




Hyperglycaemia and factors associated with dental caries in immediate postpartum women

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ABSTRACT

Objective: Dental caries and hyperglycaemia share common risk factors. The aim of this study was to identify factors associated with dental caries in women in the immediate postpartum period. It also verified whether women with hyperglycaemia presented more dental caries than those with normal glycaemia.

Material and Methods: This cross-sectional study was performed on 297 women recruited from a teaching hospital in Brazil (from October 2011 to November 2012). Dental caries and oral biofilm were evaluated by oral examination. The blood glucose was accessed by Haemoglobin A1c test. Information on socioeconomic characteristics, harmful habits and oral health habits was also gathered.

Results: More than half (66%) of the women had carious lesions. Univariate analysis showed no association between hyperglycaemia and dental caries ($p = .39$). The hierarchical logistic regression model showed that the following variables were associated with dental caries: maternal education level < 8 years (OR_{adjusted} = 2.40 [CI 1.19–4.82]), previous children (OR_{adjusted} = 1.81 [CI 1.08–3.03]), use of dental floss (OR_{adjusted} = .48 [CI 0.27–0.86]), and visible plaque index $\geq 30\%$ (OR_{adjusted} = 1.83 [CI 1.05–3.20]).

Conclusions: These findings call attention to the need to implement effective public policies directed at avoiding tooth decay in pregnancy and in the postpartum period.

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Introduction

Hyperglycaemia in pregnancy is associated with increased infant morbidity and mortality, both during pregnancy and in the postnatal period, as well as a higher risk of developing type-2 diabetes mellitus [1]. The ingestion of foods with a high glycaemic index induces an increase in glucose concentration in the blood [2]. The intake of these foods is associated with a greater risk for developing hyperglycaemia in pregnancy [3].

The excessive consumption of sugar is a foremost concern, since it is associated with the risk of onset of chronic diseases, such as diabetes and dental caries. Studies have shown that the consumption of sweetened beverages increases the risk of onset of both dental caries and hyperglycaemia in pregnancy [4–6]. The excessive intake of sugar has been reported as the most important risk factor for the appearance of dental caries [5,7]. Dental caries and hyperglycaemia in pregnancy share common risk factors [4,6].

In addition, studies suggest that pregnancy can increase the risk for dental caries development due to changes in pH and the buffer capacity of saliva [8,9], less effective oral hygiene practices and deleterious eating habits [10–12]. In several regions of the world, a high prevalence of caries in pregnant women has been reported, ranging from 50% to 87% [11,13,14].

Based on this reasoning, a question arises: Do postpartum women who develop hyperglycaemia during pregnancy have a higher number of carious lesions, compared with euglycaemic postpartum women, and which factors are associated with dental caries in this phase? Considering that there are few studies on this topic, the objective of this study was to investigate the factors associated with dental caries in the immediate postpartum period and to verify if the women with hyperglycaemia presented more dental caries than those with normal glycaemia.

Material and methods

This was a cross-sectional study, with data collected from the University Hospital of the Federal University of Maranhão (HUUFMA), in São Luís – MA, Brazil. The research was approved by the HUUFMA Ethics Committee in Research (Protocol 240/11). This was a study nested within the Multi-Centre Geravida Project. Informed consent was signed by all participants prior to participating in the study.

Study participants

The study population was postpartum women recruited by convenience sampling from the Maternal and Child Unit of

HUUFMA from October 2011 to November 2012. The eligibility criteria for participation in the study was to be women aged less than 45 years, in immediate postpartum period and hospitalized at the Maternal and Child Unit of HUUFMA. Women infected by HIV were excluded (2 women), because there is a decrease in pH and buffering capacity of saliva in HIV-infected patients, which may affect caries experience in these patients [15]. Data from 297 postpartum women were collected. A power calculation based on differences in proportions suggested that a total sample size of 264 women would have power of 95%, at least, to estimate statistically significant differences ($\alpha = 0.05$) based on pilot study of Multi-Centre Geravida Project ($\chi^2 = 7.89$).

Data collection

A single previously trained researcher was responsible for carrying out the intraoral clinical examination of the women. The examiner is one of the members of the Multi-Centre Geravida Project. A structured questionnaire was developed for this study and it was applied to collect information on oral health habits, access to dental services, socioeconomic characteristics, harmful habits and general health conditions [16]. Economic class definition was based on the Brazilian Economic Classification Criteria (BECC) developed by the Brazilian Association of Market Research Companies (ABEP 2012). The ABEP categorization allows the estimation of the purchasing power of urban families that are grouped into the following income categories: A1, A2, B1 and B2 in the A/B category; C1 and C2 in category C; D and E in the D/E category. The first category includes people in the upper-class groups [17].

The participants took a glycated haemoglobin (HbA1c) test to measure their blood sugar level. The test was performed in the same clinical analysis laboratory. Women who exhibited HbA1c rates $<5.45\%$ were diagnosed as normal; those with HbA1c rates between 5.45% and 5.95% , as having glucose intolerance and at risk for gestational diabetes mellitus (GDM); those with HbA1c rates $>5.95\%$, as having GDM [18]; and participants with HbA1c rates $\geq 6.50\%$, as having overt diabetes mellitus (DM) in pregnancy [19].

The examiner responsible for data collection received training to perform a standardized examination of tooth surfaces (according to WHO [20]) and dental plaque (according to visible plaque index [21]). The intra examiner reliability score for dental plaque assessment was 0.80.

The oral examination occurred within the period of immediate puerperium [22] and was performed in the ward of the hospital where the mothers were hospitalized. The examination was performed in the sitting position, under ambient lighting, using tweezers, a dental mirror and a WHO 621 periodontal probe [20].

The per cent value of the visible plaque index (VPI) was obtained by adding up the number of surfaces with visible biofilm, dividing the result by the total number of examined surfaces, and multiplying by 100 [21]. VPI was categorized into two levels, according to the median value found ($<30\%$ and $\geq 30\%$).

In recording the dental caries, the participants' teeth were considered healthy if there was no clinical evidence of caries. The presence of caries was recorded when there was a lesion in a pit or fissure, or on a smooth tooth surface, an unmistakable cavity, undermined enamel, or a detectably softened floor or wall (confirmed by periodontal probe – WHO). Restored teeth with one or more areas affected by a carious lesion were also considered decayed and were recorded, in addition to the restored teeth without caries and those lost to caries [20].

Data analysis

The data were analysed by the SPSS (v.18) statistical program. The outcome variable was the presence of caries, analysed in three categories (absence of caries; 1 to 2 teeth with carious lesions; and 3 or more teeth with carious lesions), and the exposure variables were sociodemographic characterization, general health condition, harmful habits and oral health data. Initial descriptive statistics were performed using absolute frequency and percentage. The categorical variables were compared among the groups by the Chi-square test or Fisher's exact test. The significance level was set at 5% (<0.05).

The association measurement odds ratio (OR) with respective 95% confidence intervals (CI 95%) was used to estimate the association between exposure and dental caries, dichotomized into presence or absence. The multivariate logistic regression model was built following a theoretical framework divided into three categories: socioeconomic variables (distal level), harmful habits and general health condition (intermediate level), and oral health (proximal level). The variables with $p < .10$ in the initial analysis of the ordinal outcome were included for the calculation of the OR-adjusted measure. For each logistic regression, an overall goodness-of-fit model was assessed by the significance of score test and likelihood ratio test [23]. Pearson's linear correlation coefficient (r) was calculated to estimate the relation between the level of HbA1c and the variables of number of decayed teeth and number of teeth with a history of caries (teeth decayed, restored and lost by caries).

Results

Among the categories of dental caries in postpartum women, the presence of caries was associated with: dark-skinned individuals ($p = .02$), low socioeconomic level ($p \leq .01$), ≤ 8 -year education level ($p \leq 0.01$) and having previous children ($p = .03$), all with statistical significance (Table 1).

Regarding harmful habits and general health condition of the sample (Table 2), only previous smoking ($p = .03$) showed significant association with caries presence. HbA1c distribution showed no association with dental caries ($p = .38$).

When the caries data were analysed, it was found that more than half of the women (66%) presented carious lesions, and 75% of these had three or more carious lesions. Use of dental floss ($p \leq .01$) and high ($\geq 30\%$) VPI ($p = .01$)

Table 1. Distribution of socioeconomic and demographic variables among the dental caries categories in postpartum women.

Variables	Caries presence					p
	Caries absence		Low ^a		High ^b	
	n	(%)	n	(%)	n (%)	
Age (in years)	101		49		147	.32
Less than 17 years old	18	(17.8)	7	(14.3)	25	(17.0)
17 to 34 years old	66	(65.3)	39	(79.6)	106	(72.1)
Over 34 years old	17	(16.8)	3	(6.1)	16	(10.9)
Skin colour (self-referenced)	101		49		147	.02*
White	38	(37.6)	18	(36.7)	31	(21.1)
Black	13	(12.9)	7	(14.3)	16	(10.9)
Darkskinned	50	(29.5)	24	(49.0)	100	(68.0)
Socioeconomic level	101		49		147	.01*
B	21	(20.7)	10	(20.4)	11	(7.6)
C	64	(63.3)	27	(55.1)	85	(57.8)
D–E	16	(16.0)	12	(24.5)	51	(34.6)
Education level	101		49		147	<.01*
≤8 years	14	(13.9)	15	(29.8)	49	(33.1)
>8 years	87	(86.1)	34	(70.2)	98	(66.9)
Marital status	101		49		147	.36
With no domestic partner	15	(14.9)	12	(24.5)	29	(19.7)
With a domestic partner	86	(85.1)	37	(75.5)	118	(80.3)
Previous children	101		49		147	.03*
Yes	44	(43.6)	25	(51.0)	89	(60.5)
No	57	(56.4)	24	(49.0)	58	(39.5)

Chi-square test or Fisher's exact test. *Statistically significant difference ($p < .05$).

^aLow presence of caries = One to two teeth with carious lesion.

^bHigh presence of caries = three or more teeth with carious lesions.

recorded statistically significant differences, according to the distribution of these variables among the groups (Table 2).

Half of the sample (50.21%) presented HbA1c rates considered normal ($\text{HbA1c} < 5.45\%$); 19.57% had rates between 5.45% and 5.95%; 6.80% had a rate of $>5.95\%$; and 23.4% had a rate of $\geq 6.50\%$. Furthermore, the analysis of the HbA1c level showed no significant correlations with number of decayed teeth ($rP = 0.005$; $p = .930$) and number of teeth with a history of caries ($rP = 0.023$; $p = .720$) (Figure 1).

The hierarchical logistic regression model (Table 3) showed that dental caries in postpartum women was positively associated with maternal education level ≤ 8 years and having previous children ($\text{OR}_{\text{adjusted}} = 2.40$ [CI 1.19–4.82]; $\text{OR}_{\text{adjusted}} = 1.81$ [CI 1.08–3.03], respectively).

After adjustment of the model, caries was not associated with any variable related to general health conditions and harmful habits. In relation to the oral health data, there was an association between use of dental floss as a protector factor ($\text{OR}_{\text{adjusted}} = 0.48$ [CI 0.27–0.86]) and high ($\geq 30\%$) VPI as a risk factor ($\text{OR}_{\text{adjusted}} = 1.83$ [CI 1.05–3.20]).

Discussion

This study investigated the HbA1c levels and the caries experience in the immediate postpartum period. In relation to dental caries, this study considered that the lesions

Table 2. Distribution of variables related to health and harmful habits and general and oral condition of postpartum women, among the dental caries categories.

Variables	Caries presence					p value
	Caries absence		Low ^a		High ^b	
	n	(%)	n	(%)	n (%)	
Hospitalization during pregnancy	101		49		147	.47
Yes	37	(36.6)	16	(32.7)	43	(29.3)
No	64	(63.4)	33	(67.3)	104	(70.7)
Previous smoking	101		49		147	.02*
Yes	7	(6.9)	7	(14.3)	28	(19.0)
No	94	(93.1)	42	(85.7)	119	(81.0)
Previous alcohol intake	101		49		147	.54
Yes	45	(44.6)	24	(49.0)	76	(51.7)
No	56	(55.4)	25	(51.0)	71	(48.3)
Tooth brushing after meals	101		49		147	.24
Yes	95	(94.1)	47	(57.9)	144	(98.0)
No	6	(5.9)	2	(2.1)	3	(2.0)
Tooth brushing frequency	101		49		147	0.65
Up to once a day	5	(5.0)	5	(10.2)	14	(9.5)
Twice a day	33	(32.7)	13	(26.5)	46	(31.3)
Three times a day or more	63	(62.3)	31	(63.3)	87	(59.2)
Dental floss use	101		49		147	<.01*
Yes	47	(47.0)	23	(46.9)	32	(21.8)
No	54	(53.0)	26	(53.1)	115	(78.2)
VPI	101		49		147	.01*
<30% (low)	66	(65.3)	27	(55.1)	68	(46.3)
$\geq 30\%$ (High)	35	(34.7)	22	(44.9)	79	(53.7)
Visit to the dentist	101		49		147	.08
Yes	17	(16.8)	13	(26.5)	19	(12.9)
No	84	(83.2)	36	(73.5)	128	(87.1)
Guidance during pregnancy	101		49		147	0.20
Yes	18	(18.0)	10	(20.4)	17	(11.6)
No	83	(82.0)	39	(79.6)	130	(88.4)

Chi-square test or Fisher's exact test. * Statistically significant difference ($p < .05$).

^aLow presence of caries = One to two teeth with carious lesion.

^bHigh presence of caries = three or more teeth with carious lesions.

present at the time of the examination (immediate postpartum period) were present during pregnancy, taking into consideration the processes involved in pathogenesis and the course of the caries disease [24]. The HbA1c test was used as a diagnostic tool to check the women's glycaemic levels. It best reflects the glycaemic exposure over time, compared with diagnostic tests of fasting glucose and glucose tolerance [25]. Then, in this study, the HbA1c test done in the immediate postpartum period reflected the women's glycaemia in the last trimester of gestation. However, the levels of HbA1c have been found to increase at the end of pregnancy and may also be influenced by possible iron deficiency in pregnant women [25,26].

This study shows that there was no association between HbA1c levels and caries prevalence. Other results, reported by Surdacka et al. [27], showed a significant positive correlation between caries rates, formation of plaque and HbA1c levels, found in 63 pregnant women (33 euglycaemic and 30 diabetic). However, in that research, it was included 28 diabetic pregnant women with higher levels of HbA1c (28 out of 30), and only two with gestational diabetes, unlike the characteristics of the present study sample, where a greater number of women with moderate levels of HbA1c were included, that is, those who developed gestational diabetes. This inclusion in the present study can explain why the distribution of HbA1c in the postpartum women has not been associated with dental caries.

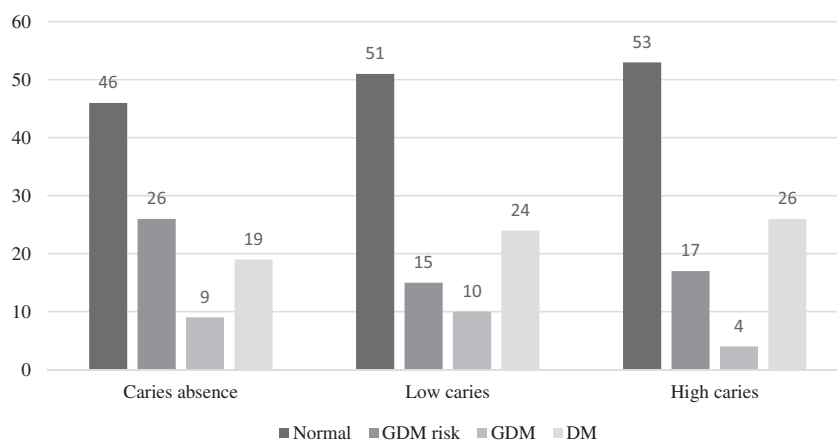


Figure 1. Percentual distribution of variables related to Haemoglobin A1c test of postpartum women, among the dental caries categories. Chi-square test or Fisher’s exact test ($p=.38$; $\alpha < 0.05$). Low presence of caries = One to two teeth with carious lesions. High presence of caries = three or more teeth with carious lesions. GDM: gestational diabetes mellitus; DM: overt diabetes mellitus.

Table 3. Logistic regression analysis between exposure and outcome variables of caries in postpartum women.

Exposure variables	OR Crude (95%CI)	<i>p</i> value	OR adjusted (95%CI)	<i>p</i> value
Skin colour				
White	Reference		Reference	
Black	1.37 (0.61–3.05)	.57	1.03 (0.41–2.60)	.94
Darkskinned	1.92 (1.12–3.38)	.02*	1.54 (0.87–2.72)	.12
Socioeconomic level**				
B	Reference		Reference	
C	1.67 (0.84–3.33)	.19	1.46 (0.70–3.06)	.30
D–E	3.69 (1.62–8.40)	<.01*	1.52 (0.95–2.45)	.08
Education level				
≤8 years	3.15 (1.63–6.08)	<.01*	2.40 (1.19–4.82)	.01*
>8 years	Reference		Reference	
Previous children				
Yes	1.80 (1.10–2.92)	.02*	1.81 (1.08–3.03)	.02*
No	Reference		Reference	
Previous smoking				
Yes	2.91 (1.24–6.83)	.02*	2.16 (0.88–5.26)	.08
No	Reference		Reference	
Dental floss use				
Yes	0.43 (0.26–0.72)	<.01*	0.48 (0.27–0.86)	.01*
No	Reference		Reference	
VPI				
Low (<30%)	Reference		Reference	
High (≥30%)	2.00 (1.22–3.29)	.01*	1.83 (1.05–3.20)	.03*
Visit to the dentist				
Yes	0.96 (0.50–1.83)	.96	1.20 (0.58–2.46)	.61
No	Reference		Reference	

Crude OR: Odds Ratio; OR Adjusted: odds ratios were adjusted considering the variables that presented *p* value <.10 in the crude analysis.

Chi-square test or Fisher’s exact test and logistic regression.

*Statistically significant difference ($p < .05$).

**To determine socioeconomic level, the Brazilian Economic Classification Criteria /2008, proposed by the Brazilian Market Research Association (accessed at: <http://www.abep.org/criterio-brasil>) was used.

Prevalence of 66% of caries was observed, and 75% of the women who had caries had three or more lesions of the disease. These data corroborate previous studies in which a high frequency of caries disease during pregnancy was reported [11,24,28,29].

The dental examination was carried out in the hospital ward under ambient lighting and without devices for drying the dental surface. It is important to emphasize that the examination conditions may have underestimated the prevalence of dental caries in the group of women studied; nevertheless, these conditions have also been observed in other studies [24,28]. On the other hand, the intraoral clinical

assessment was performed by an examiner previously trained in the parameters for dental caries examination, in accordance with the World Health Organization [20].

The use of dental floss and the amount of visible plaque were associated with carious lesions in postpartum women as proximal determinants. The maternal education level and having previous children were associated with carious lesions as distal determinants, corroborated by previous studies [13,30].

This study showed that having previous children is associated with having caries during pregnancy and postpartum period. The increase in parity has been associated with the number of untreated caries in women [31]. It has been

suggested that susceptibility to dental caries in women with a greater number of children is related not only to biological factors, but also to socioeconomic and behavioural characteristics, because these women have less time for self-care [31].

Dental caries is associated with poor oral hygiene [11,32]. In this study, tooth brushing after meals and brushing frequency were not associated with dental caries. In any case, these variables are largely subject to bias information, which can explain these findings. In contrast, the visible plaque index – an objective quantitative variable and less subject to this type of bias – was found to be associated with dental caries as a proximal determinant, together with the non-use of dental floss, which was also associated with dental caries. Considering that data collection was performed within the immediate postpartum period, these findings may also be same in pregnancy since the women just delivered. The literature reports that pregnant women have limited attention to oral health [11,33].

The strengths of this research are related to its being a large observational study, in which an expressive number of women were assessed. Furthermore, this study contributed to a still little discussed subject in the literature, that is, the relation between dental caries and hyperglycaemia in the immediate postpartum period. On the other hand, some limitations need to be elucidated as the study design that is cross-sectional and it did not permit assessment potentially causal relation of variables, the non-representative sample which may have reduced generalizability of the findings and as recommendations in future studies some features should be addressed such as the evaluation of active white spots and dietary characteristics.

Conclusions

The results of this study showed that dental caries is not associated with hyperglycaemia in the immediate postpartum period, but that there is a high prevalence of dental caries in postpartum women. The proximal factors detected were high biofilm build-up and no interdental hygiene, as elements that could trigger a disease-causing dental pathogenic process. The distal factors were the institutional and social influences, such as low maternal education level.

Recommendation

The results of this study call attention to the need to draft and implement effective public policies directed at avoiding cavities and tooth decay in pregnancy and in the postpartum period.

Disclosure statement

The authors declare no conflicts of interest with respect to the authorship and/or publication of this article.

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