

## Original Article

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### **Socioeconomic inequalities in health-related risk and protective behaviors among pregnant women diagnosed with gestational diabetes mellitus**

Desigualdades socioeconômicas nos comportamentos de risco e de proteção à saúde de gestantes com diabetes gestacional

Desigualdades socioeconómicas en los comportamientos de riesgo y de protección de la salud en gestantes con diabetes gestacional

Tatiane da Conceição Ribeiro<sup>a</sup> <https://orcid.org/0000-0002-3988-4873>

Rafaela Dias Rodrigues<sup>a</sup> <https://orcid.org/0000-0003-2305-3968>

Amanda Lopes da Silva Vitorino<sup>a</sup> <https://orcid.org/0000-0002-0314-4566>

Alanna Gomes da Silva<sup>a</sup> <https://orcid.org/0000-0003-2587-5658>

Miriam Maria Gonçalves Chaves<sup>b</sup> <https://orcid.org/0000-0002-5696-9561>

Giselle Lima de Freitas<sup>a</sup> <https://orcid.org/0000-0002-8118-8054>

Alexandra Dias Moreira<sup>a</sup> <https://orcid.org/0000-0002-4477-5241>

<sup>a</sup> Universidade Federal de Minas Gerais - UFMG, Escola de Enfermagem, Departamento de Enfermagem Materno Infantil e Saúde Pública. Belo Horizonte, Minas Gerais, Brasil.

<sup>b</sup> Prefeitura de Belo Horizonte, Secretaria Municipal de Belo Horizonte. Belo Horizonte, Minas Gerais, Brasil.

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## ABSTRACT

**Objective:** To estimate the association between sociodemographic and economic factors, prenatal care, and health-related risk and protective behaviors among pregnant women with gestational diabetes mellitus.

**Method:** This was a cross-sectional study with data collected between November 2023 and March 2024 from 391 pregnant women in a maternity hospital in Belo Horizonte, Minas Gerais, Brazil. Data collection was carried out through interviews using a semi-structured questionnaire. Poisson regression was used for data analysis.

**Results:** Fruit consumption was significantly higher among pregnant women aged over 35 years (PR: 1.29; 95% CI: 1.03–1.63) and those with higher education (PR: 1.66; 95% CI: 1.11–2.50). Vegetable consumption was significantly higher among those with higher education (PR: 1.47; 95% CI: 1.00–2.15) and without government assistance (PR: 1.39; 95% CI: 1.08–1.77). Physical activity was more prevalent among women with an income greater than three minimum wages (PR: 2.38; 95% CI: 1.36–4.16). Furthermore, women with higher income had a lower prevalence of alcohol consumption (PR: 0.25; 95% CI: 0.07–0.85).

**Conclusion:** Unfavorable socioeconomic conditions are associated with risk behaviors among pregnant women with gestational diabetes, particularly alcohol consumption. Conversely, more favorable socioeconomic conditions are associated with health-protective factors, especially fruit and vegetable consumption and physical activity.

**Descriptors:** Gestational Diabetes Mellitus; Health-Related Behaviors; Socioeconomic Factors.

## RESUMO

**Objetivo:** Estimar a associação entre fatores sociodemográficos e econômicos e os comportamentos de risco e de proteção à saúde de gestantes com diabetes mellitus gestacional.

**Método:** estudo transversal, com dados coletados entre novembro de 2023 e março de 2024 de 391 gestantes em maternidade de Belo Horizonte, Minas Gerais, Brasil. A coleta de dados foi realizada por entrevistas com a utilização de um questionário semiestruturado. Utilizou-se a regressão de Poisson para análise dos dados.

**Resultados:** O consumo de frutas foi significativamente maior entre gestantes com idade superior a 35 anos (RP:1,29;IC95%1,03-1,63) e com ensino superior (RP:1,66;IC95%-1,11-2,50). O consumo de verduras foi significativamente maior entre gestantes com ensino superior (RP:1,47;IC95%:1,00-2,15) e sem auxílio governamental (RP:1,39;IC95%1,08 – 1,77). A prática de atividade física foi mais prevalente entre aquelas gestantes com renda superior a três salários mínimos (RP:2,38; IC95%1,36-4,16). Foi demonstrado, ainda, que mulheres com maior renda tiveram menor prevalência de consumo de álcool (RP:0,25; IC95%0,07 – 0,85).

**Conclusão:** Condições socioeconômicas desfavoráveis estão associadas a comportamentos de risco em gestantes com diabetes gestacional, particularmente o consumo de álcool. Por outro lado, condições socioeconômicas mais favoráveis apresentam associação com fatores protetores à saúde, em especial o consumo de frutas e verduras e a prática de atividade física.

**Descritores:** Diabetes Mellitus Gestacional; Comportamentos Relacionados com a Saúde; Fatores Socioeconômicos.

## RESUMEN

**Objetivo:** Estimar la asociación entre factores sociodemográficos, económicos, el seguimiento prenatal y los comportamientos de riesgo y de protección para la salud de gestantes con diabetes mellitus gestacional.

**Método:** Estudio transversal con datos recolectados entre noviembre de 2023 y marzo de 2024 de 391 gestantes en una maternidad de Belo Horizonte, Minas Gerais, Brasil. La recolección de datos se realizó mediante entrevistas utilizando un cuestionario semiestructurado. Se empleó la regresión de Poisson para el análisis de los datos.

**Resultados:** El consumo de frutas fue significativamente mayor entre las gestantes mayores de 35 años (RP: 1,29; IC95%: 1,03–1,63) y entre aquellas con educación superior (RP: 1,66; IC95%: 1,11–2,50). El consumo de verduras fue significativamente mayor entre las gestantes con educación superior (RP: 1,47; IC95%: 1,00–2,15) y sin ayuda gubernamental (RP: 1,39; IC95%: 1,08–1,77). La práctica de actividad física fue más prevalente entre las gestantes con ingresos superiores a tres salarios mínimos (RP: 2,38; IC95%: 1,36–4,16). Además, se demostró que las mujeres con mayores ingresos presentaron menor prevalencia de consumo de alcohol (RP: 0,25; IC95%: 0,07–0,85).

**Conclusión:** Las condiciones socioeconómicas desfavorables están asociadas a comportamientos de riesgo en gestantes con diabetes gestacional, particularmente el consumo de alcohol. Por otro lado, las condiciones socioeconómicas más favorables se asocian con factores protectores de la salud, especialmente el consumo de frutas y verduras y la práctica de actividad física.

**Descriptores:** Diabetes Mellitus Gestacional; Comportamientos relacionados con la salud; Factores socioeconómicos.

## INTRODUCTION

Gestational Diabetes Mellitus (GDM) is an endocrine-metabolic condition that manifests during pregnancy. It has a multifactorial etiology associated with genetic predisposition and environmental factors<sup>(1)</sup> and is among the main comorbidities related to pregnancy, with an estimated global prevalence of 14%<sup>(2)</sup>. A large percentage of these cases occur usually in middle- and low-income countries, where health resources are not yet well structured<sup>(3)</sup>, and many of these women are not screened or are inadequately monitored<sup>(4)</sup>. In Brazil, the estimated prevalence of GDM is around 14%<sup>(5)</sup>.

Risk factors for GDM are mainly related to maternal overweight and modifiable behavioral factors, such as inadequate diet and physical inactivity, as well as non-modifiable factors, such as genetics, advanced maternal age, hypertension in the current pregnancy, polycystic ovary syndrome and obstetric history<sup>(6,7)</sup>.

Among the maternal complications associated with GDM, gestational hypertension, increased risk of progression to type 2 diabetes, and cerebrovascular diseases stand out<sup>(8)</sup>. The need for cesarean delivery is also more frequent in pregnant women with this comorbidity, due to outcomes such as fetal macrosomia or other obstetric complications. In the fetus and newborn, the repercussions include macrosomia, hypoglycemia, respiratory disorders, and a greater predisposition to obesity and type 2 diabetes in adulthood<sup>(8)</sup>.

Proper management of GDM, with glycemic control, balanced diet, physical activity and, when necessary, medication, is essential to prevent adverse maternal and fetal outcomes

<sup>(9)</sup>. However, adherence to these measures can be hindered by socioeconomic barriers, lack of social support, and the emotional impact of pregnancy<sup>(10)</sup>, as well as due to low maternal knowledge regarding the disease<sup>(11)</sup>.

Specifically among pregnant women with GDM, and considering the high risk of complications associated with the disease<sup>(8)</sup>, monitoring lifestyle habits through supported self-care becomes essential. Furthermore, a care plan agreed upon between healthcare professionals and pregnant women is necessary, taking into account the particularities of different contexts and population profiles. Sociodemographic factors, such as age under 35 years, and social factors, such as low education, are associated with lower levels of knowledge about GDM<sup>(9,11)</sup>, and different levels of awareness about the disease can contribute to inequalities in the adoption of healthy behaviors during pregnancy. Therefore, it is considered relevant to investigate the frequency of these behaviors among pregnant women with GDM, as well as the possible associated sociodemographic and economic differences, allowing for the obtaining of robust evidence about this population. Analyzing inequalities in risk and protective factors for health in pregnant women with gestational diabetes mellitus (GDM) can support the development of more targeted and effective actions, focusing on more vulnerable population subgroups, contributing to the reduction of health inequities and the decrease in morbidity and mortality.

All individuals should have the capacity to achieve optimal health, regardless of demographic, cultural, and economic class characteristics, without discrimination or exclusion in health systems<sup>(12)</sup>. However, evidence indicates that, in the Brazilian population, individuals with lower income and lower education levels have reduced levels of physical activity<sup>(13)</sup> and greater food insecurity, compared to more favored social classes<sup>(14)</sup>. Since these patterns are also observed among pregnant women in general<sup>(15,16)</sup>, this reinforces the hypothesis of the present study that such inequalities persist even among pregnant women with GDM. Therefore, the following question is posed, as follows: are risk and health protection behaviors distributed unequally among women with GDM, according to social and economic characteristics? This study aimed to estimate the association between sociodemographic and economic factors, prenatal care, and health-related risk and protective behaviors among pregnant women with gestational diabetes mellitus.

## **METHOD**

### **Type of study**

This is a cross-sectional study guided by the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations<sup>(17)</sup>.

### **Research location and study period**

The study was conducted at a public teaching hospital, a reference center for humanized childbirth and high-risk pregnancies, located in the northern part of the city of Belo Horizonte, in the state of Minas Gerais (MG), Brazil. It is the maternity hospital that assists the most births nationwide, with a total of 9,421 births assisted in 2023. The hospital currently serves as a referral center for six health regions for high-risk prenatal care, childbirth, and newborn care, encompassing 55 municipalities. Data were collected between November 3, 2023, and March 31, 2024.

### **Study sample and population**

The study population consisted of pregnant women diagnosed with gestational diabetes mellitus (GDM) who were admitted to and/or monitored at the above mentioned hospital where the study was conducted. To calculate the sample size, the primary outcomes considered were the prevalence of appropriate health behaviors in pregnant women, although, to our knowledge, these frequencies are undetermined for this population. Therefore, an estimated prevalence of 50% was used for the sample size calculation, as this prevalence allows for the largest possible sample size. Considering the number of deliveries performed at the hospital in 2023, with a 95% confidence level and a maximum margin of error of 5%, the sample size of 370 pregnant women was calculated.

The recruitment of pregnant women took place in person, through personal contact with all pregnant women with a prior diagnosis of gestational diabetes mellitus (GDM) in the inpatient/follow-up units of the above mentioned hospital. Immediately afterwards, a self-administered questionnaire was presented for completion.

The pregnant women were recruited in person, through a personal approach made to all pregnant women with a prior diagnosis of GDM in the inpatient/follow-up units of the hospital. They were then given a self-administered questionnaire to complete.

### **Study selection criteria**

The inclusion criteria were: pregnant women, aged 18 years or older, with a diagnosis of gestational diabetes mellitus (GDM), hospitalized and/or monitored at the study hospital. Pregnant women with a previous diagnosis of diabetes mellitus were excluded from the sample; that is, those who did not have a diagnosis of GDM in their current pregnancy because they had a history of diabetes mellitus, or those who were unconscious or had experienced fetal death at the time of the interview due to the grieving process.

### **Instrument used and study variables**

The predictors were the sociodemographic and economic characteristics collected through a questionnaire developed by the researcher, based on theoretical models used in previous studies<sup>(15,16)</sup>. The following variables were considered: advanced maternal age (less than 35 years/equal to or greater than 35 years)<sup>(18)</sup>; race/color (white/black/brown); education (primary education/secondary education/higher education); income (up to 1 minimum wage/1-2 minimum wages/above 2 minimum wages); municipality of origin (Belo Horizonte; other municipalities in Minas Gerais); receipt of government assistance (yes/no); prenatal care location (public service/private service).

The issues related to health behaviors were outcomes in this study, considering the following as health risk variables: smoking (yes/no), alcohol consumption (yes/no), consumption of ultra-processed foods (3 or more ultra-processed foods the day before the interview/up to 2 ultra-processed foods the day before the interview)<sup>(19)</sup>. As protective factors, fruit consumption was considered (less than 5 servings per week/more than 5 servings per week); consumption of vegetables (less than 5 portions per week/more than 5 portions per week) and physical exercise (yes/no)<sup>(20)</sup>. These questions from the instrument were incorporated considering the questionnaire from the 2019 National Health Survey<sup>(21)</sup>. The instrument used in this study, containing sociodemographic, economic, and health behavior data, was pre-tested with 15 pregnant women from the target population, confirming the clarity and understanding of the questions. Data were collected on paper through face-to-face interviews.

The database was double-entered by two researchers independently, and subsequently consolidated. To compare the two data entries and highlight possible discrepancies, Exceldiff® software version v5.2.7 was used.

## **Data analysis**

To assess the associations between each exposure variable (sociodemographic and economic) and health behaviors, Pearson's chi-square test was applied. For the multivariate analysis, Poisson regression with robust variance was used, starting the model with all predictor variables with a p-value  $<0.2$  in the bivariate analyses. With the use of the backward method, predictor variables with p-values  $<0.05$  were retained in the final models. The Goodness of Fit test showed that the models were adequate. A significance level of 5% ( $p<0.05$ ) was adopted to consider associations statistically significant. The Software for Statistics and Data Science (Stata®) version 14.0 was used for data analysis.

## **Ethical aspects**

The study was approved by the Ethics and Research Committee Involving Human Beings of the Federal University of Minas Gerais and the Belo Horizonte Maternity Hospital, protocols 6.074.288 and 6.190.019, respectively, on July 4, 2023, CAAE 69144623.0.3001.5132. The research ensured the subjects' voluntariness, anonymity, and the possibility of withdrawing from the study at any time. All participants signed the Informed Consent Form in accordance with Resolution 466/12 of the National Health Council.

## **RESULTS**

In total, 416 pregnant women were invited to participate in the study, but 25 refused, and the main reasons were, as follows: nine women refused due to lack of time and 16 were not interested. There were no exclusions based on the criteria indicated for this study. The final sample consisted of 391 women, aged between 15 and 46 years (Mean = 29 years, SD = 6.54). Most participants lived in the inland of Minas Gerais (65%), had completed secondary education (61%), and considered themselves of mixed race/color (61%). Their average income was 1 to 2 minimum wages (38%), and 148 women received some type of government assistance (38%) and most of them had prenatal care in public health services (92%). Moreover, 168 women (43.3%) consumed the recommended amount of fruit, while 188 (48%) maintained an adequate consumption of vegetables. Regarding physical activity, 75 women (19.3%) engaged in some type of exercise. Concerning health risk behaviors related to ultra-processed foods, 253 women (65.3%) reported having consumed these

products three or more times on the day before the interview, 6.67% smoked, and 2.30% consumed alcohol (Table 1).

**Table 1** - Sociodemographic, economic, and behavioral characteristics of pregnant women diagnosed with GDM (n=391). Belo Horizonte, Minas Gerais, Brazil, 2025.

| <b>Variables</b>                                                                                | <b>n (%)</b> |
|-------------------------------------------------------------------------------------------------|--------------|
| <b><i>Sociodemographic and economic characteristics</i></b>                                     |              |
| <b>Age</b>                                                                                      |              |
| Under 35 years old                                                                              | 288 (73.7)   |
| Over 35 years old                                                                               | 103 (26.3)   |
| <b>Race/color</b>                                                                               |              |
| White                                                                                           | 59 (15.1)    |
| Black                                                                                           | 89 (22.2)    |
| Brown                                                                                           | 243 (62.1)   |
| <b>Education</b>                                                                                |              |
| Primary education                                                                               | 82 (20.9)    |
| Secondary education                                                                             | 239 (61.1)   |
| Higher education                                                                                | 70 (18)      |
| <b>Income</b>                                                                                   |              |
| Up to 1 minimum wage                                                                            | 137 (35.3)   |
| 1-2 minimum wages                                                                               | 151 (38.9)   |
| Above 2 minimum wages                                                                           | 100 (25.8)   |
| <b>Municipality</b>                                                                             |              |
| Belo Horizonte                                                                                  | 134 (34.27)  |
| Other municipalities in Minas Gerais                                                            | 255 (65.21)  |
| <b>Government aid</b>                                                                           |              |
| Yes                                                                                             | 148 (38.05)  |
| No                                                                                              | 241 (61.95)  |
| <b>Prenatal care location</b>                                                                   |              |
| Public service                                                                                  | 358 (92.03)  |
| Private service                                                                                 | 31 (7.97)    |
| <b><i>Health behaviors</i></b>                                                                  |              |
| <b>Regular consumption of fruit</b>                                                             |              |
| Yes                                                                                             | 168 (43.3)   |
| No                                                                                              | 220 (56.7)   |
| <b>Regular consumption of vegetables</b>                                                        |              |
| Yes                                                                                             | 188 (48.1)   |
| No                                                                                              | 203 (51.9)   |
| <b>Practice of physical activity</b>                                                            |              |
| Yes                                                                                             | 313 (80.7)   |
| No                                                                                              | 75 (19.3)    |
| <b>Consumption of three or more ultra-processed foods<br/>(on the day before the interview)</b> |              |
| Yes                                                                                             | 253 (65.4)   |
| No                                                                                              | 134 (34.6)   |
| <b>Smoking</b>                                                                                  |              |
| Yes                                                                                             | 26 (6.7)     |
| No                                                                                              | 364 (93.3)   |
| <b>Alcohol use</b>                                                                              |              |
| Yes                                                                                             | 9 (2.3)      |

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Source: research data, 2024

Note: Categorical variables are expressed as numbers (percentages). N= Number of participants analyzed.

Fruit consumption was higher among women with more years of education ( $p < 0.001$ ), of white race/color ( $p = 0.039$ ), with income above three minimum wages ( $p = 0.002$ ), who did not receive government assistance ( $p < 0.001$ ), and who had prenatal care in private healthcare networks ( $p = 0.012$ ). Regarding vegetable consumption, women with higher education ( $p = 0.007$ ) and who did not receive government assistance ( $p < 0.001$ ) showed a higher frequency of consumption compared to the other groups. Furthermore, the practice of physical activity was significantly higher among women with income above three minimum wages ( $p = 0.007$ ) compared to women who earned up to one minimum wage (Table 2).

Higher frequencies of alcohol consumption were observed in women aged 35 or older ( $p = 0.040$ ), with lower income ( $p = 0.026$ ), and who received government assistance ( $p = 0.013$ ). Regarding smoking, higher frequencies were observed in women from Belo Horizonte compared to municipalities in the inland of Minas Gerais, with lower income, and who received government assistance. The highest consumption of ultra-processed foods (3 or more on the day before the interview) was found in women with lower education levels and who received prenatal care in the public health system (Table 3).

**Table 2** – Bivariate analyses of sociodemographic and economic variables and protective factors for health in pregnant women with GDM (n=391). Belo Horizonte, Minas Gerais, Brazil, 2025

|                                         | Fruit consumption |             |                  | Vegetable consumption |             |              | Physical activity |             |              |
|-----------------------------------------|-------------------|-------------|------------------|-----------------------|-------------|--------------|-------------------|-------------|--------------|
|                                         | Yes<br>n (%)      | No<br>n (%) | p *              | Yes<br>n (%)          | No<br>n (%) | p *          | Yes<br>n (%)      | No<br>n (%) | p *          |
| <b>Age (years)</b>                      |                   |             | 0.068            |                       |             | 0.424        |                   |             | 0.834        |
| <35                                     | 116 (40.5)        | 170 (59.4)  |                  | 135 (46.8)            | 153 (53.1)  |              | 56 (19.5)         | 230 (80.4)  |              |
| >=35                                    | 52 (50.9)         | 50 (49)     |                  | 53 (51.4)             | 50 (48.5)   |              | 19 (18.3)         | 83 (81.3)   |              |
| <b>Municipality</b>                     |                   |             | 0.847            |                       |             | 0.247        |                   |             | 0.121        |
| Belo Horizonte                          | 58 (43.9)         | 74 (56)     |                  | 59 (44)               | 75 (55.9)   |              | 31 (23.4)         | 101 (76.5)  |              |
| Other municipalities in<br>Minas Gerais | 109 (42.9)        | 145 (57)    |                  | 127 (49.8)            | 128 (50.2)  |              | 43 (16.9)         | 211 (83)    |              |
| <b>Education</b>                        |                   |             | <b>0.001</b>     |                       |             | <b>0.007</b> |                   |             | 0.143        |
| Primary education                       | 23 (28.4)         | 58 (71.6)   |                  | 27 (32.9)             | 55 (67.0)   |              | 10 (12.3)         | 71 (87.6)   |              |
| Secondary education                     | 105 (44.1)        | 133 (55.8)  |                  | 122 (51)              | 117 (48.9)  |              | 48 (20.1)         | 190 (79.8)  |              |
| Higher education                        | 40 (43.3)         | 29 (42)     |                  | 39 (55.7)             | 31 (44.2)   |              | 17 (24.6)         | 52 (75.3)   |              |
| <b>Race/color</b>                       |                   |             | <b>0.039</b>     |                       |             | 0.167        |                   |             | 0.261        |
| White                                   | 31 (52.5)         | 28 (47.4)   |                  | 35 (59.3)             | 24 (40.6)   |              | 15 (25.4)         | 44 (74.5)   |              |
| Black                                   | 29 (32.5)         | 60 (67.4)   |                  | 42 (47.1)             | 47 (52.8)   |              | 13 (14.6)         | 76 (85.3)   |              |
| Brown/yellow/indigenous                 | 108 (45.0)        | 132 (55.0)  |                  | 111 (45.6)            | 132 (54.3)  |              | 47 (19.5)         | 193 (80.4)  |              |
| <b>Income</b>                           |                   |             | <b>0.002</b>     |                       |             | 0.108        |                   |             | <b>0.007</b> |
| Up to 1 minimum wage                    | 48 (35.5)         | 87 (64.4)   |                  | 62 (45.2)             | 75 (54.7)   |              | 16 (11.8)         | 119 (88.1)  |              |
| 1-2 minimum wages                       | 61 (40.4)         | 90 (59.6)   |                  | 67 (44.3)             | 84 (55.6)   |              | 31 (20.5)         | 120 (79.4)  |              |
| 3 or more minimum<br>wages              | 57 (57.5)         | 42 (42.4)   |                  | 57 (57)               | 43 (43)     |              | 28 (28.2)         | 71 (71.7)   |              |
| <b>Government aid</b>                   |                   |             | <b>&lt;0.001</b> |                       |             | <b>0.001</b> |                   |             | 0.051        |

|                               |            |            |              |            |           |            |
|-------------------------------|------------|------------|--------------|------------|-----------|------------|
| Yes                           | 43 (29.4)  | 103 (70.5) | 55 (37.1)    | 93 (62.8)  | 21 (14.3) | 125 (85.6) |
| No                            | 125 (52.0) | 115 (47.9) | 133 (55.1)   | 108 (44.8) | 54 (22.5) | 186 (77.5) |
| <b>Prenatal care location</b> |            |            | <b>0.012</b> |            | 0.117     | 0.307      |
| Public service                | 146 (41.1) | 209 (58.8) | 167 (46.6)   | 191 (53.3) | 65 (18.3) | 290 (81.6) |
| Private service               | 20 (64.5)  | 11 (35.4)  | 61 (61.2)    | 38 (38.7)  | 8 (25.8)  | 23 (74.1)  |

Source: research data, 2024

\*Chi-square test p-value

Bold: p-values less than 0.05.

**Table 3** - Bivariate analyses between sociodemographic and economic variables and health risk behaviors of pregnant women with GDM (n=391). Belo Horizonte, Minas Gerais, Brazil, 2025.

|                                      | Alcohol consumption |             |              | Smoking      |             |              | Consumption of ultra-processed foods |             |              |
|--------------------------------------|---------------------|-------------|--------------|--------------|-------------|--------------|--------------------------------------|-------------|--------------|
|                                      | Yes<br>n (%)        | No<br>n (%) | p *          | Yes<br>n (%) | No<br>n (%) | p *          | Yes<br>n (%)                         | No<br>n (%) | p *          |
| <b>Age (years)</b>                   |                     |             | <b>0.044</b> |              |             | 0.926        |                                      |             | 0.168        |
| <35                                  | 4 (1.4)             | 284 (98.6)  |              | 19 (6,6)     | 269 (93.4)  |              | 93 (32.6)                            | 192 (67.3)  |              |
| >=35                                 | 5 (4.9)             | 98 (95.1)   |              | 7 (6.9)      | 95 (93.1)   |              | 41 (40.2)                            | 61 (59.3)   |              |
| <b>Municipality</b>                  |                     |             | 0.435        |              |             | <b>0.001</b> |                                      |             | 0.491        |
| Belo Horizonte                       | 2 (1.5)             | 132 (98.5)  |              | 15 (11.2)    | 119(88,8)   |              | 49 (37.1)                            | 83 (62,88)  |              |
| Other municipalities in Minas Gerais | 7 (2.8)             | 248 (97.2)  |              | 11 (4.3)     | 243(95.7)   |              | 85 (33.6)                            | 168 (66.4)  |              |
| <b>Education</b>                     |                     |             | <b>0.026</b> |              |             | 0.175        |                                      |             | <b>0.044</b> |
| Primary education                    | 5 (6.1)             | 77 (93.9)   |              | 9 (10.9)     | 73 (89.2)   |              | 58 (71.6)                            | 23 (28.40)  |              |
| Secondary education                  | 4 (1.7)             | 235 (98.3)  |              | 12 (5.0)     | 226 (98.9)  |              | 159 (66.8)                           | 79 (33.19)  |              |
| Higher education                     | 0 (0.0)             | 70 (100.0)  |              | 5 (7.1)      | 65 (92.9)   |              | 36 (52.9)                            | 32 (47.06)  |              |
| <b>Race/color</b>                    |                     |             | 0.604        |              |             | 0.496        |                                      |             | 0.057        |
| White                                | 1 (1.7)             | 58 (98.3)   |              | 3 (5,2)      | 55 (94.8)   |              | 28 (48.2)                            | 30 (51.7)   |              |
| Black                                | 1 (1.1)             | 88 (98.8)   |              | 4 (4.5)      | 85 (95.5)   |              | 30 (33.7)                            | 59 (66.2)   |              |
| Brown/yellow/indigenous              | 7 (2.9)             | 236 (97.1)  |              | 19 (7.8)     | 224 (92.2)  |              | 76 (31.6)                            | 164 (65.3)  |              |
| <b>Income</b>                        |                     |             | 0.136        |              |             | <b>0.004</b> |                                      |             | 0.698        |
| Up to 1 minimum wage                 | 6 (4.4)             | 131 (95.6)  |              | 17 (12.4)    | 120(87.6)   |              | 43 (32.0)                            | 91 (67.9)   |              |
| 1-2 minimum wages                    | 2 (1.3)             | 149 (98.7)  |              | 6 (4.0)      | 144(96.0)   |              | 51 (33.7)                            | 100 (66.2)  |              |
| 3 or more minimum wages              | 1 (1.00)            | 99 (99.00)  |              | 3 (3.00)     | 97 (97.00)  |              | 37 (37.3)                            | 62 (62.6)   |              |

|                               |          |             |              |            |              |           |              |
|-------------------------------|----------|-------------|--------------|------------|--------------|-----------|--------------|
| <b>Government aid</b>         |          |             | <b>0.013</b> |            | <b>0.031</b> |           | 0.366        |
| Yes                           | 7 (4.73) | 141 (95.27) |              | 15 (10.20) | 132(89.80)   | 46 (31.7) | 99 (68.2)    |
| No                            | 2 (0.83) | 239 (99.17) |              | 11 (4.56)  | 230(95.44)   | 87 (36.2) | 153 (63.7)   |
| <b>Prenatal care location</b> |          |             | 0.372        |            | 0.120        |           | <b>0.037</b> |
| Public service                | 9 (2.51) | 349 (97.49) |              | 26 (7.28)  | 331(92.72)   | 237(66.9) | 117 (33.05)  |
| Private service               | 0 (0.00) | 31 (100.00) |              | 0 (0.00)   | 31(100.00)   | 16(51.6)  | 16 (51.61)   |

Source: research data, 2024

\*P-value from the chi-square test.

Bold: p-values less than 0.05.

Pregnant women aged 35 or older had a higher prevalence of fruit consumption compared to those under 35 (PR: 1.29; 95% CI: 1.03-1.63). Regarding education, those with higher and secondary education showed a higher prevalence of fruit consumption compared to women with primary education (PR: 1.66; 95% CI: 1.11-2.50 and PR: 1.43; 95% CI: 0.98-2.07, respectively). Women who did not receive government assistance had a higher prevalence of adequate vegetable consumption compared to those who receive this type of assistance (PR: 1.39; 95% CI: 1.08-1.77). Women with higher and secondary education also had a higher prevalence of vegetable consumption compared to those with primary education (PR: 1.47; 95% CI: 1.00–2.15 and PR: 1.42; 95% CI: 1.02–1.99, respectively). The prevalence of physical activity was higher among people with incomes above three minimum wages and 1–2 minimum wages, compared to those earning up to one minimum wage (PR: 2.38; 95% CI: 1.36–4.16 and PR: 1.73; 95% CI: 0.99–3.02, respectively) (Table 4).

**Table 4** - Sociodemographic and economic factors associated with health-protective behaviors among pregnant women with GDM (n=391). Belo Horizonte, Minas Gerais, Brazil, 2025.

| Protective factors for health | *RP (**95% CI)     | P value |
|-------------------------------|--------------------|---------|
| Fruit consumption             |                    |         |
| Age                           |                    |         |
| Under 35 years old            | 1                  | 0.028   |
| ≥ 35 years                    | 1.29 (1.03-1.63)   |         |
| Education                     |                    |         |
| Primary                       | 1                  | 0.058   |
| Secondary                     | 1.43 (0.98 - 2.07) |         |
| Higher                        | 1.66 (1.11- 2.50)  |         |
| Vegetable consumption         |                    |         |
| Education                     |                    |         |
| Primary                       | 1                  | 0.037   |
| Secondary                     | 1.42 (1.02 – 1.99) |         |
| Higher                        | 1.47 (1.00 – 2.15) |         |
| Government aid                |                    |         |
| Yes                           | 1                  | 0.008   |
| No                            | 1.39 (1.08 – 1.77) |         |
| Practice of physical activity |                    |         |
| Income                        |                    |         |
| Up to 1 minimum wage          | 1                  | 0.053   |
| 1-2 minimum wages             | 1.73 (0.99 – 3.02) |         |
| 3 or more minimum wages       | 2.38 (1.36 – 4.16) |         |

Source: research data, 2024

\*PR: Prevalence ratio; \*\*Confidence interval

Pregnant women with higher education had a lower prevalence of smoking compared to those with primary education, with a significant association, although the magnitude was small, possibly due to the low prevalence of smoking in the population investigated. Furthermore, women from other municipalities in the inland of Minas Gerais (PR: 0.38; 95% CI: 0.18–0.79) and with income above three or more minimum wages (PR: 0.25; 95% CI: 0.07–0.85) and one to two minimum wages (PR: 0.31; 95% CI: 0.12–0.75) had a lower prevalence of alcohol consumption compared to those residing in Belo Horizonte and those with income up to one minimum wage, respectively. Regarding the consumption of ultra-processed foods, no variable remained significant in the final model (Table 5).

**Table 5** - Sociodemographic and economic factors associated with health risk behaviors among pregnant women with GDM (n=391). Belo Horizonte, Minas Gerais, Brazil, 2025.

| <b>Health risk factors</b>                           | <b>*RP (**95% CI)</b>                                                    | <b>P value</b> |
|------------------------------------------------------|--------------------------------------------------------------------------|----------------|
| <b>Smoking</b>                                       |                                                                          |                |
| <i>Education</i>                                     |                                                                          |                |
| Primary                                              | 1                                                                        |                |
| Secondary                                            | 0.27 (0.75-0.99)                                                         | 0.050          |
| Higher                                               | 1.57x10 <sup>-7</sup> (6.24 × 10 <sup>-8</sup> - 3.64x10 <sup>-7</sup> ) | P < 0.001      |
| <b>Alcohol Consumption</b>                           |                                                                          |                |
| <i>Municipality</i>                                  |                                                                          |                |
| Belo Horizonte                                       | 1                                                                        |                |
| Other municipalities in the inland of Minas Gerais   | 0.38 (0.18 – 0.79)                                                       | 0.010          |
| <i>Income</i>                                        |                                                                          |                |
| Up to 1 minimum wage                                 | 1                                                                        |                |
| 1-2 minimum wages                                    | 0.31 (0.12 – 0.75)                                                       | 0.010          |
| 3 or more minimum wages                              | 0.25 (0.07 – 0.85)                                                       | 0.027          |
| <b>Consumption of ultra-processed foods</b>          |                                                                          |                |
| No variable remained significant in the final model. |                                                                          |                |

Source: research data, 2024

\*PR: Prevalence ratio; \*\* Confidence interval

## DISCUSSION

This study aimed to estimate the association between sociodemographic and economic factors and risk and protective health behaviors in pregnant women with gestational diabetes mellitus. In addition to the results indicating a high prevalence of unhealthy habits in the studied sample, it was evident that such behaviors are more frequent in disadvantaged socioeconomic classes.

The unhealthy behaviors evidenced in this study, related to the high prevalence of inadequate diet and physical inactivity and the use of alcohol and tobacco, although less frequent, can cause complications in pregnant women with GDM, such as cardiovascular and cerebrovascular diseases<sup>(8)</sup>. Barriers to the adoption of appropriate health behaviors in pregnant women with GDM are described in the international literature, such as responsibilities with children, physical limitations, time constraints, domestic responsibilities, and labor status, making the role of Nursing fundamental in stimulating the self-efficacy of these women<sup>(10,22)</sup>. In this regard, assertive and contextualized interventions during pregnancy and postpartum, such as goal setting, self-monitoring, and motivational interviews, can improve blood glucose levels, help reduce weight, and prevent the future occurrence of type 2 diabetes<sup>(23)</sup>.

Fruit and vegetable consumption was found to be more frequent in this study among higher socioeconomic classes, while unhealthy behaviors, such as alcohol and tobacco use, were more prevalent in contexts of greater social vulnerability. Previous Brazilian studies with pregnant women have shown similar results regarding smoking habits and alcohol consumption<sup>(16,24)</sup>, although the results have not been specifically described for pregnant women with GDM. There are scarce studies (both national and international) allowing for a direct comparison of the results presented here. However, considering the findings of this research, it is emphasized that strategies aimed at adopting healthy behaviors should be integrated and intersector, with the role of public policies being essential for reducing inequalities in access to health services. Health promotion should be understood as a social and political issue, encompassing multiple dimensions of life—such as culture, working conditions, and education—in broad models that overcome the restricted view of health as the exclusive result of individual choices<sup>(25)</sup>.

On the other hand, this research did not find an independent association between the exposures investigated and the consumption of ultra-processed foods, suggesting that this consumption occurred homogeneously among the population subgroups. However, a high consumption of these foods was evident in general, in about two-thirds of the sample studied. This high frequency was also demonstrated in a previous Brazilian study, according to which approximately a quarter of the total energy consumed by pregnant women came from ultra-processed foods. In the same study, it was found that, after an educational intervention aimed at training health professionals responsible for monitoring pregnant women, there was a significant reduction in the consumption of ultra-processed foods, compared to the control group<sup>(26)</sup>. The importance of continuing education for health professionals at all levels of care

is highlighted, in order to intensify guidance to pregnant women with comorbidities to reduce avoidable maternal and fetal complications. In addition to promoting healthy eating, there is a need for comprehensive government programs aimed at providing subsidies for the purchase of fresh, unprocessed foods, as well as policies for taxing ultra-processed products and regulating the advertising of these food.

Regarding the practice of physical activity, this habit was more frequent among pregnant women with higher incomes. Evidence indicates that structural and social barriers—such as excessive domestic responsibilities, difficulty accessing transportation, and a lack of adequate spaces—limit women's adherence to physical exercise in vulnerable contexts<sup>(27)</sup>. Thus, public policies aimed at expanding safe and free areas for exercise and promoting inclusive programs during pregnancy can contribute to reducing these inequalities<sup>(27)</sup>. In this sense, the role of Nursing in Primary Health Care is essential, considering the importance of working in the community, providing appropriate guidance, and implementing contextualized, interprofessional, and women-centered practices.

The evidence provided in this study highlights the need for authorities to pay close attention to promoting health equity, especially given the increased incidence of GDM in recent years<sup>(5)</sup>, and its consequences for maternal and child health<sup>(8)</sup>. The importance of health education and supported self-care is reinforced as pillars for promoting the health of pregnant women with GDM, in individual and collective nursing interventions<sup>(27)</sup>. Investments in digital health and access to technologies are also strategic means for GDM care and should be implemented, benefiting both monitoring by the multidisciplinary team and self-care at home<sup>(28)</sup>.

Strengths of this study include, in addition to methodological rigor, its innovative character in considering various behaviors, specifically in pregnant women with GDM, both healthy habits and risk factors, and being conducted in a reference hospital for the state of Minas Gerais. Regarding the limitations of this research, it is noteworthy that the use of self-reported data may have introduced response bias, particularly concerning physical activity, food consumption, and harmful health habits. It is also important to highlight that the low prevalence of alcohol and tobacco consumption may have reduced the statistical power of the analyses. Previous Brazilian studies have demonstrated a prevalence of alcohol and tobacco use in approximately 10%<sup>(16)</sup> and 4%<sup>(24)</sup>, respectively, of pregnant women in general. Due to the scarcity of studies on lifestyle habits in pregnant women with GDM, the comparability of these findings is limited. Considering the comorbidity diagnosis in the population investigated, it is inferred that these habits should be avoided with greater rigor. Moreover,

the present study represents a local scenario, and the results may not reflect different Brazilian contexts. It is recommended that future research use representative samples of the national territory, longitudinal designs capable of tracking changes in healthy habits among pregnant women, as well as the incorporation of objective methods, such as detailed food records and physical activity monitoring devices, to assess adherence to health recommendations.

## CONCLUSION

The results of this study reinforce the potential influence of factors such as low income and low education, in addition to advanced age, on health risk behaviors in pregnant women with gestational diabetes mellitus (GDM), highlighting disparities in adherence to healthy habits. The low prevalence of adequate consumption of fruits and vegetables and the practice of physical activity, especially among people from disadvantaged socioeconomic classes, suggests the need for intervention strategies aimed at promoting health and reducing inequalities in access to information.

The formulation of inclusive public policies that promote equity in access to health services and opportunities for lifestyle improvement is essential to minimize the impacts of gestational diabetes mellitus (GDM) and improve maternal-fetal outcomes. Therefore, this study contributes to the understanding of the challenges faced by pregnant women with GDM, presenting relevant results for nursing practice, contextualized to the needs of the population, and providing support for interdisciplinary approaches that promote comprehensive and equitable maternal health care in Brazil.

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### **Availability of data and material**

Access to the dataset may be granted upon request to the corresponding author.

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### **Authors' contribution**

Conceptualization – Alexandra Dias Moreira, Tatiane da Conceição Ribeiro, Rafaela Dias Rodrigues, Amanda Lopes da Silva Vitorino, Alanna Gomes da Silva, Miriam Maria Gonçalves Chaves, Giselle Lima de Freitas, Alexandra Dias Moreira

Data curation - Alexandra Dias Moreira, Tatiane da Conceição Ribeiro, Rafaela Dias Rodrigues, Amanda Lopes da Silva Vitorino

Formal Analysis - Alexandra Dias Moreira, Tatiane da Conceição Ribeiro, Rafaela Dias Rodrigues, Amanda Lopes da Silva Vitorino

Acquisition of financing - Alexandra Dias Moreira

Investigation - Alexandra Dias Moreira, Tatiane da Conceição Ribeiro, Rafaela Dias Rodrigues, Amanda Lopes da Silva Vitorino

Methodology - Alexandra Dias Moreira, Tatiane da Conceição Ribeiro, Rafaela Dias Rodrigues, Amanda Lopes da Silva Vitorino

Project Management - Alexandra Dias Moreira, Rafaela Dias Rodrigues

Resources - Alexandra Dias Moreira

Software - Alexandra Dias Moreira

Supervision - Alexandra Dias Moreira, Tatiane da Conceição Ribeiro, Rafaela Dias Rodrigues

Validation - Alexandra Dias Moreira, Tatiane da Conceição Ribeiro, Rafaela Dias Rodrigues, Amanda Lopes da Silva Vitorino, Alanna Gomes da Silva, Miriam Maria Gonçalves Chaves, Giselle Lima de Freitas, Alexandra Dias Moreira

Visualization - Alexandra Dias Moreira, Tatiane da Conceição Ribeiro, Rafaela Dias Rodrigues, Amanda Lopes da Silva Vitorino, Alanna Gomes da Silva, Miriam Maria Gonçalves Chaves, Giselle Lima de Freitas, Alexandra Dias Moreira

Writing - original draft - Alexandra Dias Moreira, Tatiane da Conceição Ribeiro, Rafaela Dias Rodrigues, Amanda Lopes da Silva Vitorino

Writing - revision and editing - Alexandra Dias Moreira, Tatiane da Conceição Ribeiro, Rafaela Dias Rodrigues, Amanda Lopes da Silva Vitorino, Alanna Gomes da Silva, Miriam Maria Gonçalves Chaves, Giselle Lima de Freitas, Alexandra Dias Moreira

### **Conflict of interest**

The authors declare that there is no conflict of interest.

### **Corresponding Author**

Alexandra Dias Moreira

Email: [alexandradm84@gmail.com](mailto:alexandradm84@gmail.com)

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### **Associate editor:**

Carlise Rigon Dalla Nora

### **Editor-in-chief:**

João Lucas Campos de Oliveira