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Systemic conditions and oral health-related quality of life of pregnant women of normal weight and who are overweight

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Objective: This study evaluated systemic and periodontal conditions and their association with quality of life in women in the third trimester of pregnancy, assisted by the Brazilian public health-care system, with excessive and normal weight. **Methods:** Fifty pregnant women were allocated into two groups according to their pre-pregnancy body mass index (BMI): excessive (GE; $n = 25$; BMI ≥ 25.00 kg/m^2); and normal (GN; $n = 25$; $18.00 \leq$ BMI ≤ 24.99 kg/m^2). Thereafter, variables such as socio-economic level, anthropometric parameters (body mass index and gestational weight gain), systemic conditions, periodontal status, and oral health-related quality of life using the short version of the Oral Health Impact Profile (OHIP-14), were evaluated. **Results:** There was no significant difference between groups in schooling level, monthly household income and gestational weight gain ($P > 0.05$). The GE group showed a higher frequency of arterial hypertension ($P = 0.018$), sought dental services less frequently ($P = 0.035$), had a higher prevalence of periodontitis ($P = 0.011$), and had a higher OHIP-14 overall score ($P = 0.004$) characterised by physical and psychological impact. In the final binary logistic regression models, high maternal BMI was associated with arterial hypertension and periodontitis during pregnancy, while periodontitis was strongly associated with moderate and high impact on quality of life. **Conclusion:** Pregnant women in the third trimester with excessive weight, assisted by the Brazilian public health-care system, presented with a higher prevalence of arterial hypertension, worse periodontal conditions and consequent high impact on quality of life.

Key words: *Periodontal disease, pregnant women, obesity, overweight, dental public health*

INTRODUCTION

High levels of progesterone and oestrogen in pregnancy are associated with increased oral inflammation because they reduce the patients' immune response and exacerbate the inflammatory response in the presence of dental plaque[1].

A diet rich in fats, sugars and refined foods, reduced consumption of complex carbohydrates and fibre, and insufficient physical exercise are fundamental factors leading to an increase in the global prevalence of overweight/obesity[2,3].

Excessive weight has a negative effect on pregnancy and may be associated with adverse effects, such as hypertension, pre-eclampsia, gestational diabetes mellitus, large-for-gestational age babies, premature delivery, macrosomia and emergency Caesarean section[4,5].

Overweight and obesity are associated with periodontal diseases. The adipose tissue of overweight patients secretes inflammatory mediators, such as C-reactive protein (CRP), which make the host susceptible to generalised inflammation of the body. With respect to oral health in patients who are overweight or obese, inflammatory mediators are also secreted into the periodontal tissue; accordingly, patients with excessive weight may have exacerbated periodontal inflammation, even in the presence of a small amount of dental plaque, because of their reduced immune response[2,3,6].

Previous findings suggest that periodontitis during pregnancy, characterised by the presence of gram-negative periodontopathogens, is associated with preterm birth and low weight at birth[7,8]. Moreover, several studies have highlighted the negative impact of poor hygiene conditions on quality of life during pregnancy[9,10]. Likewise, oral impairments also negatively influence the quality of life of overweight/obese individuals[11,12]. Although different oral variables were addressed in the aforementioned studies, none specifically evaluated the impact of oral conditions on the quality of life of pregnant women with excessive weight.

The lack of awareness among individuals and insufficient training of professionals in the dental-care management of pregnant women have long been observed. Over time, the field of dentistry has significantly contributed to the quality of life and general health of women and infants. In Brazil, a specific programme, called the Women's Health Care Program, consists of a multiprofessional team that provides integrated services to pregnant women during the prenatal period. Prenatal dentistry plays a fundamental role in primary care by promoting female health and guiding mothers regarding their child's dental care[13].

This study aimed to evaluate the general and periodontal conditions, and their association with quality of life, in overweight/obese and eutrophic pregnant women assisted by the Brazilian public health-care system.

MATERIALS AND METHODS

STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) recommendations were followed in order to guarantee a complete and accurate description of this observational cross-sectional study[14].

Ethical aspects

This study was performed in accordance with the Declaration of Helsinki (2008), and it was approved by the Ethics Committee on Human Research. Informed written consent was obtained from all patients.

Sample composition

The study included 50 women in the third trimester of pregnancy (between the 27th and 35th gestational weeks) assisted by the Brazilian public health-care system in Bauru city, São Paulo, Brazil. Gestational age was considered as the gestational week from the patient's last monthly period. The third trimester of gestation was chosen for this evaluation because it is possible to observe high levels of periodontal inflammation during this period as a result of the elevated hormone levels.

Pregnant women were evaluated between June 1st 2018 and January 31st 2019, and were allocated into one of the following groups according to their pre-pregnancy body mass index (BMI): excessive (GE, $n = 25$) when their BMI was ≥ 25.0 kg/m^2; and normal (GN, $n = 25$) when their BMI was 18.5–24.9 kg/m^2.[15]

Eligibility and exclusion criteria

Eligibility criteria for this study were availability for regular medical follow-up during pregnancy, being in the third trimester of pregnancy during the study, having good systemic health prior to pregnancy and presenting at least two functional teeth in each quadrant. Exclusion criteria were: the presence of general impairments; neuromotor or communication difficulties; diabetes and/or decompensated hypertension; malnutrition (BMI < 18 kg/m^2); consumption of alcohol/cigarettes/drugs during pregnancy; severe gestational problems requiring absolute rest; use of medication that could interfere with the periodontal response (e.g., immunosuppressive, anticonvulsant or calcium channel-blocking drugs, such as cyclosporine, phenytoin or nifedipine, respectively); and use of orthodontic devices.

Socio-economic analysis

Level of education was categorised from 0 to 9 (0 = illiterate, 1 = incomplete primary education, 2 = completed primary education, 3 = incomplete high school, 4 = completed high school, 5 = incomplete higher education, 6 = completed higher education, 7 = specialisation, 8 = Master's degree, 9 = PhD), and the highest level of education of each participant was recorded in the study. Household monthly income was categorised into the following levels: level 1 = family income $\leq$ R$ 937.00; level 2 = family income between R$ 937.01 and R$ 1,874.00; level 3 = family income between R$ 1,874.01 and R$ 2,811.00; level 4 = family income between R$ 2,811.01 and R$ 3,748.00; level 5 = family income between R$ 3,748.01 and R$ 4,685.00; and level 6 = family income $\geq$ R$ 4,685.01. The amount R$ 937.00 (approximately USD 242.00) was considered the minimum wage as specified by the Brazilian government.

Systemic conditions and oral hygiene behaviours

Information regarding the presence of diabetes or hypertension during pregnancy was obtained from the patients' obstetric records; a score of 0 was given if the condition was absent, and a score of 1 was given if the condition was present. The diagnosis of arterial

hypertension in pregnancy was established when blood pressure levels were ≥ 140/90 mmHg[16]. For the diagnosis of gestational diabetes mellitus, the International Association of the Diabetes and Pregnancy Study Group protocol[17] was adopted, which proposed the following thresholds for maternal hyperglycaemia: ≥92 mg/dl (fasting level), ≥180 mg/dl (after 1 hour) and ≥153 mg/dl (after 2 hours).

Oral hygiene behaviour was evaluated based on self-report of the frequency of daily toothbrushing, dental floss use and regular dental appointments (at least once a year).

Anthropometric parameters

Pre-pregnancy weight was obtained from the patients' medical records, and their height was obtained using a stadiometer (Wood 2.20; WCS Ind., Curitiba, Paraná, Brazil) during the dental appointment. From this information, pre-pregnancy BMI was calculated. Maternal weight and BMI during the third trimester of pregnancy were obtained using an automatic scale (MIC model 300PP, maximum capacity 300 kg; Micheletti Ind., São Paulo-SP, Brazil). Following this, patients were classified with respect to their gestational weight gain based on the protocol established by the Institute of Medicine, which considers the pre-pregnancy BMI as a parameter to define the recommended gestational weight gain in pregnancy[18]. Patients were classified as having excessive gestational weight gain if they presented a weight gain value above the highest point of the interval indicated by the protocol (*Table 1*).

Periodontal examination

Data collection was performed by one dentist previously calibrated by a gold standard examiner in epidemiological surveys, in order to ensure uniformity in the collection of data regarding the periodontal conditions. The kappa coefficient (kappa inter-examiner reliability = 0.92; kappa intra-examiner reliability = 0.95) was calculated based on periodontal evaluation of approximately 20% of the sample ($n = 10$)[19]. A 15-day interval was observed between the examinations performed by the examiner and the gold standard examiner because of periodontal alteration after the first examination.

Table 1 Weight gain classification according to maternal body mass index (BMI) before pregnancy[18]

Nutritional status before pregnancy	BMI (kg/m^2)	Recommended weight gain (kg)
Underweight	<18.5	12.5–18
Normal weight	18.5–24.9	11–16
Overweight	25.0–29.9	7–11.5
Obese	≥30.0	5–9

Probing pocket depth (PPD) and clinical attachment level were assessed using a standard periodontal clinical probe (QD.320.05; Quinelato, Schobell Ind. Ltda, Rio Claro, São Paulo, Brazil). The PPD was measured from the free gingival margin to the bottom of the periodontal pocket, and clinical attachment level was measured from the cemento–enamel junction to the base of the periodontal pocket[20], at six dental sites (mesial buccal/lingual, cervical buccal/lingual, distal buccal/lingual) excluding the third molars.

A patient was diagnosed with periodontitis if interdental clinical attachment loss was detectable at two or more non-adjacent teeth, or buccal or oral clinical attachment loss of ≥3 mm with pocketing of >3 mm was detectable at two or more teeth and that the observed clinical attachment loss was not ascribed to non-periodontal causes, such as: (1) gingival recession of traumatic origin; (2) dental caries extending in the cervical area of the tooth; (3) the presence of clinical attachment loss on the distal aspect of a second molar and associated with malposition or extraction of a third molar; (4) an endodontic lesion draining through the marginal periodontium; and (5) the occurrence of a vertical root fracture[21]. Thereafter, according to the interdental clinical attachment level at the site with greatest loss and complexity, periodontitis was classified into stages I, II, III and IV, as stated by Tonetti *et al*[21].

Gingival inflammation was also included in the analysis, depending on the presence or absence of bleeding on probing (BOP) in each site assessed in each tooth[19]. A patient with intact periodontium (with no pockets associated with clinical attachment and bone loss) was diagnosed as a "gingivitis case" according to a BOP score of ≥10%, and further categorised as localised (BOP score ≥10% and ≤30%) or generalised (BOP score >30%), based on the case definition proposed by Trombelli *et al*[22]. The presence or absence of calculus was evaluated by visual and tactile examination, and the percentage of teeth with calculus was obtained.

Oral health impact profile

The patients' quality of life was measured using the short version of the Oral Health Impact Profile questionnaire (OHIP-14), which was applied via standardised interview to avoid different interpretations among patients and to minimise its subjectivity.

OHIP-14 is an adapted version of OHIP-49, in which the dimensions assessed are functional limitations, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap[23]. For the responses, the patients were

asked to consider the period from the beginning of gestation and the response codes were scored as 0 = never, 1 = rarely, 2 = occasionally, 3 = often, and 4 = very often. Each dimension was composed of two questions, and the response scores were averaged. The total score was assessed by addition of the averages obtained in each dimension. The overall score ranged from 0 to 28, for which the value of 0 was classified as no impact of oral condition on quality of life, $0 < \text{OHIP-14} \leq 9$ was classified as low impact, $9 < \text{OHIP-14} \leq 18$ was classified as moderate impact, and $18 < \text{OHIP-14} \leq 28$ was classified as high impact[24].

Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics for Windows (Released 2017, Version 25.0; IBM Corp., Armonk, NY, USA). With respect to the sample size, the protocol proposed by Hosmer and Lemeshow for regression logistic analysis[25] was adopted, which allows the inclusion of 10 cases for each combination of independent variables. In this study, dichotomisation of the following outcomes was performed: arterial hypertension (0, no hypertension; 1, hypertension), periodontitis (0, no periodontitis; 1, periodontitis), and quality of life (0, no/low impact on quality of life; 1, moderate/high impact on quality of life), and these were inserted on the models for a maximum of five independent variables. Thus, 50 patients were included in this study.

Statistical analysis was performed in two steps (bivariate analysis and binary logistic regression) using the stepwise backward (likelihood ratio) method. In bivariate analysis, the Kolmogorov–Smirnov test was initially applied to verify normal distribution of the sample. Following this, the *t*-test was applied to the quantitative variables with a normal distribution (maternal age, BMI during the third trimester of pregnancy, percentage of dental calculus, percentage of sites with BOP, PPD average, mean clinical attachment level). The Mann–Whitney *U*-test was applied for assessment of quantitative variables with a non-normal distribution and ordinal qualitative variables (pre-pregnancy maternal BMI, schooling level, household monthly income, percentage of sites with PPD ≥ 4 mm, percentage of sites with clinical attachment loss ≥ 4 mm, daily toothbrushing, daily flossing, OHIP-14 categorisation and all dimensions of OHIP-14). The chi-square test was used for nominal qualitative variables (presence/absence of arterial hypertension during gestation and gestational diabetes mellitus, regular dental care by professional, recommended weight gain classification during pregnancy, presence/absence of gingivitis, presence/absence of periodontitis). According to the standardised statistical criteria, all independent variables that yielded a value of $P < 0.20$ in bivariate analyses were included in the initial model of logistic regression to evaluate their possible influence on the dependent variables. Hosmer–Lemeshow, collinearity and residual analyses were implemented to explain the results obtained through logistic regression. A statistical significance level of 5% was adopted.

RESULTS

Initially, 59 pregnant women were evaluated, but nine were excluded from the sample for the following reasons: presence of pre-pregnancy diabetes mellitus ($n = 3$); hypertension ($n = 2$); orthodontic device use ($n = 3$); and smoking ($n = 1$).

The mean age of the sample was 27.84 years, and that of the GE and GN groups was 30.08 ± 4.65 years and 25.60 ± 6.63 years, respectively. Patients in the GE group had a higher BMI pre-pregnancy and during the third trimester of pregnancy ($P < 0.001$). Among the patients in the GE group, 15 (60%) were classified as overweight and 10 (40%) as obese. With respect to gestational weight gain, there were no intergroup differences as per the Institute of Medicine guidelines. Nine (36%) patients in the GE group and two (8%) in the GN group presented with arterial hypertension during pregnancy (*Table 2*).

Groups did not differ with respect to frequency of toothbrushing and use of dental floss each day; nevertheless, patients in the GE group reported a lower frequency of regular dental care by professionals ($P = 0.0357$). In terms of oral conditions, patients in the GE group had an average of 25.96 teeth which were evaluated in the periodontal analysis, whilst patients in the GN had an average of 26.92 teeth. Additionally, both groups showed a high prevalence of dental calculus and sites with BOP; however, there were no intergroup differences. Two patients in the GE group had a healthy periodontal condition, whilst four (16%) and three (12%) presented localised and generalised gingivitis, respectively. Regarding patients in the GN group, five (20%) had a healthy periodontal condition, whilst three (12%) and 10 (40%) showed localised and generalised gingivitis, respectively. Nonetheless, there was no intergroup difference for gingivitis classification ($P = 0.549$). By contrast, 16 (64%) of patients in the GE group had periodontitis, among which six (24%) and 10 (40%) were categorised into stage I and stage II periodontitis, respectively. Seven patients in the GN group presented periodontitis, among which two (8%) and five (20%) were categorised into stage I and stage II periodontitis, respectively (*Table 3*). None was classified into stage III or stage IV periodontitis, or with generalised periodontitis.

Table 2 Comparison of contextual variables and systemic conditions between groups

Variables	GE (n = 25)	GN (n = 25)	P
Maternal BMI (kg/m^2) in third trimester	33.91 ± 6.17	25.15 ± 2.29	**<0.001***
Pre-pregnancy BMI (kg/m^2)	28.22 [26.66–33.26]	23.12 [20.41–24.10]	**<0.001**†
Schooling level	4 [2–4]	4 [3–4.25]	0.284†
Household monthly income	3 [1.75–3]	2 [2–3.25]	0.578†
Gestational arterial hypertension			
No	16	23	**0.018**‡
Yes	9	2	
Gestational diabetes mellitus			
No	22	23	0.640‡
Yes	3	2	
Excessive gestational weight gain			
No	18	23	
Yes	7	2	0.068‡

Values are given as mean ± SD, median [first to third quartiles] or n.
BMI, body mass index; GE, obese group; GN, normal group; P, significance level.
*t-test.
†Mann–Whitney U-test.
‡Chi-square test.

Regarding oral health-related quality of life, 14 (56%) and six (24%) patients in the GE group showed moderate impact and high impact of oral health on quality of life, respectively. On the other hand, eight (32%) and two (8%) patients in the GN group presented moderate and high impact of oral health on quality of life, respectively. Further, patients in the GE group exhibited higher values of the overall OHIP-14 score for physical pain, psychological discomfort, physical disability and psychological disability parameters (*Table 4*).

Binary logistic regression analysis was performed to identify independent variables associated with arterial hypertension (0 = no hypertension; 1 = hypertension) during the third trimester of pregnancy (*Table 5*). The initial model was composed of the following variables: maternal BMI; excessive gestational weight gain; and periodontitis during pregnancy. In the multicollinearity analysis, all independent variables had values of tolerance of >0.80 and variance inflation factor values of <2. The final logistic regression model [$X^2(1) = 20.56$; $P < 0.001$; R^2 of Nagelkerke = 0.517]

Table 3 Comparison of oral hygiene behaviour and oral parameters between groups

Variables	GE (n = 25)	GN (n = 25)	P
Prev. dental calculus (%)	41.66 ± 32.10	36.28 ± 29.05	0.532*
Prev. sites with BOP (%)	42.16 ± 20.88	35.66 ± 16.50	0.228*
PPD average (mm)	2.34 ± 0.42	2.14 ± 0.41	0.106*
Clinical attachment level average (mm)	2.36 ± 0.37	2.15 ± 0.36	**0.045***
Prev. sites with PPD ≥ 4mm (%)	5.95 [1.73–14.22]	0.59 [0–5.50]	**<0.001**†
Prev. sites with clinical attachment loss ≥ 4 mm (%)	8.02 [1.96–11.38]	0.59 [0–6.10]	**0.001**†
Freq. daily toothbrushing/day	3 [2–3]	3 [3–3.25]	0.249†
Freq. dental floss use/day	0 [0–1]	1 [0–1]	0.293†
Gingivitis			
Healthy	2 (8)	5 (20)	0.549†
Localised	4 (16)	3 (12)	
Generalised	3 (12)	10 (40)	
Periodontitis			
No	9 (36)	18 (72)	**0.011**†
Yes	16 (64)	7 (28)	
Periodontitis stage			
Stage I	6 (24)	2 (8)	
Stage II	10 (40)	5 (20)	
Regular dental care by professional			
No	8 (32)	2 (8	**0.035**‡
Yes	17 (68)	23 (92)	

Values are given as mean ± SD, median [first to third quartiles] or n (%).
BMI, body mass index; BOP, bleeding on probing; Freq., Frequency of; GE, obese group; GN, normal group; P, significance level; PPD, probing pocket depth; Prev., Prevalance of.
*t-test.
†Mann–Whitney U-test.
‡Chi-square test.

Table 4 Comparison of dimensions and overall score of the short version of the Oral Health Impact Profile (OHIP-14) in pregnant women, with and without periodontitis

Variables	GE (n = 25)	GN (n = 25)	P
Overall OHIP-14 score	13.5 ± 5.60	8.52 ± 6.05	**0.004***
Functional limitation	1 [0–2]	0 [0–2]	0.583†
Physical pain	4 [2–4]	2 [0–4]	**0.047†**
Psychological discomfort	4 [2–4]	2 [1.5–3.25]	**0.023†**
Physical disability	3 [1–4]	0 [0–2]	**0.003†**
Psychological disability	2 [1–3.25]	1 [0–2]	**0.012†**
Social disability	2 [0–2.25]	2 [0–2]	0.399†
Handicap	1 [0–2]	0 [0–1]	0.050†
OHIP-14 categorisation			
No impact	0 (0)	3 (12)	**0.003†**
Low impact	5 (20)	12 (48)	
Moderate impact	14 (56)	8 (32)	
High impact	6 (24)	2 (8)	

Values are given as mean ± SD, median [first to third quartiles] or n (%).
BMI, body mass index; GE, obese group; GN, normal group; P, significance level.
*t-test.
†Mann–Whitney U-test.

Table 5 Binary logistic regression model showing the independent variables related to arterial hypertension during the third trimester of pregnancy

	B	P	Adjusted OR	95% CI
Final model				
Maternal BMI	0.36	0.001	1.43	1.14–1.79
Constant	−11.29	<0.001		

Variables which did not remain in the final model: gestational weight gain; periodontitis.
Adjusted OR, adjusted odds ratio; B, coefficient; BMI, body mass index; P, significance level.

revealed that high maternal BMI [adjusted odds ratio (OR) = 1.43; 95% CI = 1.14–1.79; P = 0.001] was associated with presence of arterial hypertension during the third trimester of pregnancy. The overall accuracy of the final model was 90%. In the Hosmer–Lemeshow analysis, a chi-square value for the final model of 8.45 for 8 degrees of freedom (P = 0.390) was obtained.

Additionally, binary logistic regression was performed to verify the independent variables related to periodontitis (0 = no periodontitis; 1 = periodontitis) during the third trimester of pregnancy (*Table 6*). The initial model was composed of the following variables: maternal BMI; arterial hypertension; gestational weight gain; and regular dental care by a professional. In the multicollinearity analysis, all independent variables presented tolerance values of >0.60 and variance inflation factor values of <2. The final logistic regression model [$X^2(1)$ = 8.85; P = 0.002; R^2 of Nagelkerke = 0.216] revealed that high maternal BMI (adjusted OR = 1.19; 95% CI = 1.03–1.36; P = 0.014) was associated with the presence of periodontitis during the third trimester of pregnancy. The overall accuracy of the final model was 74%. In the Hosmer–Lemeshow analysis, a chi-square value for the final model of 22.00 for 8 degrees of freedom (P = 0.004) was obtained.

Table 6 Binary logistic regression model showing the independent variables related to periodontitis during the third trimester of pregnancy

	B	P	Adjusted OR	95% CI
Final model				
Maternal BMI	0.17	0.014	1.19	1.03–1.36
Constant	−4.70	0.011		

Variables which did not remain in the final model: arterial hypertension; gestational weight gain; regular dental care by a professional.
Adjusted OR, adjusted odds ratio; B, coefficient; BMI, body mass index; P, significance level.

Finally, binary logistic regression was performed to verify the independent variables related to moderate or high impact of oral health on quality of life (0 = no/low impact; 1 = moderate/high impact) during the third trimester of pregnancy (*Table 7*). The initial model was composed of the following variables: maternal BMI; arterial hypertension; gestational weight gain; regular dental care by a professional; and periodontitis. In the multicollinearity analysis, all independent variables presented tolerance values of >0.50 and variance inflation factor values of <2. The final logistic regression model [$X^2(1)$ = 8.19; P = 0.004; R^2 of Nagelkerke = 0.204] revealed that a moderate or high impact on quality of life (adjusted OR = 6.00; 95% CI = 1.60–22.38; P = 0.007) was associated with periodontitis in the third trimester of pregnancy. The overall accuracy of the final model was 68%.

DISCUSSION

This study contributes to the body of scientific evidence as it reports that pregnant women with a high BMI, assisted by the Brazilian public health-care system, demonstrated greater prevalence of hypertension and periodontitis during the third trimester. Furthermore, high BMI had a greater impact on the quality of life of patients in this study, mainly with respect to physical and psychological dimensions, than a BMI in the normal range.

Gestational hypertension and pre-eclampsia are the most commonly diagnosed hypertensive conditions in pregnancy[26,27]. Pregnancy-induced hypertension complicates about 6%–10% of pregnancies[26], and is one of the main causes of maternal, fetal and neonatal mortality and morbidity[26]. In this study, pregnant women with high pre-pregnancy BMI and assisted by

Table 7 Binary logistic regression model showing the independent variables related to moderate/high impact of oral health on quality of life during the third trimester of pregnancy

	B	*P*	Adjusted OR	95% CI
Final model				
Presence of periodontitis	1.79	0.007	6.00	1.60–22.38
Constant	−0.28	0.451		

Variables which did not remain in the final model: maternal body mass index (BMI); arterial hypertension; gestational weight gain; regular dental care by a professional.
Adjusted OR, adjusted odds ratio; B, coefficient; *P*, significance level.

the Brazilian public health-care system showed a higher prevalence of hypertension than those with a normal pre-pregnancy BMI (*Table 2*). This finding corroborates a previous study by our research team, wherein pregnant women with a high pre-pregnancy BMI and assisted by a private health-care system also presented a higher prevalence of hypertension during their third trimester[20]. Similarly to the aforementioned research, the high maternal BMI in this study was the independent variable that remained on the final model of logistic regression explaining the presence of hypertension during pregnancy (*Table 5*).

The association between high BMI and hypertension can be explained based on the inflammatory mediators that act in both disorders. Hypertension is related to vascular inflammation and endothelial disturbance[20,28,29]. Vascular inflammation involves the release of inflammatory mediators that increase vascular permeability and promote cytoskeletal changes in the endothelial cells, which in turn cause an imbalance between vasodilation and vasoconstriction. Inflammatory mediators exacerbate vasoconstriction, further causing an increase in blood pressure. This dysfunction is more evident during pregnancy as a result of hormonal changes[20].

Comprehensive prenatal care should consider the biological aspects inherent to gestation and the family, as well as the social and economic determinants of health, in order to ensure integrated, humanised and high-quality care[30]. The Brazilian Ministry of Health noted that all pregnant women should have at least one dental visit during prenatal care, and ideally one consultation every trimester, in accordance with the guidelines of the National Oral Health Policy[13].

In this study, pregnant women with a high pre-pregnancy BMI showed a lower frequency of dental care by professionals (*Table 3*), possibly because of their low self-perception of oral health and failure to prioritise oral health over other health needs. Nevertheless, it is important to highlight that when comparing the findings of this study with those of the study by Fusco et al.[20], pregnant women assisted by the Brazilian public health-care sector seemed to report greater access to dental care (80%) during pregnancy than those assisted by the Brazilian private health-care sector (56%)[20], independent of their nutritional status. This finding reflects the effectiveness of the multiprofessional team and the integrated and interdisciplinary care offered by the Women's Health Care Program proposed by the Brazilian public health system. Furthermore, private clinics should reinforce the importance of prenatal dental care and establish partnerships with dental professionals to ensure involvement of multiprofessional teams and integrated care for those patients assisted by the private sector.

There were no intergroup differences regarding oral hygiene habits, prevalence of dental calculus and sites with BOP (*Table 3*). Nevertheless, in this study, pregnant women with a high BMI had a higher prevalence of periodontitis (*Table 3*). Moreover, high maternal BMI was the independent variable related to the presence of periodontitis (adjusted OR = 1.19; 95% CI = 1.03–1.36; $P = 0.014$) according to the final model of logistic regression (*Table 6*). This finding reinforces previous results[20,31–37].

The explanation for the aforementioned findings is that the accumulation of lipids in adipocytes and expansion of adipose tissue may initiate an inflammatory process through the production of proinflammatory cytokines and chemokines, such as tumor necrosis factor-α, interleukin-6 and CRP.[38] Therefore, patients with excessive weight present generalised inflammation, and it is possible to observe exacerbated periodontal inflammation, even with a small amount of dental plaque, ultimately leading to periodontal destruction[38,39].

The pregnant women with a high BMI not only showed a higher prevalence of periodontitis during pregnancy, but also presented a higher impact on oral health-related quality of life according to the OHIP-14 (*Table 5*). They showed greater impact related to the following OHIP-14 dimensions: physical pain; psychological discomfort; physical disability; and psychological disability. The final model of logistic regression confirmed that the presence of periodontitis is directly associated with a moderate or a high impact on quality of life (*Table 7*). It is important to highlight that the OHIP-14 shows how oral health impacts quality of life according to the patients' perception, through analysis of each of the seven dimensions proposed by this instrument. Nonetheless, quality of life is a subjective condition and several factors can influence it[40]; therefore, all health determinants and systemic changes should be considered for a better understanding of this variable, as performed in this study with respect to BMI.

Our results suggested that although there is high access to dental services, the multiprofessional teams of the Brazilian public health-care system still need better strategies to offer integrated treatment to patients presenting with any systemic compromise during pregnancy, such as high BMI and hypertension, to ensure health and better quality of life for both mother and child.

This study had some limitations. The cross-sectional design does not ensure cause-and-effect comprehension. Therefore, a longitudinal study, with a large sample size, should be conducted. As for the study by Fusco et al., monitoring the participants before pregnancy was not possible, and the pre-pregnancy weight and BMI parameters were obtained from the patients' medical records, which could have resulted in variability and subjectivity of the data. In addition, the absence of dental-plaque data is a limitation of this study, which makes it impossible to compare the oral hygiene habits of the patients. Moreover, the levels of inflammatory mediators and hormones were not evaluated; this should be performed to improve the strength of future studies.

Despite the aforementioned limitations, this study presents an important contribution to the scientific literature because participants had access to dental services during pregnancy. Nevertheless, greater focus on patients with systemic alterations during pregnancy is needed because pregnant women with a high BMI have a higher prevalence of hypertension and worse periodontal conditions in the third trimester, and consequently suffered a greater impact on their quality of life, than pregnant women with a BMI in the normal range.

CONCLUSION

Pregnant women with excessive weight, assisted by the Brazilian public health-care system, presented a higher prevalence of arterial hypertension, worse periodontal conditions, and consequent high impact on their quality of life during the third trimester, than pregnant women with a BMI in the normal range. The analysis of quality of life revealed that pregnant women with excessive weight reported greater physical and psychological impact.

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