

ORIGINAL ARTICLE

## Eating Habits of Pregnant Women With Gestational Diabetes Mellitus: A Pilot Study

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Highlights:

1. Half of pregnant women received the GDM diagnosis in the 1st trimester of pregnancy
2. Most pregnant women did not worry about their diet before being diagnosed with GDM
3. Foods rich in sodium, sugar, fat and additives were consumed less than once a week

ABSTRACT

This study evaluated the eating habits of pregnant women with gestational diabetes mellitus (GDM). The sample consisted of 74 pregnant women with GDM, most between 20 and 40 years old (92%) and with a family income of up to R\$ 2090.00 (53%). Among the participants, 44.6% reported being diagnosed with GDM in the first trimester of pregnancy, and 68% were not concerned about their diet before the diagnosis. Fruits (88.3%) were the most consumed foods in the intervals of large meals. Regarding diet frequency, most pregnant women reported consuming fruits, vegetables and legumes, milk and dairy products, rice and beans, and meat more than five times a week. The participants consumed foods rich in sodium, sugar, fat, and food additives, such as fast foods, fried foods, sweets, soft drinks, artificial and industrialized juices, and embedded food products less than once a week, potentially indicating adequacy in food choices. Further actions are required, focusing on food and nutritional education for women with GDM.

**Keywords:** Pregnancy; Eating behavior; Healthy diet.

### HÁBITOS ALIMENTARES DE GESTANTES COM DIABETES MELLITUS GESTACIONAL: UM ESTUDO PILOTO

RESUMO

Este estudo avaliou os hábitos alimentares de gestantes com Diabetes Mellitus Gestacional (DMG). A amostra foi composta por 74 gestantes com DMG, a maioria entre 20 e 40 anos (92%) e com renda familiar de até R\$ 2.090,00 (53%). Entre as participantes, 44,6% relataram ter sido diagnosticadas com DMG no primeiro trimestre de gestação e 68% não se preocupavam com a alimentação antes do diagnóstico. As frutas (88,3%) foram os alimentos mais consumidos nos intervalos das grandes refeições. Em relação à frequência alimentar, a maioria das gestantes relatou consumir frutas, verduras e legumes, leite e derivados, arroz, feijão e carnes mais de cinco vezes na semana. As participantes consumiam alimentos ricos em sódio, açúcar, gordura e aditivos alimentares, como *fast food*, frituras, doces, refrigerantes, sucos artificiais e industrializados, e embutidos foram consumidos menos de uma vez por semana, potencialmente indicando adequações nas escolhas alimentares. São necessárias novas ações, com foco na educação alimentar e nutricional para mulheres com DMG.

**Palavras-chave:** gestação; hábitos alimentares; dieta saudável.

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## INTRODUCTION

The Pan American Health Organization (PAHO) states that the number of people with diabetes mellitus is growing worldwide despite being more prevalent in developing countries. An estimated 422 million people are living with diabetes globally<sup>1</sup>. Diabetes prevalence has almost doubled since 1980, from 4.7% to 8.5% in the adult population, reflecting an increase in associated risk factors, such as overweight and obesity<sup>2</sup>.

Data from the Surveillance of Risk and Protective Factors for Chronic Diseases by Telephone Survey<sup>3</sup> shows that 7.7% of the Brazilian population had been diagnosed with diabetes. Diabetes prevalence increased by 40% between 2006 and 2018, with 8.1% of diagnoses referring to women and 7.1% to men, indicating a higher prevalence among women.

Diabetes mellitus is a chronic disease caused by insufficient insulin production or resistance, i.e., when the body cannot effectively use the produced insulin. The categories of type 1 diabetes mellitus, type 2 diabetes mellitus, and gestational diabetes mellitus (GDM) are the most prevalent. Other specific types are monogenic diabetes syndrome (neonatal diabetes or maturity-onset diabetes of the young - MODY), exocrine pancreas disease, or drug- or chemical-induced diabetes<sup>4,5</sup>.

GDM consists of increased glucose levels in the circulating bloodstream diagnosed during the gestational period. It is related to weight gain during pregnancy and associated with typical hormonal changes of pregnancy, increasing insulin resistance, and, consequently, hyperglycemia<sup>6</sup>. This pathology is commonly diagnosed in the second or third trimester of pregnancy, potentially causing adverse risks for the mother and the baby, such as fetal loss, congenital malformations, stillbirth, perinatal death, obstetric complications, and maternal morbidity and mortality<sup>7</sup>. GDM may constitute a transient clinical condition or persist post-partum, representing a significant risk factor for the future development of type 2 GDM and cardiovascular disease<sup>8</sup>.

In 2021, data from the International Diabetes Federation<sup>9</sup> estimated that 21.1 million (16.7%) women who gave birth to live children had some hyperglycemia during pregnancy, and 80.3% of these were due to GDM, 10.6% to diabetes detected before pregnancy, and 9.1% to diabetes first identified during pregnancy<sup>9</sup>.

Massucatti, Pereira, and Maioli<sup>10</sup> analyzed 396 medical records of pregnant women treated at a Basic Health Unit in Vitória, Espírito Santo, Brazil, finding 5.8% of medical records with GDM diagnosis. Furthermore, the identified risk factors were age, body weight, the number of pregnancies, and lack of nutritional monitoring.

A significant number of pregnant women had inadequate eating habits regarding meal frequencies, energy adequacy, and vitamin needs<sup>11,12</sup>. Muniz and Reis<sup>13</sup> did not show significant differences in nutritional requirements in pregnant women with and without GDM concerning their energy needs<sup>13</sup>. However, pregnant women diagnosed with GDM should be more careful with the quality of their diet, as maternal diet before and during pregnancy may represent a modifiable risk factor for GDM<sup>14</sup>.

The main concern of health professionals with pregnant women is diet quality, which will ensure the ingestion of necessary macro- and micronutrients by pregnant women to meet all inherent demands of this life stage<sup>15</sup>.

Santos<sup>16</sup> observed that many pregnant women were not used to eating fruits and vegetables daily despite the low daily intake of ultra-processed foods. Pregnant women with a daily habit of eating fruits and vegetables showed better outcomes in biochemical tests than those without this habit. That highlights the significance of nutritional monitoring in pregnant women starting at prenatal

care, aiming at adequate interventions and metabolic control required to meet physiological needs at each pregnancy stage.

It is healthy for pregnant women, especially those with GDM, to maintain a healthy diet containing adequate amounts of carbohydrates, proteins, lipids, fibers, micronutrient-rich foods, foods with high fiber content (legumes, whole grains, and vegetables), lean meats, and fish<sup>14</sup>. Also, the diet must have a low glycemic index<sup>17</sup>. Therefore, refined foods must be replaced with whole foods, dairy products must be skimmed, and meats must be lean. Foods with a high glycemic index and saturated fat, such as sweets, sugary foods, and fast foods must be avoided<sup>14</sup>. A healthy diet should also be associated with regular and guided physical exercise throughout pregnancy<sup>18</sup>. Thus, encouraging research evaluating the diet of pregnant women with GDM is vital because data on diet quality, meal times, and food preferences is still scarce in databases. This information is crucial for developing public policies and nutritional education actions for pregnant women with GDM in public and private health networks. In summary, the present study evaluated the diet quality of pregnant women with GDM, members of a private group on a social network, and seeking alternatives to improve their health and quality of life.

## METHODS

It was a descriptive, observational, cross-sectional study with a quantitative approach, performed in a private group for discussing and exchanging information regarding diabetes mellitus on a social network (Facebook®). This group comprised 1900 members, including profiles of women, men, and institutions, such as medical offices and clinics, among other companies.

The pregnant women with GDM from this social network were recruited between March and April 2020, with an invitation posted to the group identifying the researchers and presenting research objectives and the target audience. The study was conducted according to the Declaration of Helsinki guidelines and approved by the Research Ethics Committee of the State University of Minas Gerais #5.730.601 (CAAE 63749222.9.0000.5112) for studies with humans. Pregnant women who chose to participate received and signed an Informed Consent Form (ICF).

The participation of pregnant women was spontaneous and voluntary, and they were free to quit the study whenever they wanted. The structured questionnaire was available only after the participants agreed to the ICF and selected the “yes” option. The structured questionnaire was adapted from Silva<sup>19</sup>, consisting of 42 multiple-choice questions. The questions included personal data, socioeconomic characteristics, and eating habits, such as the number of daily meals and intervals between meals before and after the GDM diagnosis. The frequencies of food consumption, daily water intake, and physical exercise after the diagnosis were also questioned. The self-response questionnaire was accessed via a link generated in Google Forms. The data was analyzed with simple descriptive statistics, and the frequency of responses was expressed in percentage (%).

## RESULTS

Among the pregnant women with gestational diabetes mellitus (GDM) from a social network group, 102 agreed to participate in the study. Considering that one of the research objectives was to evaluate changes in the eating habits of pregnant women diagnosed with GDM, 28 participants were excluded because they had diabetes before pregnancy. It is worth emphasizing that GDM is a metabolic disease characterized by glucose intolerance starting during pregnancy in women with previously normal blood glucose levels<sup>6</sup>. Hence, these 28 participants would not qualify for GDM

diagnosis. Finally, the research included 74 pregnant women diagnosed with GDM without a history of diabetes before pregnancy.

The participants included volunteers from 14 Brazilian states, most from São Paulo (43%), followed by Rio Grande do Sul (13.5%), Rio de Janeiro (11%), and Paraná (8%). Most participants (92%) were between 20 and 40 years old, and 8% were over 40 years old. Most volunteers completed higher education (39%), followed by high school (35%). The reported family income of 31% of participants was one to two minimum wages, and 22% earned less than one minimum wage. Therefore, most participants (53%) had an income of up to R\$ 2090.00 (in Brazilian Reais), classified as low-income according to the Brazilian Federal Government (Class E - income up to two minimum wages). Considering the marital status of the volunteers, 90% reported being married or in a stable relationship, and only 9.5% were single. The data showed that 63.5%, 29.7%, and 6.8% of pregnant women were in the third, second, and first trimesters of pregnancy when answering the study questionnaire, respectively. A rate of 67.6% of pregnant women had first-degree relatives with diabetes. Among the volunteers diagnosed with GDM, 44.6% were in the first trimester of pregnancy, 35.1% were in the second, and 20.3% were in the third.

Regarding the obstetric history of volunteers related to parity, 33.8% were primiparous, 32.7% had given birth twice, and 67.3% were multiparous. Most women who had been pregnant (81.6%) did not have GDM in previous pregnancies.

As for eating habits before the GDM diagnosis, 68.9% of pregnant women reported not worrying about their diet, and only 31.1% (n=23) were previously concerned. Considering the number of daily meals before the GDM diagnosis, 73% of volunteers had four or more daily meals, 20.3% had three, and 5.4% had two. The most consumed meals were breakfast, lunch, and dinner (Figure 1). After the GDM diagnosis, 10.8% more pregnant women had four or more daily meals, and 4.1% more started having three daily meals. After the GDM diagnosis, all pregnant women who consumed only two daily meals changed their eating habits and began distributing their meals more evenly throughout the day.

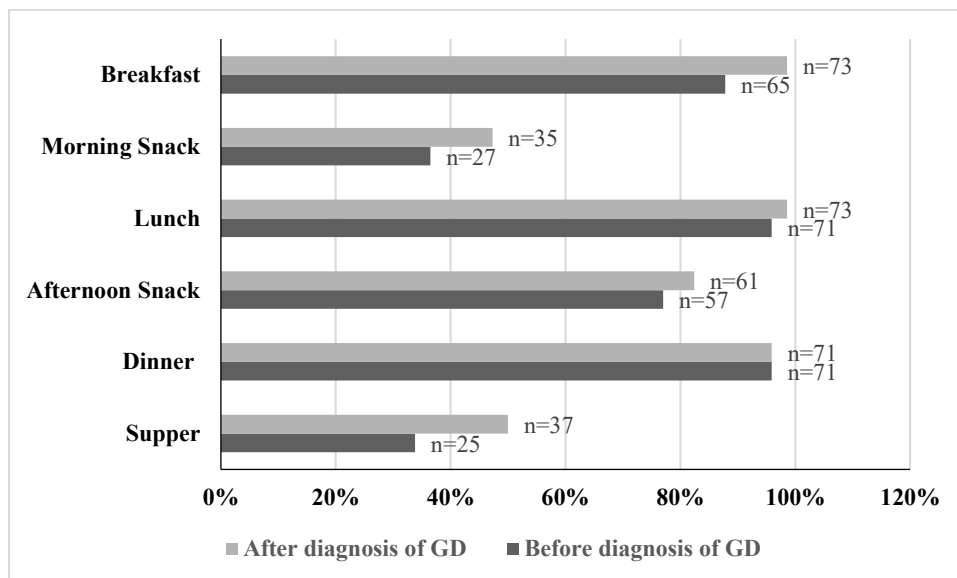


Figure 1 – Meals consumed by pregnant women before and after the GDM diagnosis

Regarding meal portioning, 54.1% (n=40) of pregnant women reported taking a two- to three-hour break between each meal, 33.8% (n=25) from three to four hours, 8.1% (n=6) from one to two hours, and 4.1% (n=3) took more than 4 hours between meals. The most consumed foods by

pregnant women in the intervals between main meals were fruits (88.3%), milk (30%), and bread/cookies (28.3%) (Figure 2). The Pan American Health Organization<sup>20</sup> shows that meals should be distributed into five to six throughout the day, with three main ones (breakfast, lunch, and dinner) and two or three snacks. It is worth noting the quantity and quality of the consumed food. Pregnant women should not skip meals, not eat food outside scheduled times, and take maximum intervals of three hours between meals to avoid glycemic variations, especially pregnant women using insulin.

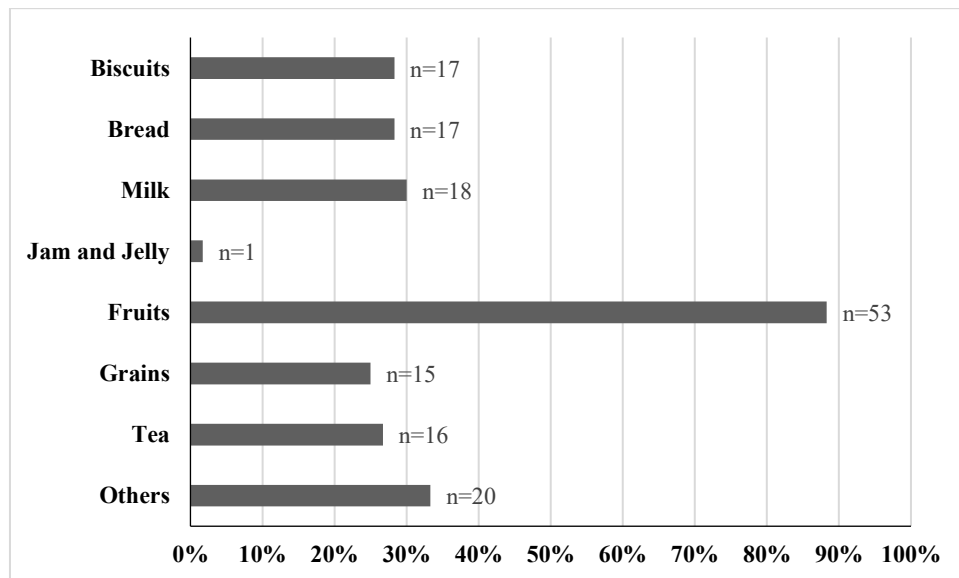


Figure 2 – Foods pregnant women with GDM consume the most in the intervals between main meals

Over 50% of participants had their main meals (breakfast, lunch, and dinner) at home. Small meals, such as morning and afternoon snacks and supper, were the least consumed by pregnant women at home (Figure 3).

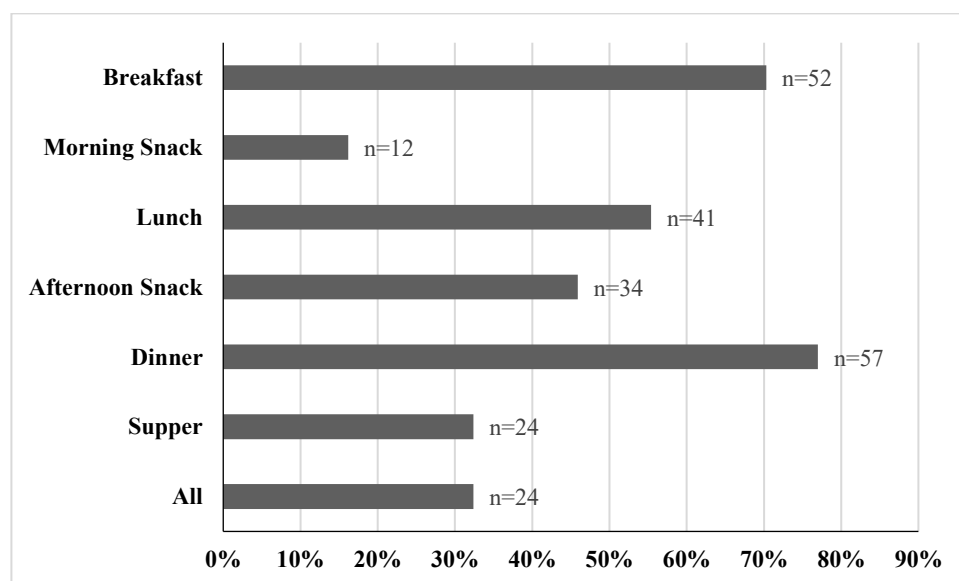


Figure 3 – Meals commonly had at home by pregnant women with GDM

Most pregnant women (41.9%) use industrialized sweeteners to sweeten their meals, and 18.9% use crystal or refined sugar. Conversely, 33.8% reported not using any sweetener. Breakfast (43.2%) and afternoon (12.2%) snacks were the meals that received sweeteners the most.

As for the intake of protein foods such as meat, 62.2% of participants reported consuming them more than five times a week, and the most frequent foods were beef (55.4%) and poultry (36.5%). The most frequent cooking methods were wet cooking (48.6%), followed by dry cooking, such as frying (20.3%). Only 1.4% of women in the studied sample did not usually consume meat, as shown in Table 1.

Table 1 – Meat consumption frequency, type, and most common meat preparation by pregnant women diagnosed with GDM

Meat consumption	Answers	Percentage (%)
None < 1 time a week	2	2.7
1 to 2 times a week	3	4.1
3 to 4 times a week	8	10.8
> 5 times a week	15	20.3
	46	62.2

Type of meat usually consumed	Answers	Percentage (%)
None	1	1.4
Beef	41	55.4
Pork	2	2.7
Poultry	27	36.5
Seafood	3	4.1

Meat cooking methods	Answers	Percentage (%)
Grilled	13	17.6
Fried	15	20.3
Baked	10	13.5
Boiled	36	48.6

Frequently consuming foods high in sugar, sodium, and fat may harm health, and most pregnant women reported having fast food, fried preparations, sweets, soft drinks and artificial juices, industrialized foods, and embedded food products less than once a week, as specified in Table 2. As for healthy foods and the recommended intake for pregnant women with GDM, most women reported frequently consuming fruits, vegetables and legumes, milk and dairy products, and rice and beans more than five times a week (Table 3).

Evaluating the liquid intake during meals, most pregnant women (68.9%) (n=51) drank water, 17.6% (n=13) consumed natural juices, and 13.5% (n=10) had soft drinks and artificial juices. Regarding daily water intake, 47.3% (n=35) of participants reported consuming one to two liters daily, 33.8% (n=25) had two to three liters, and 14.9% (n=11) drank more than three liters.

Table 2 – Frequency of consumption of fast foods, fried foods, sweets, soft drinks, artificial and industrialized juices, and embedded food products by pregnant women diagnosed with GDM

Fast foods (hamburgers, pizzas, hotdogs)	Answers	Percentage (%)
< 1 time a week	61	82.4
1 to 2 times a week	12	16.2
3 to 4 times a week	0	0.0
> 5 times a week	1	1.4
Fried preparations (French fries, pastries)	Answers	Percentage (%)
< 1 time a week	60	81.1
1 to 2 times a week	12	16.2
3 to 4 times a week	2	2.7
> 5 times a week	0	0.0
Sweets (chocolates, filled cakes, candies)	Answers	Percentage (%)
< 1 time a week	55	74.3
1 to 2 times a week	10	13.5
3 to 4 times a week	6	8.1
> 5 times a week	3	4.1
Soft drinks and artificial juices	Answers	Percentage (%)
< 1 time a week	54	73.0
1 to 2 times a week	11	14.9
3 to 4 times a week	4	5.4
> 5 times a week	5	6.8
Processed foods (cookies, snacks)	Answers	Percentage (%)
< 1 time a week	51	68.9
1 to 2 times a week	13	17.6
3 to 4 times a week	7	9.5
> 5 times a week	3	4.1
Sausage meat	Answers	Percentage (%)
< 1 time a week	45	60.8
1 to 2 times a week	21	28.4
3 to 4 times a week	5	6.8
> 5 times a week	3	4.1

Table 3 – Frequency of consumption of fruits and vegetables, milk and dairy products, and rice and beans by pregnant women diagnosed with GDM

Fruits	Answers	Percentage (%)
< 1 time a week	5	6.8
1 to 2 times a week	10	13.5
3 to 4 times a week	20	27.0
> 5 times a week	39	52.7
Vegetables	Answers	Percentage (%)

< 1 time a week	5	6.8
1 to 2 times a week	13	17.6
3 to 4 times a week	19	25.7
> 5 times a week	37	50.0
Milk and dairy products (cheeses, yogurts)	Answers	Percentage (%)
< 1 time a week	7	9.5
1 to 2 times a week	7	9.5
3 to 4 times a week	11	14.9
> 5 times a week	49	66.2
Rice and beans	Answers	Percentage (%)
< 1 time a week	1	1.4
1 to 2 times a week	4	5.4
3 to 4 times a week	21	28.4
> 5 times a week	48	64.9

The regular practice of physical activity was not a part of the daily routine of 81.1% (n=60) of women, showing a significant prevalence of a sedentary lifestyle among pregnant women diagnosed with GDM.

## DISCUSSION

Living conditions are associated with risks during pregnancy. Moreover, social determinants can promote health risks to the mother or the fetus. Living conditions directly influenced the purchasing power of foodstuffs of the participants, indirectly reflecting on eating frequency and habits<sup>21</sup>. A review and meta-analysis by Demétrio et al.<sup>22</sup> demonstrated the association between food insecurity, social determinants, and nutritional status of pregnant women. They found high food insecurity in pregnant women who were black, participated in social security programs, and had a low educational level. However, pregnant women with a partner seemed a protection factor against food insecurity.

Avanzi et al.<sup>23</sup> observed that support from family, partners, and trusted people during pregnancy offers a sense of security, positively affecting the delivery time, breastfeeding, and maternal acceptance of the baby, essential quality of life aspects. More than half the volunteers in our study were classified as low-income, and 90% of pregnant women had a partner, thus providing better emotional conditions during pregnancy.

More than 67% of pregnant women diagnosed with gestational diabetes mellitus (GDM) participating in our study had first-degree relatives affected by some diabetes. The literature reports that a family history of diabetes mellitus, especially from first-degree relatives, increases the risk of gestational diabetes in pregnant women<sup>24-26</sup>. Lewandowski<sup>26</sup> suggested a significant maternal and parental influence of diabetes on the risk of GDM. Tabák et al.<sup>24</sup> stated that a paternal history of diabetes seems a weaker GDM predictor than a history of diabetes in mothers and the maternal line.

Early diagnosis is crucial during pregnancy to prevent complications, such as fetal macrosomia, late-term fetal death, and jaundice, and facilitate the implementation of appropriate therapies<sup>27</sup>. Most study participants (81.6%) reported not having GDM in previous pregnancies. Pregnant women who had babies with macrosomia (more than 4 kg)<sup>28</sup> or a history of GDM in previous pregnancies are at higher risk of developing the disease<sup>29</sup>. A study by Bozatski, Pinto, and Lavado<sup>30</sup> with 54 pregnant women with GDM showed that 50 had no history of GDM, consistent with our findings.

Besides sociodemographic factors, understanding the eating habits of pregnant women with GDM directly impacts the living and health conditions of these women and their children. The number



of daily meals, quantity and quality of food, and the four Laws of Food – quantity, quality, balance, and adequacy<sup>31</sup> – are indispensable for correctly monitoring GDM. Our findings revealed that the GDM diagnosis directly impacted eating habits regarding food choices and diet portioning. Conversely, a study by Silva et al.<sup>32</sup> with pregnant women with GDM verified that most evaluated women (52.7%) reported having only three daily meals. This frequency was lower than for the population in the present study, in which more than 70% of pregnant women with GDM had more than four meals a day.

A Norwegian longitudinal study by Elvebakk et al.<sup>14</sup> did not show differences in the intake of the top 15 food and beverage groups among pregnant women with and without diabetes. However, the diet reported by pregnant women with or without GDM was not ideal according to nutritional recommendations, showing an excessive intake of red and processed meats associated with a low intake of fatty fish and vegetables.

Park et al.<sup>33</sup> concluded that fruits (34.4%), dairy products (28.8%), bread (18.4%), cakes (12.8%), and biscuits (5.6%) were the foods most consumed in the intermediate meals of 44 pregnant women with GDM, similar to our findings. Both studies observed a frequent consumption of fruit between meals. The World Health Organization (2002) recommends a daily intake of at least 400 grams of fruits and vegetables<sup>34</sup>. The Food Guide for the Brazilian Population (2014) recommends consuming fresh or minimally processed foods. Moreover, when meals outside the home are necessary, the general population should avoid fast food and prioritize establishments offering freshly prepared meals and fresh and minimally processed foods, as they typically provide higher nutritional quality<sup>35</sup>.

The present study investigated the intake of sugar added to preparations among GDM volunteers. The most common practice was replacing table sugar with sweeteners, followed by excluding sugar and its substitutes, thus eliminating sweeteners from preparations. Archibald et al.<sup>36</sup> stated that sweeteners are a satisfactory alternative to replace sugar, but they must be used in moderation, not exceeding six sachets or 15 drops a day. According to PAHO<sup>37</sup>, pregnant women should be advised to avoid foods with significant concentrations of sucrose, glucose, honey, glucose syrup, and fructose as sweeteners due to their high glycemic index.

The present study showed that nearly half (49%) the participants followed the adequate water intake recommendation. According to the Pan American Health Organization<sup>1</sup>, pregnant women should drink at least two liters of water daily, avoiding it during meals. However, our findings revealed the common practice of drinking liquids during small and large meals.

A sedentary lifestyle is a risk factor for non-communicable chronic diseases<sup>38</sup>. This risk may be even higher during pregnancy, which may cause hypertension and gestational diabetes. More than 80% of study participants diagnosed with GDM were sedentary. Silva et al.<sup>32</sup> found similar data regarding physical activities, as 85.3% of the evaluated pregnant women reported not practicing any exercise. Laredo-Aguilera et al.<sup>39</sup> demonstrated that physical activities help monitor GDM. Strength exercises, aerobics, or their combination may help control glucose, HbA1c, and insulin<sup>39</sup>. Wang et al.<sup>40</sup> found that women in Shanghai (China) with GDM who practiced physical exercises had lower abnormal plasma glucose levels, especially when their daily exercise duration equaled or exceeded 60 minutes.

A healthy lifestyle, including physical exercise and a healthy diet, before and during pregnancy, may protect women against GDM<sup>41</sup>. Furthermore, GDM control must be associated with correct prenatal care, including targeted physical activities<sup>42</sup>, a healthy diet, and, if necessary, using medication to control plasma glucose levels<sup>43</sup>.

The limitations of this study include the sample size and the assessment method of food consumption. The sample was representative but small and restricted to a specific audience. Therefore, the findings should be generalized with caution. Considering this is a cross-sectional research, causality between the associated variables is impossible to infer. Further research with a larger sample is required to develop the addressed topic and validate the findings.

The limitations of the food frequency questionnaire are not considering the size of individual food portions consumed by participants and using a finite food list that did not cover all foods consumed by individuals. Foods were limited to those that most contributed to the investigated nutrients. Furthermore, the challenges in completing the food frequency questionnaire may lead to inaccurate reports on usual intake, as it depends on the respondent's memory.

As for strengths, this is an unprecedented study that allowed to characterize the food consumption pattern of pregnant women with GDM. Although our findings cannot be generalized, the data may guide nutritional intervention strategies in clinical practice, encouraging healthy eating habits to reduce pregnancy risks.

## CONCLUSION

After receiving the GDM diagnosis, most pregnant women were more concerned with their eating habits. Therefore, they chose to consume healthy foods and have a fractional diet, avoiding foods that could harm their health. Despite occasional changes in eating behavior, further guidance is required on a healthy diet and lifestyle. Different methodologies of food and nutritional education, multidisciplinary monitoring during pregnancy, and regular practice of appropriate physical exercises for this physiological moment are also necessary. It is worth noting that nutritional assessment, clinical and biochemical data, and body composition should be evaluated along with eating habits to identify nutritional changes and seek appropriate intervention strategies.

## REFERENCES

- <sup>1</sup> Diabetes – PAHO/WHO. Pan American Health Organization. Access Jan. 31, 2023. Available at: <https://www.paho.org/en/topics/diabetes>
- <sup>2</sup> Zhou B, Lu Y, Hajifathalian K, et al. Worldwide trends in diabetes since 1980: a pooled analysis of 751 population-based studies with 4-4 million participants. *The Lancet*. 2016;387(10027):1.513-1.530. DOI: 10.1016/S0140-6736(16)00618-8
- <sup>3</sup> Vigil Brasil 2018 – Vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico. Ministério da Saúde. Access Jan. 31, 2023. Available at: <https://www.gov.br/saude/pt-br/centrais-de-conteudo/publicacoes/publicacoes-svs/vigitel/vigitel-brasil-2018.pdf/view>
- <sup>4</sup> American Diabetes Association. Standards of Medical Care in Diabetes – 2016 Abridged for Primary Care Providers. *Clin Diabetes*. 2016;34(1):3-21. DOI: 10.2337/diaclin.34.1.3
- <sup>5</sup> Sousa M, Rego T, Armas JB. Insights into the Genetics and Signaling Pathways in Maturity-Onset Diabetes of the Young. *Int J Mol Sci*. 2022;23(21):12910. DOI: 10.3390/ijms232112910
- <sup>6</sup> Choudhury AA, Devi Rajeswari V. Gestational diabetes mellitus- A metabolic and reproductive disorder. *Biomed Pharmacother*. 2021;143:112183. DOI: 10.1016/j.biopha.2021.112183
- <sup>7</sup> Karami M, Mousavi SH, Rafiee M, Heidari R, Shahrokhi SZ. Biochemical and molecular biomarkers: unraveling their role in gestational diabetes mellitus. *Diabetol Metab Syndr*. 2023;15(1):5. DOI: 10.1186/s13098-023-00980-8
- <sup>8</sup> Fu J, Retnakaran R. The life course perspective of gestational diabetes: An opportunity for the prevention of diabetes and heart disease in women. *eClinicalMedicine*. 2022;45:101294. DOI: 10.1016/j.eclinm.2022.101294
- <sup>9</sup> International Diabetes Federation. IDF Diabetes Atlas, 10th edn. Brussels, Belgium: 2021. Published 2021. Access Jan. 31, 2023. Available at: <https://diabetesatlas.org/citation-usage/>
- <sup>10</sup> Massucatti LA, Pereira RA, Maioli TU. Prevalência de diabetes gestacional em unidades de saúde básica. *Rev Enferm Atenção Saúde*. 2012;1(1):70-79.
- <sup>11</sup> Bueno AA, Beserra JAS, Weber ML. Características da alimentação no período gestacional. *Life Style*. 2016;3(2):29-42.
- <sup>12</sup> Schwedhelm C, Lipsky LM, Temmen CD, Nansel TR. Eating Patterns during Pregnancy and Postpartum and Their Association with Diet Quality and Energy Intake. *Nutrients*. 2022;14(6):1167. DOI: 10.3390/nu14061167
- <sup>13</sup> Muniz N de A, Lilian Barros de Sousa Moreira Reis. Nutritional therapy in gestational Diabetes Mellitus. *Com Ciênc Saúde*. 2013;24(04):363-374.

- <sup>14</sup> Elvebakk T, Mostad IL, Mørkved S, Salvesen KÅ, Stafne SN. Dietary Intakes and Dietary Quality during Pregnancy in Women with and without Gestational Diabetes Mellitus – A Norwegian Longitudinal Study. *Nutrients*. 2018;10(11):1811. DOI: 10.3390/nu10111811
- <sup>15</sup> Vitolo MR. *Nutrição – da gestação ao envelhecimento*. Editora Rubio; 2014.
- <sup>16</sup> Santos ACB dos. *Frequência de consumo de frutas, hortaliças e produtos ultraprocessados e estado nutricional de gestantes de Cruzeiro do Sul, Acre*. Mestrado em Nutrição em Saúde Pública. Universidade de São Paulo; 2018. DOI: 10.11606/D.6.2018.tde-28112016-151830
- <sup>17</sup> Rasmussen L, Poulsen CW, Kampmann U, Smedegaard SB, Ovesen PG, Fuglsang J. Diet and Healthy Lifestyle in the Management of Gestational Diabetes Mellitus. *Nutrients*. 2020;12(10):3050. DOI: 10.3390/nu12103050
- <sup>18</sup> Malta MB, Gomes C de B, Barros AJD, et al. Effectiveness of an intervention focusing on diet and walking during pregnancy in the primary health care service. *Cad Saúde Pública*. 2021;37(5):e00010320. DOI: 10.1590/0102-311x00010320
- <sup>19</sup> Silva CAO e. *Diabetes gestacional vs hábitos alimentares: impacto da diabetes gestacional nos hábitos alimentares das grávidas que recorreram à consulta externa do Hospital Pedro Hispano*. bachelorThesis. [s.n]; 2009. Access Jan. 31, 2023. Available at: <https://bdigital.ufp.pt/handle/10284/1600>
- <sup>20</sup> Organização Pan-Americana da Saúde. Ministério da Saúde. Federação Brasileira das Associações de Ginecologia e Obstetrícia. Sociedade Brasileira de Diabetes. *Tratamento do Diabetes Mellitus Gestacional no Brasil*. Brasília (DF). Published on-line 2019. Available at: <https://diabetes.org.br/wp-content/uploads/2021/06/ConsensoBrasileiroManejoDMG2019.pdf>.
- <sup>21</sup> Xavier RB, Jannotti CB, Silva KS da, Martins A de C. Risco reprodutivo e renda familiar: análise do perfil de gestantes. *Ciênc Saúde Coletiva*. 2013;18(4):1.161-1.171. DOI: 10.1590/S1413-81232013000400029
- <sup>22</sup> Demétrio F, Teles CA de S, Santos DB dos, Pereira M. Food insecurity in pregnant women is associated with social determinants and nutritional outcomes: a systematic review and meta-analysis. *Ciênc Saúde Coletiva*. 2020;25(7):2.663-2.676. DOI: 10.1590/1413-81232020257.24202018
- <sup>23</sup> Avanzi SA, Dias CA, Silva LOL e, Brandão MBF, Rodrigues SM. Importância do apoio familiar no período gravídico-gestacional sob a perspectiva de gestantes inseridas no PHPN. *Rev Saúde Coletiva UEFs*. 2019;9:55-62. DOI: 10.13102/rscdauefs.v9i0.3739
- <sup>24</sup> Tabák ÁG, Tamás G, Péterfalvi A, et al. The effect of paternal and maternal history of diabetes mellitus on the development of gestational diabetes mellitus. *J Endocrinol Invest*. 2009;32(7):606-610. DOI: 10.1007/BF03346517
- <sup>25</sup> Shin JA, Yoon KH. The Effect of Parental Transmission of Diabetes on the Development of Gestational Diabetes Mellitus. *Korean J Intern Med*. 2010;25(3):237. DOI: 10.3904/kjim.2010.25.3.237
- <sup>26</sup> Lewandowska M. Gestational Diabetes Mellitus (GDM) Risk for Declared Family History of Diabetes, in Combination with BMI Categories. *Int J Environ Res Public Health*. 2021;18(13):6936. DOI: 10.3390/ijerph18136936
- <sup>27</sup> Bezerra CP, Romão P, dos Santos MM, Lourenço N, Gheller ACGV, Costa FM. Diabetes mellitus gestacional: a importância do diagnóstico na redução de riscos materno-fetal. *Facider – Rev. Científica*. 2018;0(11). Access Feb. 1, 2023. Available at: <http://revista.sei-cesucol.edu.br/index.php/facider/article/view/168>
- <sup>28</sup> Tavares M da GR, Lopes ÉS, Barros RA de JPA, Azulay RS de S, Faria M dos S. Profile of Pregnant Women with Gestational Diabetes Mellitus at Increased Risk for Large for Gestational Age Newborns. *Rev Bras Ginecol E Obstetrícia RBGO Gynecol Obstet*. 2019;41(05):298-305. DOI: 10.1055/s-0039-1687860
- <sup>29</sup> Erem C, Kuzu UB, Deger O, Can G. Clinical research Prevalence of gestational diabetes mellitus and associated risk factors in Turkish women: the Trabzon GDM Study. *Arch Med Sci*. 2015;4:724-735. DOI: 10.5114/aoms.2015.53291
- <sup>30</sup> Bozatski BL, Pinto MF, Lavado MM. Perfil epidemiológico de gestantes diabéticas no município de Itajaí, SC. *Arq Catarin Med*. 2019;48(2):34-55.
- <sup>31</sup> Chávez-Bosquez O, Pozos-Parra P. The Latin American laws of correct nutrition: Review, unified interpretation, model and tools. *Comput Biol Med*. 2016;70:67-79. DOI: 10.1016/j.combiomed.2015.12.019
- <sup>32</sup> Silva MG da, Holanda VR de, Lima LSV de, Melo GP de. Estado Nutricional e Hábitos Alimentares de Gestantes Atendidas na Atenção Primária de Saúde. *Rev Bras Ciênc Saúde*. 2018;22:349-356.
- <sup>33</sup> Park H jin, Lee J, Kim JM, Lee HA, Kim SH, Kim Y. A Study of Snack Consumption, Night-Eating Habits, and Nutrient Intake in Gestational Diabetes Mellitus. *Clin Nutr Res*. 2013;2(1):42. DOI: 10.7762/cnr.2013.2.1.42
- <sup>34</sup> World Health Organization. Office of World Health Reporting. *The World health report : 2002 : reducing risks, promoting healthy life : overview*. World Health Organization; 2002. Access Sept. 17, 2023. Available at: <https://apps.who.int/iris/handle/10665/67454>
- <sup>35</sup> Philippi ST. *Alimentação saudável e o redesenho da pirâmide dos alimentos*. Editora Manole; 2014.
- <sup>36</sup> Archibald A, Dolinsky V, Azad M. Early-Life Exposure to Non-Nutritive Sweeteners and the Developmental Origins of Childhood Obesity: Global Evidence from Human and Rodent Studies. *Nutrients*. 2018;10(2):194. DOI: 10.3390/nu10020194

- <sup>37</sup> Organização Pan-Americana da Saúde. Ministério da Saúde. Federação Brasileira das Associações de Ginecologia e Obstetrícia. Sociedade Brasileira de Diabetes. Tratamento do Diabetes Mellitus Gestacional no Brasil. Brasília (DF); Published on-line 2019. Access Feb. 1, 2023. Available at: <https://diabetes.org.br/wp-content/uploads/2021/06/ConsensoBrasileiroManejoDMG2019.pdf>
- <sup>38</sup> Katzmarzyk PT, Friedenreich C, Shiroma EJ, Lee IM. Physical inactivity and non-communicable disease burden in low-income, middle-income and high-income countries. *Br J Sports Med.* 2022;56(2):101-106. DOI: 10.1136/bjsports-2020-103640
- <sup>39</sup> Laredo-Aguilera JA, Gallardo-Bravo M, Rabanales-Sotos JA, Cobo-Cuenca AI, Carmona-Torres JM. Physical Activity Programs during Pregnancy Are Effective for the Control of Gestational Diabetes Mellitus. *Int J Environ Res Public Health.* 2020;17(17):6151. DOI: 10.3390/ijerph17176151
- <sup>40</sup> Wang R, Yang Q, Sun T, et al. Physical Exercise is Associated with Glycemic Control among Women with Gestational Diabetes Mellitus: Findings from a Prospective Cohort in Shanghai, China. *Diabetes Metab Syndr Obes Targets Ther.* 2021;14:1949-1961. DOI: 10.2147/DMSO.S308287
- <sup>41</sup> Zakaria H, Abusanana S, Mussa BM, et al. The Role of Lifestyle Interventions in the Prevention and Treatment of Gestational Diabetes Mellitus. *Medicina (Mex).* 2023;59(2):287. DOI: 10.3390/medicina59020287
- <sup>42</sup> Ferrari N, Joisten C. Impact of physical activity on course and outcome of pregnancy from pre- to postnatal. *Eur J Clin Nutr.* 2021;75(12):1698-1709. DOI: 10.1038/s41430-021-00904-7
- <sup>43</sup> Nankervis A, Price S, Conn J. Gestational diabetes mellitus: A pragmatic approach to diagnosis and management. *Aust J Gen Pract.* 2018;47(7):445-449. DOI: 10.31128/AJGP-01-18-4479

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