

Changes in Oral Health-Related Quality of Life during Pregnancy

José Antonio Gil-Montoya (✉ jagil@ugr.es)

University of Granada: Universidad de Granada <https://orcid.org/0000-0002-8691-5003>

Ximena Leon-Rios

Universidad de Granada

Tania Rivero

Universidad de Granada

Manuela Expósito-Ruiz

University of Granada: Universidad de Granada

Iñigo Perez-Castillo

University of Granada: Universidad de Granada

María José Aguilar-Cordero

University of Granada: Universidad de Granada

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Abstract

Purpose

To evaluate the evolution of perceived quality of life in relation to oral health during pregnancy and to determine the risk factors involved in this process.

Methods

A follow-up study was carried out with pregnant Spanish women. Two oral examinations and an oral health-related quality of life (OHRQoL) assessment, using the OHIP-14 questionnaire, were performed in the first and third trimester of pregnancy. Data on sociodemographic characteristics, medical history, O'Sullivan Test measures, oral hygiene habits, history of caries, and periodontal status of participants were collected through structured medical-dental questionnaires.

Results

A complete dataset comprising 246 pregnant women was available for analysis. Overall scores for negative impacts on the OHIP questionnaire were significantly higher during late pregnancy (74%). This indicated a deterioration in oral health-related quality of life amongst participants. Items describing "painful aching", "self-consciousness", "unsatisfactory diet", and "interrupted meals" showed the greatest increase between the first and third trimester of gestation. Multivariate analysis showed that pre-gestational/gestational diabetes mellitus and poor oral hygiene habits during the first trimester of gestation were directly associated with worse oral health-related quality of life during the third trimester of gestation (hyperglycemia: OR: 2.86; 95% CI: 1.019-8.050; $p=0.043$ / Oral Hygiene: OR: 1.33; 95% CI: 0.970-1.836; $p=0.076$).

Conclusions

In the present research, hyperglycemia during pregnancy and poor oral hygiene habits during the first trimester of gestation led to a higher risk of poor oral quality of life during late pregnancy.

Plain English Summary

Physiological changes occurring during pregnancy may influence oral health-related quality of life in pregnant women. The identification of risk factors related to oral health status during early pregnancy could prevent deteriorations in quality of life during late pregnancy. We conducted a follow-up study with pregnant Spanish women. Oral health-related quality of life was assessed during the first and third trimesters of gestation using the OHIP-14 questionnaire. Negative responses to items of the questionnaire were clearly more prevalent during late pregnancy. This implies a reduction in oral health-related quality of life amongst participants. Gestational and pre-gestational diabetes mellitus, and poor oral hygiene during the first trimester of gestation were the main determinants of decreased oral health-related quality of life during late pregnancy.

Introduction

Pregnancy is a physiological process characterized by increased levels of sexual hormones which strongly influence the periodontal status of women[1]. Periodontal disease is a common chronic inflammatory condition which originates following infection and results in breakdown of the periodontium[2]. When inflammation is confined to the soft tissue, it is called gingivitis. Untreated gingivitis may develop into periodontitis, which results in a loss of connective tissue and bone around the teeth[2]. The direct effect exerted by progesterone and estrogens on periodontal tissues, in combination with changes in oral hygiene habits during pregnancy can lead to the development of gingivitis and periodontal disease[1,2] but, also, to increased prevalence of caries, tooth erosion, and the development of benign tumors such as *epulis fissuratum* or xerostomia (dry mouth sensation)[3]. These hormones act upon receptors located in certain groups of periodontal cells, inducing gingival microvasculature and gingivitis[3]. This type of gingivitis is similar to plaque-induced gingivitis, with the exception that large amounts of bacterial plaque are not always present[4]. In addition to gingivitis, periodontitis is also frequent amongst pregnant women, although statistics on prevalence depend on the different definitions used in the scientific literature[5], ranging from 0%[6] to 61%[7].

The concept of oral health was conceived by Locker *et al.* It was first defined as the conceptual model of oral health and describes the way in which disease promotes the deterioration of oral health its impact on well-being[8]. Several authors have observed a relationship between changes in oral health during pregnancy and decreased oral health-related quality of life (OHRQoL)[9-11]. Oral health assessment is conducted not only by means of clinical exploration but also using OHRQoL questionnaires which are widely employed by researchers, sponsors and health professionals. Some of these questionnaires are designed to target specific populations, namely, the Geriatric Oral Health Assessment Index[12] and the Child Oral Health Quality of Life Questionnaire[13], whilst others focus on evaluating the general adult population, such as the Oral Health Impact Profile (OHIP). These assessment tools aim to evaluate the functional and psychological impact that diseases in the oral cavity have on patients. They cover aspects such as pain perceptions, eating difficulties, sleeping disorders or self-consciousness[14]. Specifically, the short version of the OHIP questionnaire (OHIP-14) has been extensively used in different populations, such as with pregnant women[9,10,15-18]. It has also been validated within a Spanish population[19]. However, there is a scarcity of longitudinal prospective studies analyzing change at different time points[20,21].

OHRQoL assessment runs parallel to clinical explorations. This is particularly valuable during pregnancy given the multiple changes that women experience in their mood and pain perceptions, amongst other aspects[1]. Studies on this subject have observed that pregnant women often have decreased quality of life associated with periodontal disease[10] and caries[9]. Educational level and economic status have also been found to negatively impact OHRQoL[22,23]. However, results are not always consistent[16]. Most of the studies conducted to date in this field had a cross-sectional design and did not consider women's status prior to gestation, during early pregnancy, or at different time points throughout gestation. It is, therefore, not possible to establish a causal relationship between oral health and quality of life, nor is

it possible to discount the likelihood that other variables may have an impact on OHRQoL. Follow-up from early pregnancy onwards is required, alongside analysis of variables that might impair OHRQoL, in order to identify at-risk groups within which it would be interesting to implement early preventive measures to tackle decreased OHRQoL[18].

Besides the effects that periodontal disease can exert on pregnant women's health, the association between periodontal disease, pregnancy and perinatal outcomes such as preterm delivery, low birth weight and preeclampsia, is a subject that has drawn great attention from the scientific community in recent years[24]. Although results from these studies are not conclusive, preserving and promoting oral health during pregnancy should be prioritized in routine care[24].

For these reasons, we aimed to evaluate the evolution of oral health-related quality of life during pregnancy, in addition to analyzing the risk factors that may influence this change.

Materials And Methods

This study was nested within a wider research project following-up on pregnant women, however, it was fully independent in both the design and execution of the oral examination and other measurements. The study was approved by the Ethics Committee of the University of Granada (reference 72-2015) and conducted in accordance with the principles of the Declaration of Helsinki, updated in Fortaleza, Brazil, in 2003.

Sample and setting

Participants were recruited through the Gynecology and Obstetrics Service of the Virgen de las Nieves University Hospital Complex in Granada, Spain. This complex houses a medical center which was responsible for a total of 2,956 deliveries in 2019. Women were recruited during 2018-2019 and were followed-up from week 10-12 of gestation to weeks 30-32. Women were invited to participate in the present study during their first prenatal routine appointment. In order to be included in the present research, women had to be aged >16 years old, in the 10th, 11th or 12th week of gestation at study start, and sign an informed consent form. Women were excluded if they were unable to sign informed consent, possessed any disability that impeded study participation, were pregnant with twins, had less than six teeth or had been treated for periodontal disease in the last six months. Finally, 295 women met inclusion criteria for the present research.

Oral Health Related-Quality of Life Assessment

OHRQoL was assessed during the first and third trimesters of gestation (weeks 10-12 and 30-32) using the OHIP-14 questionnaire. This questionnaire is a subjective oral health measurement that has proven to be an accurate, valid and reliable clinical tool (Cronbach $\alpha=0.88$)[25]. The OHIP-14 consists of 14 items which pertain to the frequency of adverse impacts on patient's oral status during the previous months. It is assessed on a 5-point Likert scale (0 = never, 1 = hardly ever, 2 = occasionally, 3 = fairly often and 4 =

very often) with potential final scores ranging from 0 to 56 and higher scores indicating poorer oral health. This tool was developed based on the conceptual model defined by Locker[8] and focuses on seven domains: functional limitations, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicaps. These items represent a hierarchy of factors which have the potential to increasingly and negatively impact aspects of everyday life.

Oral Examination and Data Collection

Two trained dentists with experience in OHIP-14 assessment and periodontal disease examination (>80% inter-rater reliability for clinical attachment level, plaque index and OHIP assessment) performed all clinical measures at both follow-up timepoints. Oral examination was performed at the obstetrics and gynecology service office, under artificial light, using disposable dental mirrors and a “University of North Caroline” periodontal probe. Examinations followed WHO guidelines[26]. Data on self-reported oral hygiene habits (tooth brushing, and use of mouthwash and floss), routine dental examinations and history of caries (DMFT index) were collected. In order to diagnose active non-plaque-induced gingivitis, “bleeding on probing (BOP)” (absence or presence of bleeding after probing to assess gingival inflammation) was assessed and oral hygiene was measured according to the Sillness and Löe plaque index[27]. Finally, clinical attachment loss and periodontal pocket depth was measured for each tooth, except for the third molar, in order to evaluate periodontitis. Cases of periodontitis were defined in line with Tonetti MS *et al.* [28]. This states that periodontitis is present when epithelial clinical attachment loss (vestibular-palatal) is > 3 mm and periodontal pocket depth is ≥ 3 mm in two or more teeth. Accordingly, gingivitis was defined as gingival inflammation with presence of bleeding when probing pockets with a depth of < 3mm[28].

Other socio-demographic variables such as age, level of education and employment status, body mass index (BMI), unhealthy habits (smoking), history of previous pregnancies and deliveries, obstetric history, and prescribed medication were collected at recruitment. During week 24 of gestation, participants were screened for gestational diabetes mellitus via the O’Sullivan test. Upon positive O’Sullivan’s test results (hyperglycemia in pregnancy), cases of gestational diabetes mellitus were diagnosed using the glucose challenge test.

Participant Follow-Up

During the first prenatal visit, all participants underwent an oral health examination, where they were also provided with oral health information in relation to oral diseases and conditions which could be experienced during pregnancy. The Spanish public health system closely follows-up pregnant women during their pregnancy through three routine prenatal visits to obstetrics and gynecology services (weeks 12, 24 and 32 of gestation). Women were assessed a second time during their last prenatal visit to the hospital. Here, their periodontal status was recorded, in addition to any changes in the number of teeth or the emergence of new caries. Women who underwent dental treatment or dental cleaning during the follow-up period were excluded from the study.

Statistical Analysis

Qualitative variables were described as absolute frequencies and percentages. Numerical variables were described as mean and standard deviation or median and interquartile range whenever data were non-normally distributed. Normality of continuous variables was evaluated using the Kolmogorov-Smirnov test. Differences in characteristic of participants and oral health during the first and third trimesters of gestation were evaluated using bivariate analysis. The McNemar test was used to analyze qualitative variables. Student's paired t-tests or the Wilcoxon signed-rank test were used for quantitative variables, depending on normality test outcomes.

OHIP was analyzed by calculating three summary variables, as suggested by Slade *et al.*, [29]:

- Prevalence: The percentage of respondents reporting one or more impacts "fairly often" or "very often." This variable identifies those whose oral health impacts are chronic rather than transitory.
- Extent: The number of items reported "fairly often" or "very often."
- Severity (overall score): The sum of the response codes for the 14 items. This considers impacts experienced at all frequency levels. Given the response codes, this score can range from 0 to 56, higher values indicate more frequent impacts.

No cut-off points for the OHIP-14 have been identified to identify patients at risk of poor oral health. Thus, to ease the interpretation of results, "severity" (defined as the sum of the scores obtained for the 14 items) was categorized using the median split, as described by Locker *et al.*[30], for bivariate and multivariate analyses (median= 12.0, range: 10-18). "Extent" was categorized by a "0" if there were no negative answers, or "1" if there was at least one negative answer. Crude odds ratios (OR) and their 95% confidence intervals (95% CI) were calculated to analyze the association between each variable and oral health status during the third trimester of gestation. Variables with a *p* value <0.10 following crude analyses were adjusted in the multivariate model. The selection criterion was based on a "backward stepwise selection" process, with variables producing a *p* value >0.10 being excluded at each step. We evaluated the contribution of each variable to the model using the likelihood-ratio test.

Results

Finally, data were available from 246 pregnant women who completed follow-up (83.4 % acceptance rate). A total of 23 women did not complete the OHIP-14 questionnaire during the first trimester of gestation, whilst 26 were lost to follow-up. Fourteen of those lost to follow-up were lost due to failure to attend their third trimester appointment at the Maternal and Child Hospital for personal reasons not related to problems in the oral cavity. The remaining 12 women had a high-risk pregnancy and were consequently admitted to the fetal medicine unit.

Participant oral hygiene habits and characteristics are shown in Table 1. Mean participant age was 31.1± 5.8. A total of 22 women had pre-gestational diabetes mellitus or developed gestational diabetes during

the study. Almost 80% of participants were working at the time of study and only 12% were regular smokers. More than 82% of participants had completed high school or higher academic study.

Differences in OHIP assessment of oral health and gingival inflammation between the first and third trimester of gestation are shown in Table 2. Prevalence of negative impacts (percentage of women who answered “frequently” or “always” to one or more items) was clearly higher during the third trimester of gestation (74%). This implies worse oral health-related quality of life amongst participants at this stage. The “extent” of these impacts was also significantly different between gestational trimesters, although “severity” (mean = 13.1; SD: 5.2) was not significantly different. Periodontal status during pregnancy worsened considerably between the first and third trimester of gestation, with average percentages of periodontitis and gingivitis increasing from 5.3% to 30.9%, and 37.5% to 64.5%, respectively.

Analysis of each separate OHIP item is presented in Table 3. “Painful aching in mouth” and “interrupting meals” were the items that suffered the biggest increase in terms of negative impacts between the first and third trimester of gestation (prevalence). Items pertaining to “handicap” and “difficulty at performing daily activities due to oral health conditions” were not responded to, either because the question was difficult to understand, or because these items did not present any concern to respondents (Table 3). The percentage of women reporting negative impacts in relation to the item pertaining to “self-consciousness” was especially high in comparison to other items (36.6% in the first trimester and 47.2% in the third trimester of gestation).

Following multivariate analysis, hyperglycemia during pregnancy and plaque indices emerged as risk factors predicting the severity of negative impacts during the third trimester of gestation (adjusted OR=2.86 [1.01-8.05] and =1.33[0.97-1.83], respectively). Prevalence had a protective effect on severity during late pregnancy following adjustment (Table 5).

Discussion

Studies evaluating changes in oral health-related quality of life during pregnancy are lacking, with most of the studies conducted to date having a cross-sectional design and analyzing only one trimester of gestation. In the present research, we conducted a follow-up study of pregnant women and observed clear oral-health related quality of life detriment during early pregnancy, alongside significant decreases in oral-health related quality of life during late pregnancy. Moreover, we observed that hyperglycemia during pregnancy was associated with higher severity of negative impacts during late pregnancy. Oral hygiene during the first trimester of gestation was also associated with more severe negative impacts during the third trimester, although this association was weak.

We observed a clear deterioration in participant’s oral health-related quality of life during pregnancy. The dimensions that varied the most from the first to the third trimester of gestation were “physical pain”, “psychological discomfort”, and “physical disability”. Examination of prevalence rates and scores for individual items indicated that the most common impacts were those related to physical pain and psychological discomfort, with feeling self-conscious and painful aching in the mouth being the most

prevalent. These results are in line with those observed in the general population, as shown by some national health surveys (mean severity score: 4.9) [14,29]. However, the absolute scores observed in our study of pregnant women were clearly higher (mean severity score: 13 for both first and third trimesters of gestation). Overall OHIP-14 score outcomes observed in the present research were similar to those obtained by Caracho *et al.*[15] in a study conducted with obese pregnant women (overall score: 13.5). These outcomes are also in line with those reported by Musskopf *et al.*, [20] (overall score: 12.9), however, scores were slightly higher than those obtained by Lu *et al.*[16] who reported overall scores of 7.92. These data suggest that OHRQoL in pregnant women is clearly worse than OHRQoL in the general population[10]. It should be considered that the OHIP-14 questionnaire was used as a subjective measure of the impacts of oral disorders and conditions on quality of life. It may, therefore, exclude other important items which could cause stress or concern to pregnant women. In this sense, Fakheran *et al.* [17] conducted a qualitative analyse on this subject which uncovered the importance of domains such as “dentists’ refusal to treat pregnant women”, “negative feelings towards pregnancy”, and “concerns about fetal health”.

As already mentioned, the OHIP-14 questionnaire was used as a subjective measure of the impacts of oral disorders and conditions on quality of life. The OHIP aims to evaluate the positive and negative impact of oral health on well-being, according to social, psychological and biological dimensions[8]. Some studies have shown the importance of the extent to which oral health problems are experienced by women in different occupational contexts and with different socio-economic statuses[21]. However, in the present research, occupational and socioeconomic status were not associated with oral health-related quality of life during late pregnancy.

Besides the association with hyperglycaemia in pregnancy, another remarkable finding is that women with worse oral hygiene during early pregnancy (higher plaque index values) had higher OHIP severity risk during late pregnancy. However, although typical pregnancy gingivitis is not always bacteria plaque-dependent, a greater accumulation of plaque exacerbates gingivitis[24]. In the present research, we observed higher values of bacteria plaque and an elevated percentage of women with bleeding gums, both of which are symptoms of gingival inflammation. Pregnant women considered this inflammation to be one of the main contributors to “painful aching in the mouth” [24]. Two other recent studies have produced similar results[20,22]. To the best of our knowledge, only one study has been conducted to assess OHRQoL in pregnant Spanish women. Women allocated to a preventive oral program had better OHRQoL (OHIP-14 overall score = 2.7) compared with women allocated to a control group (OHIP-14 overall score = 4.2)[22]. This program consisted of regular examinations, alongside recommendations about the prevention of dental plaque, dental cleaning and dental treatment when necessary[22]. The control group presented higher impact values regarding OHQoL in relation to OHIP items pertaining to “physical pain”, “psychological discomfort”, “physical disability”, and “psychological disability”.

On the other hand, Musskopf *et al.*[20], conducted a clinical trial with pregnant women analyzing changes in OHIP outcomes throughout gestation. Pregnant women were allocated to receive comprehensive nonsurgical periodontal therapy or a control group. Therapy consisted of dental cleaning and treatment

when needed, alongside monthly assessments of bacteria plaque up to week 24 of gestation. Meanwhile, the control group only received dental cleaning and oral hygiene advice. Both groups improved OHIP severity scores during late pregnancy, although differences between groups were not statistically significant. According to these authors, women who did not receive comprehensive periodontal therapy were at five times greater risk of having poor OHIP-14 scores during pregnancy. These results suggest that the implementation of oral health prevention programs in women at risk of poor oral health could reduce the number of negative impacts, as measured by the OHIP-14, during late pregnancy. Moreover, these programs should focus on the prevention of gingivitis and periodontitis as these are some of the main contributors to decreased oral health-related quality of life in pregnant women[35].

The present research is not exempt from limitations. Although we observed significant results, the number of pregnant women with pre-gestational or gestational diabetes mellitus was low. Thus, bigger samples are needed to be able to compare our findings. Whilst the OHIP questionnaire has been validated within a Spanish population, there are always concerns regarding the appropriate interpretation of questions by participants. The item pertaining to “has been feeling self-conscious” received the highest number of negative impacts out of all of the questions. However, we cannot be sure that all patients correctly interpreted this question. Moreover, the OHIP questionnaire was originally designed for patients to self-report their experiences over the four months prior to assessment. Despite this, women in the present research reported their experiences in relation to the 3-4 weeks prior to administration of the scale. Nonetheless, we consider that this decision to shorten the recall period will have reduced the risk of recall bias inherent to this type of study design[4]. Finally, as has been highlighted by some authors[23], socio-economic and educational status are closely associated with OHRQoL in pregnant women. This could compromise the extrapolation of our results to other populations, given that our sample belonged to a public hospital in the south of Spain which was characterized by a specific socio-economic and educational status.

Conclusions

Pregnant women with pre-gestational or gestational diabetes mellitus, as well as those with poor oral hygiene habits, during the first trimester of gestation had a higher risk of presenting decreased oral health-related quality of life during the third trimester of gestation. Health professionals and carers should place emphasis on the early identification of women at risk of oral disease. This will enable measures to be adopted early on in order to prevent the progression of disease and, consequently, improve quality of life during late pregnancy.

Declarations

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Ethics approval: This study was approved by the Ethics Committee of Granada, number 72-2015, and conducted in accordance with the principles of the Declaration of Helsinki, updated in Fortaleza, Brazil, in 2003.

References

1. Hartnett, E., Haber, J., Krainovich-Miller, B., Bella, A., Vasilyeva, A., & Lange Kessler, J. (2016). Oral Health in Pregnancy. *J Obstet Gynecol Neonatal Nurs*, *45*(4), 565-573, doi:10.1016/j.jogn.2016.04.005.
2. George, A., Johnson, M., Blinkhorn, A., Ellis, S., Bhole, S., & Ajwani, S. (2010). Promoting oral health during pregnancy: current evidence and implications for Australian midwives. *J Clin Nurs*, *19*(23-24), 3324-3333, doi:10.1111/j.1365-2702.2010.03426.x.
3. Güncü, G. N., Tözüm, T. F., & Cağlayan, F. (2005). Effects of endogenous sex hormones on the periodontium—review of literature. *Aust Dent J*, *50*(3), 138-145, doi:10.1111/j.1834-7819.2005.tb00352.x.
4. Figuero, E., Carrillo-de-Albornoz, A., Martín, C., Tobías, A., & Herrera, D. (2013). Effect of pregnancy on gingival inflammation in systemically healthy women: a systematic review. *J Clin Periodontol*, *40*(5), 457-473, doi:10.1111/jcpe.12053.
5. Manau, C., Echeverria, A., Agueda, A., Guerrero, A., & Echeverria, J. J. (2008). Periodontal disease definition may determine the association between periodontitis and pregnancy outcomes. *J Clin Periodontol*, *35*(5), 385-397, doi:10.1111/j.1600-051X.2008.01222.x.
6. Borgo, P. V., Rodrigues, V. A., Feitosa, A. C., Xavier, K. C., & Avila-Campos, M. J. (2014). Association between periodontal condition and subgingival microbiota in women during pregnancy: a longitudinal study. *J Appl Oral Sci*, *22*(6), 528-533, doi:10.1590/1678-775720140164.
7. Usin, M. M., Tabares, S. M., Parodi, R. J., & Sembaj, A. (2013). Periodontal conditions during the pregnancy associated with periodontal pathogens. *J Invest Clin Dent*, *4*(1), 54-59,

doi:10.1111/j.2041-1626.2012.00137.x.

8. Locker, D. (1988). Measuring oral health: a conceptual framework. *Community Dent Health*, 5(1), 15.
9. Moimaz, S. A., Rocha, N. B., Garbin, A. J., Garbin, C. A., & Saliba, O. (2016). Influence of oral health on quality of life in pregnant women. *Acta Odontol Latinoam*, 29(2), 186-193.
10. Geevarghese, A., Baskaradoss, J. K., & Sarma, P. S. (2017). Oral Health-Related Quality of Life and Periodontal Status of Pregnant Women. *Matern Child Health J*, 21(8), 1634-1642, doi:10.1007/s10995-016-2255-y.
11. Acharya, S. (2008). Oral health-related quality of life and its associated factors in an Indian adult population. *Oral Health Prev Dent*, 6(3), 175-184.
12. Atchison, K. A., & Dolan, T. A. (1990). Development of the Geriatric Oral Health Assessment Index. *Journal of dental education*, 54(11), 680-687.
13. Jokovic, A., Locker, D., Stephens, M., Kenny, D., Tompson, B., & Guyatt, G. (2002). Validity and reliability of a questionnaire for measuring child oral-health-related quality of life. *J Dent Res*, 81(7), 459-463.
14. Locker, D., & Quiñonez, C. (2009). Functional and psychosocial impacts of oral disorders in Canadian adults: a national population survey. *J Can Dent Assoc*, 75(7), 521.
15. Caracho, R. A., Foratori-Junior, G. A., Fusco, N. D. S., Jesuino, B. G., Missio, A. L. T., & Sales-Peres, S. H. C. (2020). Systemic conditions and oral health-related quality of life of pregnant women of normal weight and who are overweight. *Int Dent J*, 70(4), 287-295, doi:10.1111/idj.12547.
16. Lu, H. X., Xu, W., Wong, M. C., Wei, T. Y., & Feng, X. P. (2015). Impact of periodontal conditions on the quality of life of pregnant women: a cross-sectional study. *Health Qual Life Outcomes*, 13, 67, doi:10.1186/s12955-015-0267-8.
17. Fakheran, O., Keyvanara, M., Saied-Moallemi, Z., & Khademi, A. (2020). The impact of pregnancy on women's oral health-related quality of life: a qualitative investigation. *BMC Oral Health*, 20(1), 294, doi:10.1186/s12903-020-01290-5.
18. George, A., Ajwani, S., Johnson, M., Dahlen, H., Blinkhorn, A., Bhole, S., et al. (2015). Developing and Testing of an Oral Health Screening Tool for Midwives to Assess Pregnant Woman. *Health Care Women Int*, 36(10), 1160-1174, doi:10.1080/07399332.2014.959170.
19. Montero-Martín, J., Bravo-Pérez, M., Albaladejo-Martínez, A., Hernández-Martín, L. A., & Rosel-Gallardo, E. M. (2009). Validation the Oral Health Impact Profile (OHIP-14sp) for adults in Spain. *Med Oral Patol Oral Cir Bucal*, 14(1), E44-50.
20. Musskopf, M. L., Milanesi, F. C., Rocha, J. M. D., Fiorini, T., Moreira, C. H. C., Susin, C., et al. (2018). Oral health related quality of life among pregnant women: a randomized controlled trial. *Braz Oral Res*, 32, e002, doi:10.1590/1807-3107bor-2018.vol32.0002.
21. Lamarca, G. A., Leal, M. o. C., Leao, A. T., Sheiham, A., & Vettore, M. V. (2012). Oral health related quality of life in pregnant and post partum women in two social network domains; predominantly home-based and work-based networks. *Health Qual Life Outcomes*, 10, 5, doi:10.1186/1477-7525-10-5.

22. Martínez-Beneyto, Y., Montero-Martin, J., Garcia-Navas, F., Vicente-Hernandez, A., Ortiz-Ruiz, A. J., & Camacho-Alonso, F. (2019). Influence of a preventive program on the oral health-related quality of life (OHRQoL) of European pregnant women: a cohort study. *Odontology*, *107*(1), 10-16, doi:10.1007/s10266-018-0356-3.
23. Lamarca, G. A., Leal, M. o. C., Leao, A. T., Sheiham, A., & Vettore, M. V. (2014). The different roles of neighbourhood and individual social capital on oral health-related quality of life during pregnancy and postpartum: a multilevel analysis. *Community Dent Oral Epidemiol*, *42*(2), 139-150, doi:10.1111/cdoe.12062.
24. Bobetsis, Y. A., Graziani, F., Gürsoy, M., & Madianos, P. N. (2020). Periodontal disease and adverse pregnancy outcomes. *Periodontol 2000*, *83*(1), 154-174, doi:10.1111/prd.12294.
25. Slade, G. D. (1997). Derivation and validation of a short-form oral health impact profile. *Community Dent Oral Epidemiol*, *25*(4), 284-290, doi:10.1111/j.1600-0528.1997.tb00941.x.
26. Organization, W. H. (2013). Oral health surveys: basic methods - 5th edition. (5th Edition ed.). France: WHO.
27. SILNESS, J., & LOE, H. (1964). PERIODONTAL DISEASE IN PREGNANCY. II. CORRELATION BETWEEN ORAL HYGIENE AND PERIODONTAL CONDITON. *Acta Odontol Scand*, *22*, 121-135, doi:10.3109/00016356408993968.
28. Tonetti, M. S., Greenwell, H., & Kornman, K. S. (2018). Staging and grading of periodontitis: Framework and proposal of a new classification and case definition. *J Periodontol*, *89 Suppl 1*, S159-S172, doi:10.1002/JPER.18-0006.
29. Slade, G. D., Nuttall, N., Sanders, A. E., Steele, J. G., Allen, P. F., & Lahti, S. (2005). Impacts of oral disorders in the United Kingdom and Australia. *Br Dent J*, *198*(8), 489-493; discussion 483, doi:10.1038/sj.bdj.4812252.
30. Locker, D., Matear, D., Stephens, M., Lawrence, H., & Payne, B. (2001). Comparison of the GOHAI and OHIP-14 as measures of the oral health-related quality of life of the elderly. *Community Dent Oral Epidemiol*, *29*(5), 373-381, doi:10.1034/j.1600-0528.2001.290507.x.
31. Wandera, M. N., Engebretsen, I. M., Rwenyonyi, C. M., Tumwine, J., Astrøm, A. N., & Group, P-E. S. (2009). Periodontal status, tooth loss and self-reported periodontal problems effects on oral impacts on daily performances, ODP, in pregnant women in Uganda: a cross-sectional study. *Health Qual Life Outcomes*, *7*, 89, doi:10.1186/1477-7525-7-89.
32. Genco, R. J., & Borgnakke, W. S. (2020). Diabetes as a potential risk for periodontitis: association studies. *Periodontol 2000*, *83*(1), 40-45, doi:10.1111/prd.12270.
33. Kumar, A., Sharma, D. S., Verma, M., Lamba, A. K., Gupta, M. M., Sharma, S., et al. (2018). Association between periodontal disease and gestational diabetes mellitus-A prospective cohort study. *J Clin Periodontol*, *45*(8), 920-931, doi:10.1111/jcpe.12902.
34. Abariga, S. A., & Whitcomb, B. W. (2016). Periodontitis and gestational diabetes mellitus: a systematic review and meta-analysis of observational studies. *BMC Pregnancy Childbirth*, *16*(1), 344, doi:10.1186/s12884-016-1145-z.

35. Ferreira, M. C., Dias-Pereira, A. C., Branco-de-Almeida, L. S., Martins, C. C., & Paiva, S. M. (2017). Impact of periodontal disease on quality of life: a systematic review. *J Periodontal Res*, 52(4), 651-665, doi:10.1111/jre.12436.

Tables

Table 1. Participant characteristics (n=246)	
	First trimester of gestation
Characteristic	n(%); mean(SD)
Age	31.1 (5.8)
Educational level	
Elementary School	40 (16.2)
High school/Professional training	91 (36.9)
Higher education or above	115 (46.7)
Smoker	31 (12.6)
Positive O’Sullivan’s test result (week 24 of gestation) (Gestational/Pre-gestational diabetes mellitus)	22 (8.9)
Number of teeth ^a	26.9 (4.8)
DMFT Index ^b	8.6 (5.6)
Dental cleaning performed in the last six months	81 (32.9)
Frequency of daily tooth brushing	
Once per day	101 (41.1)
Two or more times per day	145 (58.9)
Use of mouthwash	
Does not use mouthwash regularly	158 (64.2)
Uses mouthwash regularly	88 (35.8)
Use of dental floss	
Never uses dental floss	189 (76.8)
Uses dental floss only during pregnancy	18 (7.3)
Uses dental floss regularly	39 (15.9)
^a Third molars were considered	
^b Caries Index: Number of teeth with caries + permanent teeth with fillings + absent teeth	

Table 2. Evolution of OHIP, oral hygiene and gingival inflammation during pregnancy			
Variable	OHIP	OHIP	- p value
	First trimester	Third trimester	
Prevalence ^a n (%)	133 (54.1)	182 (74.0)	- p<0.001 ^d
Extent ^b (Me[P ₂₅ -P ₇₅])	1 [0-1]	1 [0-2]	- p<0.001 ^e
Severity ^c (Me[P ₂₅ -P ₇₅])	12[9-17]	12 [10-18]	- 0.679 ^e
Dental Plaque Index (Me[P ₂₅ -P ₇₅])	1.24[0.64-2]	2[1.59-2.96]	- p<0.001 ^e
Gingival Bleeding Index (Me[P ₂₅ -P ₇₅])	35.3[10.32-59.37]	65[48.27-78]	- p<0.001 ^e
^a Percentage of women who answered “frequently” or “always” to one or more items. ^b Median and interquartile range of items answered “frequently” or “always”. ^c Median and interquartile range of OHIP overall scores ^d McNemar test ^e Wilcoxon test			

Table 3. Prevalence and severity of impacts throughout pregnancy, according to individual OHIP-14 items.						
OHIP item	Prev ^a first trimester n(%)	Prev ^a third trimester n(%)	p value ^b	Sever ^c first trimester (Me[P ₂₅ -P ₇₅])	Sever ^c third trimester (Me[P ₂₅ -P ₇₅])	p value ^d
<i>Functional limitation</i>						
Had trouble pronouncing words	1 (0.4)	1 (0.4)	0.101	1[0-1]	0[0-1]	0.057
Felt that sense of taste worsened	20 (8.1)	29 (11.8)	0.222	2[1-2]	2[1-2]	0.932
<i>Physical pain</i>						
Had painful aching in mouth	16 (6.5)	38 (15.4)	p=0.002	1[0-2]	1[0-2]	0.986
Food caused discomfort	25 (10.2)	32 (13.0)	0.381	2[0.75-2]	2[1-2]	0.153
<i>Psychological discomfort</i>						
Has been feeling self-conscious	90 (36.6)	116 (47.2)	p=0.018	2[2-4]	2[2-4]	0.016
Has felt tense	41 (16.7)	47 (19.1)	0.566	2[1-2]	2[1-2]	0.167
<i>Physical disability</i>						
Diet has been unsatisfactory	10 (4.1)	34 (13.8)	p<0.001	1[0-2]	2[0-2]	0.011
Has had to interrupt meals	6 (2.4)	0	p=0.014	0[0-1]	0[0-1]	0.308
<i>Psychological disability</i>						
Finds it difficult to relax	1 (0.4)	0	0.156	0[0-1]	0[0-1]	0.503
Has been a bit embarrassed	2 (0.8)	7 (2.8)	0.180	0[0-1]	1[0-1]	0.037
<i>Social disability</i>						
Has been irritable with people	2 (0.8)	6 (2.4)	0.289	0[0-1]	0[0-1]	0.136
Has had difficulty performing usual tasks	0	0	-	0[0-1]	0[0-0]	p<0.001

<i>Handicap</i>						
Has found life less satisfying	0	0	-	0[0-1]	0[0-0]	0.145
Has been totally unable to function	0	0	-	0[0-0]	0[0-0]	p<0.001
<p>^a Percentage of participants reporting 'fairly often' or 'very often' to at least one item</p> <p>^b McNemar test</p> <p>^c OHIP-14 overall score</p> <p>^d Wilcoxon test</p>						

Table 4. Bivariate analysis of study variables and OHIP outcomes during the third trimester of gestation.

Variables	Oral Health-related Quality of Life (OHIP-14)					
	Prevalence during the third trimester		Extent during the third trimester (>1 vs ≤1)		Severity during the third trimester (>12 vs ≤12)	
	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
Age	0.99(0.94-1.04)	0.729	1.00(0.96-1.05)	0.744	1.00(0.96-1.05)	0.749
Educational level						
Elementary/Primary and high/secondary school	1	0.982	1	0.558	1	0.815
College or above	0.99(0.53-1.83)		1.18(0.66-2.10)		0.93(0.54-1.61)	
Smoking habit	0.71(0.31-1.62)	0.424	0.83(0.37-1.86)	0.660	0.79(0.37-1.70)	0.553
Gestational/pre-gestational diabetes mellitus	0.86(0.32-2.34)	0.780	1.38(0.56-3.43)	0.480	2.45(0.95-6.31)	0.062
BMI	0.98(0.95-1.01)	0.272	0.99(0.96-1.02)	0.771	0.97(0.94-1.00)	0.119
Use of floss						
Never	1	0.210	1	0.375	1	0.573
Only during pregnancy	3.20(0.71-14.39)	0.129	1.95(0.73-5.16)	0.177	1.52(0.57-4.04)	0.392
Frequently	1.55(0.67-3.58)	0.306	1.22(0.59-2.48)	0.583	1.28(0.64-2.56)	0.472
Regularly uses mouthwash	1.31(0.71-2.41)	0.381	1.12(0.65-1.93)	0.673	1.06(0.63-1.79)	0.818
Dental cleaning performed in the last six months	0.916(0.502-1.672)	0.774	1.00(0.57-1.74)	0.994	1.01(0.59-1.72)	0.971
Number of teeth	1.05(0.99-1.12)	0.052	1.00(0.95-1.06)	0.737	1.00(0.95-1.05)	0.962
DMFT Index in the first trimester	1.00(0.95-1.05)	0.830	0.99(0.95-1.04)	0.938	0.99(0.95-1.04)	0.889
Plaque Index in the first trimester	1.29(0.92-1.82)	0.128	1.31(0.97-1.78)	0.078	1.37(1.02-1.85)	0.033
Gingival Bleeding Index	0.99(0.98-	0.454	1.00(0.99-	0.915	1.00(0.99-	0.464

in the first trimester	1.00)		1.00)		1.01)	
Negative impacts in the first trimester (prevalence)	0.96(0.54-1.71)	0.908	0.77(0.46-1.30)	0.340	0.62(0.37-1.03)	0.066
Extension in the first trimester	0.97(0.75-1.26)	0.860	0.84(0.65-1.09)	0.202	0.80(0.63-1.02)	0.082
Extension in the first trimester (>1 vs ≤1)	0.79(0.39-1.59)	0.513	0.71(0.36-1.42)	0.343	0.58(0.30-1.12)	0.108
Severity in the first trimester	0.99(0.94-1.04)	0.730	0.97(0.92-1.02)	0.254	0.95(0.91-0.99)	0.040
Severity in the first trimester (>12 vs ≤12)	0.77(0.43-1.36)	0.370	0.64(0.37-1.09)	0.103	0.52(0.31-0.87)	0.012
BMI, body mass index; DMFT, Caries Index: Number of teeth with caries + permanent teeth with fillings + absent teeth						

Variables	OR	95% CI	p value
Gestational/pre-gestational diabetes mellitus	2.86	1.01-8.05	0.046
Prevalence in the first trimester	0.61	0.34-1.07	0.089
Plaque Index in the first trimester	1.33	0.97-1.83	0.076
OR, adjusted OR; p value, significance level			