

PREGNANCY AND DIABETES: RELATIONSHIP BETWEEN NUTRITIONAL STATUS AND GLYCEMIC CONTROL

Gestação e diabetes: relação entre estado nutricional e o controle glicêmico

Embarazo y Diabetes: relación del estado nutricional y el control glucémico

Original Article

ABSTRACT

Objective: To assess the relationship between nutritional status and glycemic control in pregnant women with diabetes hospitalized in a public maternity hospital in Fortaleza-CE. **Methods:** Observational, descriptive and cross-sectional study conducted with 11 diabetic pregnant women hospitalized in a reference maternity hospital between July and November 2012. Clinical, obstetric, pre-natal, weight gain, insulin and glucose data were obtained from records and prenatal care cards; socioeconomic data and obstetric and nutritional history data were obtained through direct interviews. Qualitative variables were presented in absolute numbers and simple frequency, and quantitative variables were presented using mean and standard deviation. **Results:** The participants were aged 31.4 ± 4.2 years. The majority (81.9%, $n=9$) started pregnancy with weight deviation such as overweight (27.3%; $n=3$) and obesity (54.5%; $n=6$) and used a greater amount of insulin per day, mean of 39.5 ± 16.8 International Units (IU) and 53.3 ± 32.7 IU, respectively, when compared to the women who started pregnancy with eutrophic values, mean of 26.7 ± 8.6 IU. Patients with adequate nutritional status before pregnancy have achieved good levels of fasting glucose and glucose 1h after breakfast, and overweight and pre-pregnancy obese women had inadequate glycemic control at all times (fasting, 1h after breakfast, 1h after lunch and 1h after dinner). **Conclusion:** Inadequate pre-pregnancy nutritional status, such as overweight and obesity, and weight gain above what is recommended during pregnancy are factors that positively influence the difficulty in obtaining optimal glycemic control in pregnant women with diabetes.

Descriptors: Gestational Diabetes; Nutritional Status; Glucose; Insulin.

RESUMO

Objetivo: Avaliar a relação entre o estado nutricional e o controle glicêmico de gestantes internadas com diabetes em uma maternidade pública em Fortaleza-CE. **Métodos:** Estudo observacional, descritivo e transversal realizado com 11 gestantes diabéticas, hospitalizadas em uma maternidade de referência, entre julho e novembro de 2012. Os dados clínicos, obstétricos, de pré-natal, ganho de peso, insulino-terapia e glicemia foram obtidos por meio de busca ao prontuário e cartão da gestante; por meio de entrevista direta, coletaram-se dados socioeconômicos, antecedentes obstétricos e nutricionais. Apresentaram-se as variáveis qualitativas em número absoluto e frequência simples, e as quantitativas, em média e desvio padrão. **Resultados:** As participantes apresentaram idade de $31,4 \pm 4,2$ anos. A maioria (81,8%; $n=9$) iniciou a gestação com desvio ponderal, como sobrepeso (27,3%; $n=3$) e obesidade (54,5%; $n=6$), e estas utilizaram uma maior quantidade de insulina por dia, média de $39,5 \pm 16,8$ Unidades Internacionais (UI) e $53,3 \pm 32,7$ UI, respectivamente, quando comparadas com as que começaram o período gravídico eutróficas, média de $26,7 \pm 8,6$ UI. Participantes com estado nutricional adequado antes de engravidar atingiram bons níveis de glicemia em jejum e 1h após o desjejum, e as participantes com sobrepeso e obesidade pré-gestacional apresentaram controle glicêmico inadequado em todos os horários (em jejum, 1h após o desjejum, 1h após o almoço e 1h após o jantar). **Conclusão:** O estado nutricional pré-gravídico inadequado, como sobrepeso e obesidade, e o ganho de peso superior ao recomendado na gestação são fatores que influenciam positivamente na dificuldade de obter o controle glicêmico ideal da gestante com diabetes.

Descritores: Diabetes Gestacional; Estado Nutricional; Glicemia; Insulina.

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RESUMEN

Objetivo: *Evaluar la relación del estado nutricional y el control glucémico en embarazadas con diabetes ingresadas en una maternidad pública de Fortaleza-CE. Métodos:* Estudio observacional, descriptivo y transversal realizado con 11 embarazadas diabéticas ingresadas en una maternidad de referencia entre julio y noviembre de 2012. Los datos clínicos, obstétricos, de prenatal, ganancia de peso, terapia con insulina y glucemia fueron obtenidos a través de consulta al historial clínico y la tarjeta de la embarazada. A través de entrevista directa se recogieron los datos socioeconómicos, los antecedentes obstétricos y nutricionales. Se presentó las variables cualitativas con número absoluto y frecuencia simple y las cuantitativas con media y desviación típica. **Resultados:** Las participantes tenían edad de 31,4±4,2 años. La mayoría (81,8%; n=9) empezó el embarazo con desvío ponderal como el sobrepeso (27,3%; n=3) y la obesidad (54,5%; n=6), y estas utilizaron mayor cantidad de insulina al día, media de 39,5±16,8 Unidades Internacionales (UI) y 53,3±32,7 UI, respectivamente, al comparar con las que empezaron el embarazo eutróficas con media de 26,7±8,6 UI. Las participantes con el estado nutricional adecuado antes de quedarse embarazadas tuvieron buenos niveles de glucemia en ayuno y 1h después del desayuno y las participantes con sobrepeso y obesidad pre-gestacional presentaron el control glucémico inadecuado en todos los horarios (en ayuno, 1h después del desayuno, 1h después de la comida y 1h después de la cena). **Conclusión:** El estado nutricional pre-gestacional inadecuado como el sobrepeso y la obesidad y la ganancia de peso superior al recomendado en el embarazo son factores que influyen positivamente en la dificultad para la obtención del control glucémico ideal para la embarazada con diabetes.

Descriptor: *Diabetes Gestacional; Estado Nutricional; Glucemia; Insulina.*

INTRODUCTION

Gestational diabetes mellitus (GDM) is defined as any degree of glucose intolerance with onset during the second or third trimester of pregnancy. It is usually reverted to normal tolerance post-partum, but it can persist after childbirth^(1,2).

Its prevalence varies according to population characteristics and diagnostic criteria. In the United States of America, it varies from 1.1%-14.3%, with the most common prevalence of 2%-5%. In Canada, there is a prevalence of 6.5%^(3,4). In Brazil, data from the World Health Organization – WHO report a prevalence of 7.6%⁽⁵⁾. Studies conducted in Brazil report a prevalence of 5.8% and 3.6% in Vitória, ES, and Salvador, BA, respectively^(6,7).

It is known that pregnancy complicated by diabetes mellitus (DM) represents one of the major causes of maternal

and fetal morbidity and mortality. High-risk prenatal care aims to identify risk factors through pregnancy planning, GDM screening, and multidisciplinary follow-up in order to obtain early and proper diagnosis of diabetes and thus prevent complications during pregnancy, childbirth and post-partum^(8,9).

Some of the risk factors that contribute to the onset of GDM are age ≥ 25 years, known diabetes in first-degree relatives, history of poor obstetric outcomes (macrosomia, polyhydramnios, fetal or neonatal deaths from unknown causes, recurrent pregnancy loss, gestational diabetes), overweight, obesity or excessive weight gain, excessive fetal growth, polyhydramnios, hypertension or preeclampsia, central distribution of excessive body fat, polycystic ovary syndrome, and short stature ($< 1.50\text{m}$)^(1,2).

The most common GDM-related outcomes in pregnant women are preeclampsia and cesarean delivery. Fetal outcomes associated with gestational diabetes include macrosomia, preterm birth, shoulder dystocia, hypoglycemia, and perinatal death⁽¹⁰⁾.

Following the GDM diagnosis, the main objective of the treatment is to prevent or minimize fetal and neonatal outcomes to maintain a good glucose level⁽¹¹⁾. Initially, it consists of appropriate dietary control, physical activity, and monitoring of glucose levels⁽²⁾. When glycemic control is not achieved in the initial treatment, it is recommended the use of insulin therapy, which is considered the standard drug treatment⁽²⁾.

Pre-pregnancy and pregnancy nutritional status are directly associated with adverse perinatal outcomes. Multidisciplinary support during prenatal care with a focus on nutritional status is of utmost importance for all pregnant women, especially those with GDM, as it ensures an appropriate intervention for glycemic control and adequate weight gain^(12,13).

Thus, the present study is justified by the importance of showing the influence of nutritional status on glycemic control of patients with GDM. It aims to assess the relationship between nutritional status and glycemic control of pregnant women with diabetes hospitalized in a public maternity hospital in Fortaleza, CE.

METHODS

This is an observational, descriptive, cross-sectional study conducted at the *Maternidade Escola Assis Chateaubriand - MEAC* (Assis Chateaubriand Maternity Hospital), a reference institution for obstetrics and gynecology in the state of Ceará.

Data were collected from July to November 2012. The sample comprised all the pregnant women hospitalized with

diabetes during this period, with a minimum permanence of seven days, and who met the inclusion criteria.

Of all pregnant women hospitalized (n=250) at the MEAC during the period of data collection, 16 had diabetes, accounting for a prevalence of 6.4%. This percentage is similar to the national prevalence and allows inference from the findings of the present study. Of the 16 women selected, five were excluded for not presenting a minimum permanence of seven days. Therefore, the final sample comprised 11 participants.

The study included singleton pregnant women aged ≥ 20 years diagnosed with pregestational type I or type II diabetes mellitus (DM) or gestational diabetes mellitus (GDM) who had a maternity record. The study excluded twin pregnancies, patients who used corticosteroids, and those with comorbidities associated with altered body weight, such as chronic kidney disease, cancer, and wasting syndrome.

The main researcher/author of the present study was a resident nutritionist in the *Programa de Residência Integrada Multiprofissional em Atenção Hospitalar à Saúde* (Multiprofessional Integrated Residency Program with Emphasis on Hospital Care) at the maternity hospital where this research took place. She was responsible for obtaining information from participants as they were lying in hospital beds.

Data collection was done in two stages. The first stage took place within up to 48 hours after hospital admission, and the second stage took place after seven days of hospitalization. Medical and pregnancy records were searched to obtain data on gestational age, glucose values, insulin therapy, presence of associated diseases, and information about prenatal care, pre-pregnancy weight (or weight until the 13 weeks of pregnancy), and weights recorded in the days of consultations to check weight gain. Direct interviews were carried out to collect information about the mother, including socio-economic data (age, marital status, origin, occupation, housing, education level, and family income), family history of gynecology/obstetrics outcomes (twin pregnancy, prematurity, fetal abnormality), personal and family history of chronic diseases (hypertension, diabetes, cancer), obstetric history (number of pregnancies, births and abortions, number of children, last day of last pregnancy), data on current pregnancy (last menstrual period - LMP, gestational week, associated pathologies), and anthropometric data (pre-pregnancy weight, height, current weight). All these data were recorded on a formulary specifically tailored to this end. A pre-test was conducted to test the suitability of spaces and variables.

Prenatal care analysis followed the guidelines of the *Programa de Humanização no Pré-Natal e Nascimento - PHPN*⁽¹⁴⁾ (Program for the Humanization of Prenatal and Childbirth Care), which establishes a minimum of six prenatal consultations, preferably one during the first trimester, two during the second trimester, and three during the last trimester.

Nutritional status in early pregnancy was determined by the pre-pregnancy body mass index (BMI), according to the following classification: $< 18.5 \text{ Kg/m}^2$ = underweight (U); $18.5 - 24.99 \text{ Kg/m}^2$ = normal (N); $25 - 29.9 \text{ Kg/m}^2$ = overweight (OW); and $> 30 \text{ Kg/m}^2$ = obesity (O)⁽¹⁵⁾. The nutritional status of current pregnancy was determined by the maternal BMI using pregnancy weight. BMI was correlated to gestational age and classified as underweight, normal, overweight, and obesity⁽¹⁶⁾.

Weight gain was assessed according to the pre-pregnancy BMI classification, as for each initial nutritional status (U, N, OW, O) there is a recommended weekly weight gain range that must be followed until the end of pregnancy⁽¹⁵⁾. Patients' weight was measured in both stages of data collection.

With regard to blood glucose levels and the amount of insulin, the data were recorded in the second stage of data collection through the daily glycemic profile and insulin therapy scheme, respectively.

The goals set for the characterization of a good glycemic control considered the following reference values: $< 95 \text{ mg/dL}$ for fasting glucose and $< 140 \text{ mg/dL}$ for glucose 1h postprandial glucose^(1,11,17).

The analysis of insulin therapy took into account: the gestational age at the beginning (up to 12 weeks, 13-26-weeks, and more than 27 weeks; the length of treatment of 7 days; the total daily insulin dose (IU/day); and pregnant women's current weight-based insulin doses⁽¹⁸⁾.

Data were organized in a database. Qualitative variables were presented as absolute number and simple frequency, and quantitative variables were presented as mean and standard deviation.

The present study was approved by the Research Ethics Committee of the MEAC (Opinion No. 013/12) following the guidelines of Resolution 466/12 of the *Comissão Nacional de Ética em Pesquisa - CONEP* (National Commission on Research Ethics). Participants signed a Free Informed Consent Form and the person in charge of the MEAC authorized the research.

RESULTS

Participants had a mean age of 31.4 ± 4.2 years, and the majority lived in a common-law marriage (n=8; 72.7%),

were originally from Fortaleza (n=7; 63.6%), had a paid job (n=6; 54.5%), had a family income of 1 minimum wage (n=5; 45.5%), and had not completed high school (n=8; 72.7%) (Table I). The average minimum wage among participants was 1.9 ± 1.3 , and the average number of people living in the same house was 3.6 ± 2.0 , with a rate of 0.5 wages per person.

GDM was the most prevalent clinical diagnosis (63.6%; n=7), and hypertensive disorders of pregnancy (HDP) (27.3%; n=3) were among the outcomes of the current pregnancy. With regard to reproductive history, 63.6% (n=7) of women were multigravida, 36.4% have been pregnant 3-4 times (n=4), and 45.5% reported abortion (n=5) (Table II).

Regarding the family history of gynecology/obstetrics outcomes, 81.8% (n=9) of the 11 interviewees reported a known history of type I or II diabetes or GDM.

The majority of women were more than 27 weeks pregnant (81.8%; n=9), with a mean gestational age of 30.1 ± 6.6 weeks at the first stage of the research.

The average number of prenatal consultations was 5 ± 2.1 . With regard to the relationship between number of consultations and current gestational age, 45.5% (n=5) of patients did not attend the minimum number of consultations during the first trimester of pregnancy, and 27.3% (n=3) did not attend the minimum number of consultations during the second trimester of pregnancy (Table II).

According to Table III, information on lifestyle revealed that 27.3% (n=3) of participants practiced physical activity, and the majority did not drink alcohol (72.7%; n=8) and did not smoke (90.9%; n=10).

The nutritional status of participants revealed that 81.8% (n=9) entered pregnancy with weight deviations, such as overweight (27.3%; n=3) and obesity (54.5%; n=6). During pregnancy, at the 1st and 2nd stage of the interview, there was an increase in obesity rate (63.6%; n=7) (Table IV).

With regard to weight gain during pregnancy, excessive weight gain was reported at the moment of admission (1st stage of the interview) by women with pre-pregnancy

Table I - Socioeconomic characterization of pregnant women with diabetes admitted to the *Maternidade Escola Assis Chateaubriand – MEAC* (Assis Chateaubriand Maternity Hospital). Fortaleza-CE, 2012.

Variables	n	%
Age group		
25-30 years	04	36.4
31-36 years	07	63.6
Marital status		
Single	03	27.3
Married/Common-law marriage	08	72.7
Origin		
Capital	07	63.6
Countryside	04	36.4
Occupation		
Unemployed	05	45.5
Employed	06	54.5
Family income		
Less than 1 minimum wage	01	09.1
1 minimum wage	05	45.5
2-3 minimum wages	03	27.3
4-5 minimum wages	02	18.2
Education		
Incomplete elementary school	04	36.4
Complete elementary school	02	18.2
Incomplete high school	02	18.2
Complete high school	03	27.3
Total	11	100.00

Table II - Clinical, obstetric and prenatal data from pregnant women with diabetes admitted to the *Maternidade Escola Assis Chateaubriand – MEAC* (Assis Chateaubriand Maternity Hospital). Fortaleza-CE, 2012.

Variables	n	%
Clinical diagnosis		
DMI	01	09.1
DMII	03	27.3
GDM	07	63.6
Complications of current pregnancy		
HDP	03	27.3
PTL	01	09.1
Encephalocele	01	09.1
No complications	06	54.5
Reproductive history		
Primiparous	04	36.4
Multigravida	07	63.6
No. of previous pregnancies		
1-2 pregnancies	02	18.2
3-4 pregnancies	04	36.4
More than 4 pregnancies	01	09.1
Total	07	63.6
Abortions		
Yes	05	45.5
No	02	18.2
Prenatal consultations		
Attended the minimum number during the first trimester		
Yes	06	54.5
No	05	45.5
Attended the minimum number during the second trimester		
Yes	08	72.7
No	03	27.3
Total	11	100.0

GDM: Gestational diabetes mellitus; DMI: type I Diabetes Mellitus; DMII: type II Diabetes Mellitus; HDP: Hypertensive Disorders of Pregnancy; PTL: Preterm labor.

Table III - Lifestyle of pregnant women with diabetes admitted to the *Maternidade Escola Assis Chateaubriand – MEAC* (Assis Chateaubriand Maternity Hospital). Fortaleza-CE, 2012.

Variables	Physical activity		Drinking		Smoking	
	n	%	n	%	n	%
Before pregnancy						
Yes	04	36.4	03	27.3	01	09.1
No	07	63.6	08	72.7	10	90.9
During pregnancy						
Yes	03	27.3	--	--	--	--
No	08	72.7	11	100.0	11	100.0
Total	11	100.0	11	100.0	11	100.0

overweight and obesity (36.4%; n=4). Weekly weight gain during the seven days of hospitalization was insufficient in 45.5% (n=5) of participants, excessive in 36.4% (n=4), and adequate in 18.2% (n=2). Table V shows that only the

patients who entered pregnancy obese presented a weight gain above the average (0.3±0.2).

The total daily insulin dose (IU/day) used was 44.7±26.7 IU/day. The relationship between pre-pregnancy

Table IV - Pre-pregnancy and pregnancy nutritional status of pregnant women with diabetes admitted to the *Maternidade Escola Assis Chateaubriand – MEAC* (Assis Chateaubriand Maternity Hospital). Fortaleza-CE, 2012.

Variables	n	%
Pre-pregnancy nutritional status		
Underweight	--	--
Normal	02	18.2
Overweight	03	27.3
Obesity	06	54.5
Pregnancy nutritional status during the 1 st stage of interview		
Underweight	--	--
Normal	01	09.1
Overweight	03	27.3
Obesity	07	63.6
Pregnancy nutritional status during the 1 st stage of interview		
Underweight	--	--
Normal	01	09.1
Overweight	03	27.3
Obesity	07	63.6
Total	11	100.0

Table V - Association between pre-pregnancy nutritional status and weight gain during pregnancy until hospital admission with glycemic control of pregnant women with diabetes admitted to the *Maternidade Escola Assis Chateaubriand – MEAC* (Assis Chateaubriand Maternity Hospital). Fortaleza-CE, 2012.

Variables	Pre-pregnancy Nutritional Status					
	Normal		Overweight		Obesity	
	Mean	SD	Mean	SD	Mean	SD
Weekly weight gain (kg)	0.3	0.1	0.3	0.2	0.3	0.2
Insulin therapy (IU/d)	26.7	8.7	39.5	16.8	53.3	32.7
Glycemic control (mg/dl)						
Fasting	90.8	21.8	136.1	2.3	111.5	27.0
1h after breakfast	138.7	16.7	192.3	46.2	174.2	43.3
1h after lunch	160.2	21.6	210.6	17.4	149.3	22.6
1h after dinner	161.7	34.5	196.0	47.1	154.8	13.7

SD=Standard Deviation

nutritional status and amount of insulin used revealed that overweight and obese pregnant women used greater amounts of insulin per day (39.5 ± 16.8 IU/day and 53.3 ± 32.7 IU/day, respectively) (Table V).

Concerning glycemic control and pre-pregnancy nutritional status, patients at normal weight achieved adequate glycemic control, with adequate levels of fasting glucose (90.8 ± 21.8) and glucose 1 hour after breakfast (138.7 ± 16.7). However, overweight and obese pregnant women presented inadequate glycemic control at all times, with inadequate levels of fasting glucose and glucose after meals (1h after breakfast, 1h after lunch, and 1h after dinner) (Table V).

DISCUSSION

Pregnant women with diabetes who are diagnosed and treated during a quality prenatal care are at higher risk of developing complications, particularly fetal outcomes. Maternal glycemic control should be highlighted, as it is a key to health prevention and promotion of pregnant women in addition to adequate nutritional status, healthy diet, and physical activity^(19,20).

Advanced maternal age is a risk factor for developing GDM, and the mean age of 31.4 ± 4.2 years found in the present study reflects this assumption and is in agreement with a research⁽⁶⁾ that found a rate of 60.9% women over 30 years old, revealing that age can be considered a risk

factor for GDM. Similar result (31.3 ± 6.3 years) was found in a population of 50 pregnant and postpartum women hospitalized for GDM control⁽⁹⁾. These results may be explained by the increasing rate of pregnancy at age 30, as women are focused on achieving professional goals before becoming a mother⁽⁹⁾.

The prevalence of GDM among pregnant women found in the present study corroborates a research that aimed to describe the frequency of the different types of diabetes mellitus in women attending high-risk prenatal care, which has found a rate of 84% ($n=145$) of women with GDM among the 173 pregnant participants with diabetes⁽²¹⁾. Other authors⁽²²⁾ have found similar results: the majority of the 505 medical records of pregnant women with diabetes indicated the presence of GDM (80.52%).

These results are in accordance with a previously established prevalence in pregnant women, with GDM more prevalent than pre-pregnancy DM. However, if diabetes is diagnosed in the first half of pregnancy, it is considered pre-pregnancy diabetes that has not been previously identified, which may increase the frequency of pre-pregnancy diagnosis^(2,20,21).

Recent research⁽²³⁾ on the presence of risk factors for diabetes highlighted a prevalence of multigravidas (76%), which has also been found in the present research. The literature does not consider being multigravida a risk factor for GDM. However, there is a high prevalence of diabetes among multigravidas, which may be related to postpartum weight retention. Maternal age and parity are two key factors to determine postpartum weight retention, and studies point to greater weight retention in multigravidas when compared to primiparous women^(18,24).

The family history of diabetes is a well-known risk for GDM. The presence of DM in parents can influence the early onset of DM⁽²⁵⁾. This risk factor was found in most of the participants of the present research, which corroborates a study that found that 65% of 66 pregnant women with GDM seen at a public hospital of Minas Gerais had family history of diabetes⁽²³⁾. It is also in accordance with the findings of a research conducted in India to describe the clinical profile, maternal and fetal outcomes, and progression to diabetes in women with GDM, which revealed that 70% of participants had family history of DM2 in father, mother, or both⁽²⁶⁾.

One way to avoid GDM-related outcomes is to undergo adequate prenatal care to have an early diagnosis and minimize hazardous effects, particularly to the fetus⁽⁹⁾. The monitoring of patients in the present study revealed a great number of pregnant women who have not started prenatal care correctly during the first trimester.

Research⁽²⁷⁾ has selected 157 pregnant women with GDM divided into two groups: newborns appropriate for

gestational age (AGA) and newborns large for gestational age (LGA). The research found that pregnant women in the LGA group have started treatment at a more advanced gestational age (32.4 ± 3.7). Therefore, the number of consultations at the service was lower ($n=4$)⁽²⁷⁾.

Thus, it is understood that pre-pregnancy and pregnancy nutritional status can determine good obstetric outcomes. Data from the present research confirm what is found in literature: the direct association between obesity and GDM⁽²⁸⁾. Another author⁽²⁴⁾ has found the same relationship: nearly half of pregnant women entered pregnancy obese, and 23.3% overweight.

The participants of the present research who entered pregnancy obese presented and excessive weight gain during pregnancy. This finding is similar to that of a research aiming to assess the association between gestational weight gain and pregnancy prognosis, which found statistically higher values of excessive weight gain among women who entered pregnancy with excessive weight⁽²⁹⁾.

A study conducted at a health center of Rio Grande do Sul with 315 pregnant women randomized to a control group (receiving routine care) and an intervention group (receiving food information according to nutritional status) confirmed that food information has been effective in reducing clinical outcomes like gestational diabetes. Additionally, it highlights that dietary information should be implemented before 20 weeks of pregnancy⁽¹³⁾.

As excessive weight gain is directly related to gestational diabetes, the work of a nutritionist in the prenatal service, monitoring and providing nutritional guidelines, favors a better pregnancy outcome⁽²⁹⁾.

With regard to insulin therapy, the sample of the present study showed that the amount of insulin used per day increased as BMI increased. Other authors, who assessed the impact of BMI on the treatment and perinatal outcomes of patients with GDM, corroborate this finding as they have observed a statistically significant increase in insulin dose according to BMI⁽³⁰⁾. The association between obesity and diabetes found in the literature suggests that obese pregnant women should use insulin more often⁽³¹⁾.

Achieving adequate glycemic control during pregnancy is very complex. The results of the present research have shown abnormal levels in most of the participants, differing from a study that assessed the optimal dose of insulin in the treatment of GDM in the third trimester of pregnancy and perinatal outcomes⁽³²⁾. The aforementioned study showed that glycemic control was achieved in all pregnant women, with average levels of $92.7 \text{ mg/dl} \pm 13.1$ for fasting glucose and $95.7 \text{ mg/dl} \pm 19.3$ for glucose after meals⁽³²⁾. Another study, whose data are more similar to those of the present research, reported glycemic control in less than

10% of patients⁽³³⁾. The difficult glycemic control may be related to the fact that pregnant women do not start prenatal care at the appropriate time, and when there is the need for hospitalization, they usually arrive at the service with inadequate diet and weight gain, making metabolic control even more damaging.

As the present study population included a limited number of patients due to the reduced number of pregnant women admitted to the hospital during data collection, future studies should be carried out with larger samples in order to evaluate the results obtained in pregnant women with diabetes.

CONCLUSION

Inadequate pre-pregnancy nutritional status, such as overweight and obesity, and weight gain above the recommended during pregnancy are factors that positively influence the difficulty to achieve optimal glycemic control in pregnant women with diabetes, showing the importance of nutritional therapy since prenatal care.

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