1,915 had gestational diabetes mellitus and 10,797 were classified as usual gestational risk. It was observed that 74.1% of diabetics received adequate/more than adequate prenatal care compared to 65% of women with usual gestational risk. On the other hand, the group of diabetics was composed mostly of women over 35 years of age, with underlying hypertension, pre-gestational excess weight and excess gestational weight gain who were multiparous, with history of cesarean deliveries and abortions. The outcomes of "prematurity" and "birth of large-sized newborn" for the gestational age were higher among diabetics. Conclusion: Diabetic women had more unfavorable demographic conditions, clinical/obstetric history and neonatal outcomes compared to women with usual gestational risk. Nevertheless, prenatal care was a factor of extreme importance to prevent other negative outcomes (neonatal death and Apgar <5) to increase among diabetic women compared to those with usual gestational risk. Therefore, the role of prenatal care among Brazilian women is reiterated, especially among the high gestational risk women.

Keywords: Prenatal care. Gestational diabetes mellitus. Prematurity. Neonatal mortality.

Resumo

Objetivo: Avaliar os desfechos neonatais adversos e fatores associados entre gestantes com diabetes mellitus gestacional e de risco gestacional habitual. Métodos: Estudo transversal, de âmbito nacional e de base hospitalar, conduzido entre fevereiro de 2011 e outubro de 2012. Foram excluídas as mulheres com gestações múltiplas ou natimortos. As informações foram coletadas via questionário padronizado, cartão de pré-natal e/ou prontuário. Resultados: Das 12.712 puérperas avaliadas, 1.915 tinham diabetes mellitus gestacional e 10.797 foram classificadas em risco gestacional habitual. Verificou-se que 74,1% das mulheres com diabetes receberam assistência pré-natal adequada/mais que adequada em relação a 65% das mulheres com risco gestacional habitual. Em contrapartida, o grupo das mulheres com diabetes foi composto em sua maioria por mulheres acima de 35 anos, com hipertensão prévia, excesso de peso pré-gestacional e ganho de peso gestacional excessivo, multíparas, com histórico de cesárea e abortos. Os desfechos "prematuridade" e "nascimento de recém-nascido grande para idade gestacional" foram superiores entre as

mulheres com diabetes. **Conclusão***: As mulheres com diabetes detiveram condições demográficas, antecedentes clínicos/obstétricos e desfechos neonatais mais desfavoráveis em relação às mulheres de risco gestacional habitual. Apesar disso, o pré-natal foi um dos fatores que exerceu extrema importância para que outros desfechos negativos (óbito neonatal e o Apgar<5) não fossem superiores entre as mulheres com diabete sem relação às de risco gestacional habitual. Portanto, reitera-se o papel do pré-natal entre as mulheres brasileiras, sobretudo as de alto risco gestacional.*

Palavras-chave: *Cuidado pré-natal. Diabetes mellitus gestacional. Prematuridade. Mortalidade neonatal.*

INTRODUCTION

Pregnancy is a physiological phenomenon that involves physical, social and emotional changes. This phase goes through, most of the time, without complications. However, around 10% of women present with clinical and/or obstetric conditions that are unfavorable for their health and/or that of the fetus.[1,2]

In 2017, the Ministry of Health, in its Reception and Risk Classification Manual, listed the factors for classifying gestational risk. According to the Manual, pregnant women who do not present with individual, sociodemographic risk factors, associated with previous obstetric history and diseases or conditions that may negatively interfere with the gestational outcome are classified as having habitual gestational risk.[1]

On the other hand, high-risk pregnancies can be affected by a number of known risk conditions, such as maternal age above 35 and below 18 years, multiple pregnancies, underlying medical conditions (chronic arterial hypertension, heart disease, diabetes mellitus), among others, that should be taken care of prenatally.[2]

Taking a look at gestational diabetes mellitus, we can see that this disease is considered one of the most prevalent gestational complications worldwide; prevalence varies between 1 and 41%, depending on the diagnostic method and the population studied. This condition causes an increase in maternal and perinatal morbidity and mortality and in health costs.[2-4]

Brazilian studies revealed a prevalence of gestational diabetes mellitus between 5 and 18%.[5,6] However, no population-based study published after the Brazilian Study of Gestational Diabetes was found in the literature. That was a study involving 6,000 pregnant women from six Brazilian capitals with an estimated prevalence of this condition between 2.4% and 7.2%.[7]

Although a number of articles assessed high-risk pregnant women, there are still few studies comparing diabetic women with those at normal risk. Thus, the present study aimed to evaluate adverse neonatal outcomes and potential associated factors (socioeconomic, clinical as well as obstetric history, current pregnancy data) among women with gestational diabetes mellitus and usual gestational risk, based on the data from the survey conducted in hospitals in Brazil called: "Birth in Brazil: National Survey on Childbirth and Birth".

METHODS

This was a cross-sectional study based on data from the hospital-based and nationwide survey "*Nascer no Brasil: Inquérito Nacional sobre Parto e Nascimento*" ("Birth in Brazil: National Survey on Childbirth and Birth"), conducted in public and private services, between 2011 and 2012. Sample details are reported in the study by Vasconcellos et al.[8] and, regarding the method, in the study by Leal et al.[9]

Information on gestational diabetes mellitus was obtained from the prenatal cards and/or medical records. The usual gestational risk was self-reported and defined based on the postpartum woman's negative response to the following question: "Were you considered a high-risk pregnant woman?"

In this study, women with multiple pregnancies or stillbirths were excluded. Regarding the sample size, 12,712 women met the inclusion criteria, of which 1,915 had gestational diabetes mellitus and 10,797 self-reported usual gestational risk.

The variables assessed in our study were socioeconomic – region of residence (North, Northeast, Southeast, South and Central-West), maternal age (12 to 19 years, 20 to 34 years and 35 or more), skin complexion (white, black, brown/*mulata*/dark brown, indigenous/yellow), education (less than 8 years, 9 to 11 years, 12 or more years), economic class (A+B, C, D+E); clinical and obstetric history – chronic arterial hypertension (no, yes), primiparity (no, yes), cesarean section (no, yes), stillbirth (no, yes), low birth weight (no, yes), prematurity (no, yes), abortion (no, yes); current pregnancy and

prenatal information – pre-pregnancy nutritional status (underweight, normal weight, overweight and obesity), adequacy of weight gain during pregnancy (insufficient, adequate, excess), adequacy of prenatal care (adequate or more than adequate , inadequate or partially adequate), prenatal service used (*Sistema Único de Saúde* (SUS, Government Unified Health System)), mixed or private), source of payment for the birth expenses (public, private), method of delivery (normal, cesarean), need for induction of labor (no, yes); neonatal outcomes – neonatal death (no, yes), 5-minute Apgar score (<7, ≥7), gestational age (less than 28 weeks, 28-31 weeks, 32-36 weeks, 37-42 weeks) and birth weight by gestational age (small for gestational age (SGA), appropriate for gestational age (AGA), large for gestational age (LGA).

The classification into economic classes was carried out in accordance with the *Associação Brasileira de Empresas de Pesquisa* (ABEP, Brazilian Association of Research Companies), which estimates the purchasing power of people and families according to the possession of goods and the level of education of the head of the family. The classification is carried out in terms of "economic classes" into five categories (A to E), and their subdivisions (A1, A2, B1, B2, C1, C2, D1, D2, E). For this classification, the questionnaire applied to the postpartum women was used. Because of the small number of class A and class E women, the sample socioeconomic classes were grouped into three categories: A + B, C + D or E.[10]

To classify pre-gestational nutritional status, the cutoff points recommended by the Institute of Medicine (IOM) were used, based on body mass index (BMI = Weight (kg)/height (m2)) – low weight (<18.5 kg/m2); eutrophic (18.5 to 24.9 kg/m2); overweight (25 to 29.9 kg/m2) and obese (≥30 kg/m2).[11]

To calculate total gestational weight gain, the pre-pregnancy weight (baseline) was subtracted from the weight of the last prenatal visit contained in the pregnant woman's card. This variable was also based on the IOM recommendations, according to the pre-pregnancy nutritional status. Weight gain of < 12.5 kg for underweight women was considered insufficient; < 11.5 kg for eutrophic ones; < 7.0 kg for overweight women and < 5.0 kg for obese women. Weight gain of: 12.5 to 18.0 kg for underweight women is considered adequate; 11.5 to 16.0 kg for eutrophic; 7.0 to 11.5 kg for overweight women; and 5.0 to 9.0 kg for obese women. And finally, weight gain is considered excessive if it exceeds 18.0 kg for underweight women; 16.0 kg for eutrophic; 11.5 kg for overweight women and 9.0 kg for obese women. The range of adequate weight gain was corrected according to gestational age at birth, with each gestational week below 40 being deducted from the minimum and maximum, for each pre-gestational BMI range, the average weekly weight gain in the second and third gestational trimesters.

The following parameters were used to evaluate the adequacy of prenatal care: gestational trimester at the time of starting prenatal care, the total number of health visits carried out, corrected according to gestational age at the time of delivery, routine exams performed and guidance provided about the reference maternity hospital for birth care. To assess the adequacy of the number of health visits, the recommendation of the Ministry of Health was used; they recommend to carry out at least one visit in the first trimester of pregnancy, two in the second and three in the last trimester.[12] The number of health visits was considered adequate when pregnant women completed 100% of the minimum number of visits expected for the gestational age at the time of birth. More information about the adequacy of prenatal care used in this work is reported in the publication by Domingues et al.[13]

In order to classify birth weight for gestational age we used the curves of the International Fetal and New Born Growth Consortium for the 21st Century (INTERGROWTH21st). These curves were constructed based on data from different countries and ethnic groups, and allow anthropometric assessment in the fetal, neonatal and postnatal period of babies, regardless of gestational age at birth. Based on these curves, newborns are classified as SGA (birth weight below the 10th percentile); AGA (between the 10th and 90th percentiles); or LGA (above the 90th percentile).[14]

Statistical analyses were carried out in the SPSS (Statistical Package for the Social Sciences) software for Windows, version 22, using procedures for complex samples that include the sample weight of postpartum women and the effect of the sample design. Pearson's chi-square test was used to evaluate the association between gestational diabetes mellitus and usual gestational risk and socioeconomic factors, clinical and obstetric history, prenatal and current pregnancy

characteristics, and perinatal and neonatal outcomes. The data were described in terms of absolute and relative frequencies and relevant confidence intervals for the rates of postpartum women in each of the groups according to the characteristics of interest. The significance level adopted was 5%.

The main study was approved by the *Comitê de Ética em Pesquisa* (CEP, Research Ethics Committee) of the National School of Public Health of the Oswaldo Cruz Foundation (Opinion No. 92/10; CAAE: 0096.0.031.000-10). This investigation was submitted to the CEP of the National Institute of Women's, Children's and Adolescents' Health Fernandes Figueira and approved by Opinion No. 43538821.0.0000.5269, complying with the requirements of Resolution No. 466/2012 of the National Health Council. All participating women were interviewed and released information only after signing the Free and Informed Consent Form.

RESULTS

The sample size of the present study was constituted by 12,712 postpartum women, 1,915 women with gestational diabetes mellitus and 10,797 with usual gestational risk. Most of the postpartum women were from the Southeast Region (42.5%); they were between 20 and 34 years old (75.3%) and had 9 to 11 years of schooling (44.1%); they self-reported being brown/ dark brown or mulatto (56.4%) and belonged to the socioeconomic class C (53.5%) (Table 1).

With regard to age group, more adolescents (20.8%) were observed at usual risk, while the group of women with diabetes included a greater number of women over 35 years of age (18.7%) (p-value <0.001) (Table 1). There was a higher frequency of women in this group who self-reported being white (p-value <0.001) (Table 1). In general, women with diabetes had better economic conditions (class A or B) (p-value <0.001) (Table 1

Table1. Sociodemographic differences between women with gestational diabetes mellitus and those at usual gestational risk, 2011 and 2012. Brazil.

Variables		Usual risk		Gestational diabetes mellitus		p-value
	n (%)	n	% (95% CI)	n	% (95% CI)	
Region of residence						< 0.001
North	1,289 (10.1)	1,124	10.4 (9.6-11.3)	165	8.6 (5.9-12.4)	
North East	3,474 (27.3)	3,080	28.5 (26.3-30.8)	394	20.6 (16.5-25.3)	
Southeast	5,445(42.8)	4,506	41.7 (39.9-44.6)	939	49.0 (43.9-54.2)	
South	1,697 (13.4)	1,368	12.7 (11.3-14.2)	330	17.2 (14.5-20.3)	
Midwest	807 (6.3)	719	6.7 (5.9-7.6)	87	4.6 (3.1-6.7)	
Maternal age						< 0.001
2-19 years	2,447 (19.3)	2,246	20.8 (19.7-22.0)	201	10.5 (8.7-12.5)	
20-34 years	9,006 (70.9)	7,650	70.9 (69.7-72.0)	1.357	70.9 (68.2-73.4)	
35 or more	1,258 (9.9)	900	8.3 (7.6-9.1)	357	18.7 (16.5-21.0)	
Education						0.064
Up to 8 years	4,794 (37.9)	4,118	38.3 (36.6-40.1)	676	35.4 (32.1-38.8)	
9-11 years	5,510 (43.6)	4,679	43.6 (41.7-45.5)	831	43.5 (40.1-46.9)	
More than 12 years	2,347 (18.6)	1,944	18.1 (16.5-19.8)	403	21.1 (18.0-24.5)	
Skin Complexion						< 0.001
White	4,339 (34.1)	3,637	33.7 (31.5-35.9)	702	36.7 (33.4-40.1)	
Black	1,081 (8.5)	884	8.2 (7.1-9.4)	197	10.3 (8.5-12.4)	
Brown/Dark brown/ Mulatto	7,097 (55.8)	6,107	56.6 (54.4-58.7)	990	51.7 (48.2-55.2)	
Yellow/Indigenous	193 (1.5)	167	1.6 (1.2-2.0)	25	1.3 (0.8-2.1)	
Economic class						< 0.001
A+B	3,037 (24.1)	2,468	23.1 (21.6-24.6)	569	30.0 (26.6-33.5)	
C	6,654 (52.8)	5,645	52.7 (51.1-54.4)	1.009	53.1 (49.9-56.3)	
D+E	2,913 (23.1)	2,592	24.2 (22.6-25.9)	322	16.9 (14.6-19.6)	

Pearson's chi-square test

As to clinical and obstetric history (Table 2), a higher percentage of women with diabetes had underlying chronic hypertension (6.7%) (p-value <0.001). Among women with habitual gestational risk, the majority (50.2 %) was primiparous, while 49.8% of women with diabetes were multiparous (p-value <0.001). Among the multiparous women, 39.0% had already undergone cesarean sections, 46.3% of those with gestational diabetes and 37.5% of those with usual gestational risk (p-value <0.001) (Table 2).

Among pregnant women with gestational diabetes mellitus, 33.7% had already had at least one abortion in previous pregnancies, while the percentage of this outcome was lower in the usual gestational risk group (29.8%) (p-value 0.021) (Table 2).

Table 2. Clinical and obstetric differences between women with gestational diabetes mellitus and those at usual gestational risk, 2011 and 2012. Brazil.

Variables	Total	Usual risk		Gestational diabetes mellitus		p-value
	n (%)	n	% (95% CI)	n	% (95% CI)	
Underlying chronic hypertension						< 0.001
No	12,408 (97.6)	10,621	98.4 (98.0-98.7)	1,787	93.3 (91.6-94.7)	
Yes	304 (2.4)	176	1.6 (1.3-2.0)	128	6.7 (5.3-8.4)	
Primiparity						< 0.001
No	6,533 (51.4)	5,380	49.8 (48.5-51.1)	1,153	60.2 (57.1-63.2)	
Yes	6,179 (48.6)	5,417	50.2 (48.9-51.5)	762	39.8 (36.8-42.9)	
*Previous cesarean section**						< 0.001
No	3,982 (61.0)	3,363	62.5 (600-65.0)	619	53.7 (49.2-58.1)	
Yes	2,550 (39.0)	2,016	37.5 (35.0-40.0)	534	46.3 (41.9-50.8)	
*Stillbirth history**						0.281
No	3,280 (96.1)	5,180	96.3 (95.5-96.9)	1.100	95.4 (93.7-96.7)	
Yes	253 (3.9)	201	3.7 (3.1-4.5)	53	4.6 (3.3-6.3)	
*LBW History**						0.233
No	5,690 (87.1)	4,701	87.4 (86.0-88.6)	989	85.8 (83.1-88.1)	
Yes	843 (12.9)	679	12.6 (11.4-14.0)	164	14.2 (11.9-16.9)	
*History of prematurity**						0.123
No	5,833 (89.3)	4,823	89.6 (88.4-90.8)	1.011	87.6 (84.8-90.0)	
Yes	700 (10.7)	557	10.4 (9.2-11.6)	143	12.4 (10.0-15.2)	
*Abortion history**						0.021
No	5,020 (69.5)	4,184	70.2 (68.5-71.8)	836	66.3 (63.4-69.1)	
Yes	2,204 (30.5)	1,779	29.8 (28.2-31.5)	425	33.7 (30.9-36.6)	

Note: LWB – Low birth weight
Pearson's chi-square test
* These variables were evaluated excluding primiparous women

In relation to pre-pregnancy nutritional status, most women were eutrophic (60%). However, a greater number of women with normal pregnancy risk who were underweight (9.1%) or eutrophic (62.4%) and more women with diabetes who were overweight (30.4% overweight and 20% obese) were observed. (p-value <0.001). Among women with diabetes, the rate of excess gestational weight gain was higher compared to women with usual gestational risk (46.3% versus 39.5%) (p-value <0.001) (Table 3).

Prenatal care was considered adequate or more than adequate for 74.1% of women with diabetes compared to 64.9% of women with usual gestational risk (p-value <0.001). A higher proportion of cesarean deliveries was observed among women with gestational diabetes mellitus (59.9% versus 48.5%, p-value <0.001) (Table 3).

Table 3. Differences between women with gestational diabetes mellitus and with usual gestational risk, in relation to current pregnancy and prenatal care 2011 and 2012. Brazil.

Variables	Total	Usual risk		Gestational diabetes mellitus		p-value
	n (%)	n	% (95% CI)	n	% (95% CI)	
Pre-pregnancy nutritional status						<0,001
Low weight	1,039 (8.2)	984	9.1 (8.3-10.0)	54	2.8 (2.1-3.8)	
Eutrophy	7,629 (60.0)	6734	62.4 (60.9-63.8)	894	46.7 (43.9-49.5)	
Overweigh	2,877 (22.6)	2294	21.3 (19.9-22.7)	582	30.4 (27.4-33.6)	
Obesity	1,168 (9.2)	784	7.3 (6.7-7.9)	384	20.0 (18.1-22.1)	
Prenatal adequacy						< 0.001
Inadequate or partially adequate	4,284 (33.7)	3788	35.1 (33.6-36.6%)	496	25.9 (23.2-28.8)	
Adequate or more than adequate	8,428 (66.3)	7009	64.9 (63.4-66.4%)	1.419	74.1 (71.2-76.8)	
Prenatal service						0.597
SUS	5,380 (42.3)	4606	42.7 (40.1-45.3)	774	40.4 (35.6-45.4)	
Mixed	5,524 (43.)	4680	43.3 (40.5-46.2)	893	44.0 (39.0-49.3)	
Private	1,809 (14.2)	1511	14.0 (12.7-15.4)	297	15.5 (11.4-20.7)	
Payment source						0.134
Public	10,254 (80.7)	8761	81.1 (79.5-82.7)	1,493	78.0 (73.0-82.3)	
Private	2,458 (19.3)	2037	18.9 (17.3-20.5)	421	22.0 (17.7-27.0)	
Adequacy of weight gain during pregnancy						< 0.001
Insufficient	3,353 (26.4)	2904	26.9 (25.8-28.0)	449	23.4 (21.1-25.9)	
Adequate	4,204 (33.1)	3624	33.6 (32.2-34.9)	579	30.3 (27.5-33.2)	
Excessive	5,155 (40.6)	4269	39.5 (38.4-40.7)	886	46.3 (43.6-49.0)	
Delivery route						< 0.001
Normal	6,329 (49.8)	5562	51.5 (48.6-54.4)	767	40.1 (36.1-44.2)	
Cesarean section	6,383 (50.2)	5235	48.5 (45.6-51.4)	1,147	59.9 (55.8-63.9)	
Labor induction						0.822
No	11,152 (87.7)	9476	87.8 (85.7-89.5)	1,676	87.5 (84.6-90.0)	
Yes	1,560(12.3)	1322	12.2 (10.5-14.3)	239	12.5 (10.0-15.4)	

Note: SUS - Unified Health System
Pearson's chi-square test

Regarding neonatal outcomes (Table 4), there was no significant difference between the groups in relation to neonatal death and 5-minute Apgar scores. However, women with gestational diabetes mellitus had more newborns with borderline prematurity (11.6% versus 8.4%, p-value 0.002) and LGA (15.9% versus 7.8%, p-value <0.001).

Table 4. Differences between women with gestational diabetes mellitus and with usual gestational risk, regarding perinatal and neonatal outcomes, 2011 and 2012. Brazil.

Variables	Total	Usual risk		Gestational diabetes mellitus		p-value
	n (%)	n	% (95% CI)	n	% (95% CI)	
Neonatal death						0.069
No	12,644 (99.5)	10,735	99.4 (99.2-99.6)	1,909	99.7 (99.4-99.9)	
Yes	68 (0.5)	62	0.6 (0.4-0.8)	5	0.3 (0.1-0.6)	
Apgar 5 minutes						0.511
<7	98 (0.8)	86	0.8 (0.6-1.1)	12	0.6 (0.3-1.2)	
≥ 7	12,614 (99.2)	10.711	99.2 (98.9-99.4)	1.903	99.4 (98.8-99.7)	
Gestational age at birth						0.002
< 28	24	23	0.2 (0.1-0.4)	1	0.0 (0.0-0.3)	
≥28 to 31	123	104	1 (0.6-1.6)	18	1 (0.6-1.7)	
32 to 36	1,125	903	8.4 (7.6-9.2)	223	11.6 (9.9-13.7)	
37 to 42	11,439	9,767	90.5 (89.4-91.4)	1673	87.3 (85.2-89.9)	
Weight/Gestational age						< 0.001
SGA	773 (6.1)	693	6.4 (5.8-7.1)	79	4.1 (3.2-5.4)	
AGA	10,781 (84.9)	9,250	85.7 (84.8-86.7)	1,531	80.0 (76.9-82.7)	
LGA	1,151 (9.1)	847	7.8 (7.2-8.6)	304	15.9 (13.4-18.8)	

Note: SGA – small for gestational age; AGA – appropriate for gestational age; LGA – large for gestational age
Pearson's chi-square test

DISCUSSION

Although a number of articles have already highlighted the main risk factors associated with gestational diabetes mellitus, there are still few studies that have evaluated the main differences in relation to socioeconomic conditions, obstetric and clinical history and neonatal outcomes between these women and those at usual gestational risk especially using national data.[6] In addition it is important to point out that the most comprehensive study on gestational diabetes mellitus in Brazil was published in 2001, which estimated the prevalence of this disease based on data from six Brazilian capitals (Porto Alegre, São Paulo, Rio de Janeiro, Salvador, Fortaleza and Manaus).[7]

In our study, the differences observed between women with gestational diabetes mellitus and those at usual risk were associated with the region of residence, age, education, skin complexion, socioeconomic class, parity, history of cesarean section and abortion, pre-pregnancy nutritional status, adequacy of gestational weight gain, adequacy of prenatal care and route of delivery.

Advanced maternal age is closely associated with an increased frequency of chronic diseases, such as high blood pressure and diabetes mellitus as well as unfavorable gestational outcomes, such as

chromosomal abnormalities, miscarriages, pre-eclampsia and maternal mortality, among others.[5] According to the Brazilian Diabetes Society and the Ministry of Health, age greater than or equal to 35 years is considered a risk factor for gestational diabetes mellitus.[12,15]

With the exception of women aged 35 or over, in general, women in the usual risk group were younger. Childbirth at an older maternal age increases the risk of being diagnosed with gestational diabetes mellitus, as described in the study by Liu et al.[16]

As to the skin complexion, most women with diabetes reported themselves to be white, corroborating results found in other studies.[16,17] However, other studies have demonstrated that black women have a greater biological predisposition to diseases such as hypertension and diabetes mellitus, which are enhanced due to poverty and lack of access to quality health services.[18]

In the present study, it was found that the two groups evaluated were mostly classified in the economic class C. According to recent studies, income does not directly cause gestational risk, but it interferes with material living conditions, the environment, access to health services, health, education and access to adequate food.[19,20]

Considering the impact of income on food with repercussions on women's nutritional status, the study conducted by Soares et al.[21] demonstrated an increase in obesity among the low-income population. It is noteworthy that obesity increases the risk of chronic diseases and during pregnancy it is closely associated with gestational diabetes mellitus due to physiological changes mediated by placental hormones during pregnancy, which can increase insulin resistance and predispose this outcome.[22]

The literature has already demonstrated that pre-gestational excess weight and excess weight gain, especially at the beginning of pregnancy, can increase the risk of gestational diabetes mellitus.[23] The Brazilian Institute of Geography and Statistics, in 2013, found that women with gestational diabetes mellitus had a higher percentage of overweight individuals.[24] These findings corroborate our study, since a higher rate of overweight and pre-gestational obesity was observed among women with gestational diabetes mellitus compared to those with usual gestational risk.

Regarding the gestational weight gain, we observed that the rate of excess weight gain was higher among women with gestational diabetes mellitus compared to those with usual gestational risk. Excess weight gain can reduce insulin secretion by the β-cells and trigger gestational diabetes mellitus.[25] Given the impact of the maternal nutritional status on gestational diabetes mellitus, efforts to reduce the prevalence of obesity among women of childbearing age are necessary. In this connection, reproductive planning and adequacy of weight and blood glucose levels, when necessary, are important strategies to be implemented to avoid negative gestational outcomes.[25]

Regarding underlying disorders, a higher prevalence of chronic hypertension was observed among pregnant women with gestational diabetes mellitus compared to those at usual risk. Arterial hypertension is considered a polygenic and multifactorial disease. The common link between gestational diabetes mellitus and arterial hypertension is considered to be in the cycle of endothelial dysfunction and relative insulin deficiency[2]. Age over 35 years, BMI over 30kg/m^2 and multiparity are factors that have been associated with both gestational diabetes mellitus and chronic arterial hypertension. These data corroborate this study's data, since women with gestational diabetes mellitus, in addition to having a higher prevalence of chronic hypertension, also presented with the aforementioned conditions.

As to obstetric history, our study found a higher prevalence of multiparity and cesarean sections among women with gestational diabetes mellitus. Parity is not directly associated with the progression of pancreatic

cellular dysfunction and the onset of gestational diabetes mellitus, which suggests that the development of this condition is consequent to increased maternal age, pre-pregnancy weight and weight gain during pregnancy between multiparous women. According to Santos et al.,[6] the number of pregnancies is an indirect risk factor for gestational diabetes mellitus; they demonstrated that multiparous women (three pregnancies or more) were twice as likely to develop gestational diabetes mellitus compared to primiparous women, but this association lost statistical significance when adjusted for age and nutritional status.[6] These data once again confirm the great impact of the nutritional status on gestational diabetes mellitus.[25]

Regarding the method of delivery, studies reported that the presence of gestational diabetes mellitus is not an indication for cesarean section, and medical evaluation is necessary to define the method of birth. The preference for cesarean section occurs when there are risks for the newborn or the mother due to inadequate glycemic control.[26]

According to the World Health Organization (WHO), at a population level, cesarean section rates of up to 15% are associated with a reduction in maternal and neonatal mortality.[27] Although in the present study we observed significant differences between cesarean section rates among the groups assessed, it was observed that the frequency of this procedure was four times higher (59.9%) among women with diabetes and approximately three times higher (48.5%) for those with usual gestational risk. Similarly, other studies have already demonstrated a frequency of approximately 50% of cesarean sections among pregnant women with gestational diabetes mellitus.[2,28] These data revealed that cesarean sections in Brazil, regardless of gestational risk, still remain a recurrent practice. According to Leal et al.,[9] this can be partially explained by the deep-rooted culture in this country that cesarean section is the safest way to deliver a child.[9]

In this study, a significant difference was observed between the adequacy of prenatal care among women with gestational diabetes mellitus in relation to those with usual gestational risk. A higher level of education was also observed among women with diabetes compared to those with usual gestational risk. Furthermore, it is important to highlight that women with diabetes belonged mostly to the economic classes A, B, and C, while women with usual pregnancy risk were in lower classes (D and E). Such factors may partially explain the findings regarding the adequacy of prenatal care. Corroborating the findings of the present study, Dode & Santos[5] found that greater education and belonging to higher economic classes increased the probability, with high statistical significance, of developing gestational diabetes mellitus, when compared to the risks of mothers with less education and low economic level.[5]

Regarding the neonatal outcomes assessed in the present study, a higher frequency of LGA or premature newborns was observed among pregnant women with gestational diabetes mellitus. The increase in the frequency of LGA newborns associated with gestational diabetes mellitus has already been described in several studies and occurs with a rate between 15% and 25%.[29,30] This is due to the transfer of glucose in greater quantities to the fetus via the placenta through the mechanism of facilitated diffusion. Consequently, the fetus develops hyperglycemia and hyperinsulinemia that stimulate fetal growth and increased fat deposition in the chest and abdomen.[30]

As to prematurity, we found a rate of 12.6% among women with diabetes. A study carried out in France involving 716,152 births, in the same year of collection of the present study, showed 8% of premature births among pregnant women with gestational diabetes mellitus.[2] Delivery before 37 weeks is considered the most important determinant of neonatal morbidity because it can be the cause of several neonatal complications, such as respiratory distress syndrome, jaundice, sepsis, hypoglycemia and neonatal death, thus increasing the length of hospital stay and possibly the need for care in the Intensive Care Unit. Therefore, glycemic control is essential for reducing prematurity.[2]

Although women with diabetes had a higher frequency of unfavorable negative outcomes compared to women with usual gestational risk, it is extremely important to point out that prenatal care in this group was one of the factors that would mitigate possible differences in the occurrence of neonatal death and Apgar<5 years.

Although the Ministry of Health listed the risk factors associated with pregnancy in 2017, the assessment of gestational risk must be carried out by the doctor based on his/her precepts, which makes this assessment difficult in epidemiological studies.[1] As a limitation of the present study, it is important to point out that it was not possible to assess pregnancy risk based on the afore mentioned recommendation, due to the unavailability of this information in the prenatal card. For this reason, the present study assessed gestational risk based on the woman's self-report. Nevertheless, Garcia et al.,[20] in their cross-sectional study with 1,777 women, observed that the score calculated to assess the risk was overestimated when compared to the woman's self-report which was based on the following question: “During prenatal care, did any health professional tell you that your pregnancy was a low, medium or high risk pregnancy?”.[20]

In short, the present study performed on a national basis, found that those women with gestational diabetes mellitus had more unfavorable demographic conditions, clinical and obstetric history and neonatal outcomes compared to women with usual gestational risk. However, prenatal care was one of the factors that was extremely important so that other negative outcomes (neonatal death and Apgar score<5) were not higher among women with diabetes compared to those with habitual pregnancy outcomes. Hence, the importance of carrying out prenatal care among Brazilian women, especially those at high gestational risk, is reiterated

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Contributors

Marano D contributed to the study design, analysis and interpretation of data, critical review of the intellectual content and final approval of the version to be published; Magalhães CAS contributed to the interpretation of data, writing of the article and final approval of the version to be published; Moreira MEL contributed to the critical review of the intellectual content, and final approval of the version to be published; Bastos MAD contributed to the interpretation of data and critical review of the content. All authors approved the final version of the manuscript and are responsible for all aspects of it, including ensuring its accuracy and integrity.

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