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The effects of pregnancy on oral health, salivary ph and flow rate

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Abstract

Background The frequent occurrence of dental caries and periodontal diseases in women during pregnancy may be due to many factors, such as salivary variables. The aim of this study was to evaluate the effects of pregnancy on salivary pH, flow rate, the DMFT index, and CPI sores.

Methods A total of 198 volunteers (pregnant in different trimesters and non- pregnant) were included for the present observational cross-sectional study. Data about sociodemographic characteristics and dental and systemic health conditions were recorded. Unstimulated saliva samples were collected for 5 min via the spitting method. The pH of the saliva was measured by a portable pH meter. The salivary flow rate was determined by the weight measurement method. The DMFT index and CPI were determined. The statistical evaluation was performed using Robust ve Poisson Regression analyses ($p<0.05$).

Results It was determined that there was a gradually significant decrease in the Ph value from the first trimester to the third trimester during pregnancy, which was lower than the control group. ($p<0.001$) The flow rate of pregnants in their third trimester was lower than that of first trimester ($p=0.017$). The CPI scores of pregnant women were significantly greater than that of non-pregnants ($p=0.042$), while the DMFTs were similar among all groups.

Conclusion Our findings indicate that pregnancy leads to a notable reduction in unstimulated salivary pH and flow rate, which also has a detrimental impact on periodontal health.

Trial registration Clinical Trials-ID: NCT06343337; Registration Date: 04.01.2024.

Keywords Periodontal diseases, Dental caries, Saliva, Pregnant woman

Introduction

The basic physiological changes that occur during pregnancy affect the oral health of women as well as their general health [1]. Pregnancy causes modifications in the immune system, which can affect the body's ability to respond to oral infections. This may lead to a greater susceptibility to periodontal diseases. Although physiological and hormonal changes increase susceptibility to periodontal diseases and dental caries, which are among the most common health problems in society, the results obtained from studies on this subject are controversial [1]. The frequent presence of these diseases during pregnancy may be due to many factors, such as the accumulation of dental plaque, differences in microbial

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composition, changes in the amount of saliva, and decreases in pH [2–4]. Increases in the levels of steroid hormones, especially during pregnancy, decrease the resistance of the gingiva to periodontal pathogens and increase gingival vascularity and blood flow, causing pregnancy gingivitis [5–7].

Dental caries is a multifactorial infectious disease characterized by mineral loss in dental hard tissues [8]. During pregnancy, calcium loss occurs in the hard tissues of the teeth, similar to the bones, through the pulpal route, and the concentration of calcium and phosphate in the saliva also decreases [9]. As a result of the decrease in calcium and phosphate levels in oral fluids, minerals pass from the teeth to the saliva in order to maintain the ion balance in the environment. Meanwhile, demineralization occurs in the dental hard tissues [3].

Many environmental factors, such as nutrition, oral hygiene habits, socioeconomic status, educational status, and the amount and quality of saliva, play roles in the development of caries [8]. One reason why dental caries are more common during pregnancy is changes in the amount and content of saliva. Although some studies have shown that the salivary glands are affected by pregnancy, as in other exocrine glands, others have reported that the amount of saliva and its flow rate do not change significantly during this period [7, 10, 11].

In the literature, there are many controversial results regarding whether the amount and quality of saliva change during pregnancy, how they change during different trimesters of pregnancy, and how these changes affect tooth and periodontal diseases. For this reason, this study aimed to evaluate the salivary pH, flow rate, caries incidence, and periodontal status of pregnant and non-pregnant women in different trimesters.

Methods

Study design

The experimental design of this cross sectional study was in accordance with the STROBE statement. The study was retrospectively registered at ClinicalTrials.gov (NCT06343337).

Human ethics and consent to participate

This study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was received for this research from the Ethics Committee of Health Sciences of Mugla Sitki Kocman University (Report no: 2021/21-VII). Written informed consent was obtained from the participants involved in the study.

Study size

"The power analysis was conducted using G*Power V3.1.9.7. Considering the effect sizes for saliva flow rate and pH values from the reference study [3] , the effect size for saliva flow rate was found to be 0.27 and for pH it was 0.39. Using Cohen's recommended medium effect size of 0.3, the sample size was calculated. With a 95% confidence level (1-α), a 95% test power (1-β), and an effect size of f=0.3, the minimum required number of cases to be included in the study was determined to be 196. The study was completed with a total of 198 participants, and according to the Post Hoc power analysis, the power of the test was determined to be 95.3%."

Participants

Between 2021 and 2023, volunteer pregnant women in different trimesters (for study groups) and non-pregnant women (for the control group) aged 18–35 years, who were treated at the Obstetrics and Gynecology Outpatient Clinic of the Faculty of Medicine at Mugla Sitki Kocman University in Mugla, Turkey, were included in this study. Patients were selected for randomization based on their registration numbers. Specifically, those with even-numbered registration numbers were preferred. This method was employed to ensure a systematic approach to participant selection, reducing potential biases that could arise from other randomization methods. By using even-numbered registration numbers, the selection process became more straightforward and structured, facilitating an easier way to identify and include participants in the study. After the patients were briefly informed about the study face to face and verbally, those who agreed to participate were included. Individuals with severe systemic disease, those who used drugs that directly affect the salivary flow rate (e.g., antihypertensive, diuretic, psychotherapeutic, and antiarthritic medications), and those who used cigarettes or alcohol were excluded from the study.

Data sources/measurement

Oral health questionnaire and assigning to groups

New oral health questionnaire and assessment forms were developed based on the WHO's reports [12] for this study. Questions were asked about participants' sociodemographic characteristics, systemic health conditions, eating habits, dental care routines, and oral and dental problems, and the data were recorded. Interviews with the participants and intraoral examinations were conducted by researchers OCD and FY, respectively. Additionally, the gestational weeks of pregnant women were queried, and they were assigned to study groups (1st trimester: 1–12 weeks, 2nd trimester: 13–26 weeks, 3rd trimester: 27th week to birth), while non-pregnant women who are in the first three days of their menstrual period were assigned to the control group. The recruitment of participants continued until the desired number was reached.

Saliva collection and measurements

To evaluate the salivary flow rate and pH, the unstimulated saliva of the participants was collected in a glass tube at least 1 h after breakfast, between 10:00 and 11:00 in the morning, at 23 °C at room temperature with 61.5% humidity for 5 min using the spitting method by researcher OCD**.** Before beginning the saliva collection process, those who felt hungry or thirsty were allowed to drink water and eat, but then they were asked to brush their teeth, and saliva collection started 1 h later. During sample collection, individuals were allowed to sit in a comfortable position with their head forward and mouth slightly open, and they were asked not to speak. Samples were collected in sterile, dry, preweighed deionized glass test tubes. Analysis of pH was performed using a calibrated benchtop pH meter (Hanna Instruments®, HI 2211, Woonsocket, RI, USA) within half an hour of sample collection to prevent degradation of the saliva. The salivary flow rate was determined by the weight measurement method using sensitive scales (Shimadzu, AW220, Japan). To determine the net saliva amount, the tare weight of the container tube was subtracted from the saliva-filled gross weight and divided by 5, and the flow rate per minute was determined in g/min or l/min considering a salivary density equal to 1 g/cm^3 with an uncertainty of ± 0.001 rpm (Flow rate = gross weight-bare weight/5 min). The obtained data were recorded. The salivary pH and flow rate measurements were made by a blind researcher (SEH) who was unaware of the subjects' groups.

Oral examination and determination of DMFT and CPI

The caries experience and periodontal status of the participants were determined by the researcher (FY) who had undergone standardization and calibration training in accordance with the recommendations and criteria of the World Health Organization [12]. Caries experience was measured by the DMFT index (total number of decayed, missing, and filled teeth) using dental mirror, dental explorer. The Community Periodontal Index (CPI) values used to determine periodontal health status were scored between 0 and 4 (0: healthy periodontal conditions; 1: gingival bleeding on probing; 2: calculus and bleeding; 3: periodontal pocket 4–5 mm; and 4: periodontal pocket ≥ 5.5 mm) using WHO periodontal probe.

Statistical methods

The collected data from all groups were imported to the Statistical Package for Social Sciences (SPSS) for Windows software, version 25.0 (IBM, Armonk, NY: IBM Corp.). Standard descriptive methods, such as the mean, standard deviation, median, frequency, minimum and maximum were applied to determine the characteristics of the sample. The data were first evaluated using the Kolmogorov–Smirnov test to evaluate distribution normality. Since the data were not normally distributed, they were evaluated using Robust and Poisson Regression analyses. The significance level was set at $p < 0.05$.

Results

Descriptive data

The sociodemographic characteristics, systemic health conditions, eating habits, dental care routines, and oral and dental problems of the participants are shown in Table 1. A total of 198 participants (51 women in the control group, 47 women in the 1st trimester group, 51 women in the 2nd trimester group, and 49 women in the 3rd trimester group) were included in this study (Fig. 1).

Results concerning the determination of predictors for pH

The results of the robust regression analysis for determining the predictors of unstimulated salivary pH are presented in Table 2. Since the group variable is categorical, it has been included in the model as a dummy variable. According to data, an increase in age reduces the pH value by 0.011, and the obtained coefficient is statistically significant ($p = 0{,}035$). When considering the first trimester as a reference, the pH value is 0.217 lower in the second trimester and 0.243 lower in the third trimester, while it is 0.363 higher in the control group compared to those in the first trimester ($p < 0.001$). When the educational levels of the participants are evaluated, when those who graduated from primary school are taken as a reference, the pH value was found to be 0.364 higher in those with a master's/doctorate degree compared to those who graduated from primary school. The pH value was 0.105 lower in drug users compared to non-users ($p = 0.004$); 0.114 lower in floss and interface brush users compared to non-users ($p = 0.006$); and 0.107 higher in mouthwash users compared to non-users ($p = 0.019$). As a result of the model created, the R2 value of the Ph value was determined as 32.61%.

For the regression model, the variables of systemic disease, health insurance, tooth brushing frequency, mouthwash use, sugary/acidic foods consumed per day, presence of indispensable foods and beverages, and dry mouth sensation were excluded from the model by the elimination method, as they did not have a significant effect on salivary pH score as a result of robust analysis.

Table 1 Demographic data of the participants

		Control	1st trimester	2nd trimester	3rd trimester	Total	*p*
Age	Mean ± S.D	29.04 ± 6.89	28.87 ± 5.46	28.92 ± 4.12	27.84 ± 5.93	28.67 ± 5.67	0.72 (kw = 1.338)
	Med (IQR)	29 (22—35)	28 (25—33)	29 (26—31)	29 (23—31.5)	29 (24—33)	
	Min—max	20—42	18—42	20—39	18—44	18—44	
Education level	Primary school	8 (15.7%)	15 (31.9%)	13 (25.5%)	14 (28.6%)	50 (25.3%)	0.009* (cs = 21.832)
	High school	7 (13.7%)	11 (23.4%)	14 (27.5%)	19 (38.8%)	51 (25.8%)	
	University	32 (62.7%)	21 (44.7%)	23 (45.1%)	14 (28.6%)	90 (45.5%)	
	MSc-Phd	4 (7.8%)	0 (0%)	1 (2%)	2 (4.1%)	7 (3.5%)	
Health assurance	Yes	48 (94.1%)	44 (93.6%)	48 (94.1%)	44 (89.8%)	184 (92.9%)	0.821 γ
Systemic disease (non-severe)	Yes	13 (25.5%)	14 (29.8%)	11 (21.6%)	7 (14.3%)	45 (22.7%)	0.31 (cs = 3.583)
The use of drugs (that do not affect the flow of saliva)	Yes	12 (23.5%)	13 (27.7%)	6 (11.8%)	8 (16.3%)	39 (19.7%)	0.192 (cs = 4.738)
Teeth brushing frequency	2 times a day	27 (52.9%)	23 (48.9%)	24 (47.1%)	22 (44.9%)	96 (48.5%)	0.452 (cs = 8.838)
	1 times a day	18 (35.3%)	19 (40.4%)	23 (45.1%)	15 (30.6%)	75 (37.9%)	
	Less than 1 per day	5 (9.8%)	4 (8.5%)	4 (7.8%)	11 (22.4%)	24 (12.1%)	
	More than 2 times a day	1 (2%)	1 (2.1%)	0 (0%)	1 (2%)	3 (1.5%)	
Usage of dental floss/interface brush	Yes	17 (33.3%)	6 (12.8%)	7 (13.7%)	4 (8.2%)	34 (17.2%)	0.004* (cs = 13.229)
Usage of mouthwash	Yes	4 (7.8%)	8 (17%)	8 (15.7%)	6 (12.2%)	26 (13.1%)	0.532 (cs = 2.199)
Acidic food with sugar consumed daily	1 times a day or less than	36 (70.6%)	38 (80.9%)	36 (70.6%)	34 (69.4%)	144 72.7(%)	0.237 (cs = 8.009)
	3 times a day	11 (21.6%)	6 (12.8%)	9 (17.6%)	5 (10.2%)	31 (15.7%)	
	More than 3 times a day	4 (7.8%)	3 (6.4%)	6 (11.8%)	10 (20.4%)	23 (11.6%)	
Indispensable food or beverage	Yes	16 (31.4%)	15 (31.9%)	17 (33.3%)	15 (30.6%)	63 (31.8%)	0.993 (cs = 0.092)
Feeling of dry mouth	Yes	20 (39.2%)	22 (46.8%)	14 (27.5%)	22 (44.9%)	78 (39.4%)	0.191 (cs = 4.751)

S.D standard deviation, *Med (IQR)* median (25th–75th percentiles), *min–max* minimum–maximum values, *kw* Kruskal–Wallis variance analysis, *cs* chi-square test, *γ* Fisher's exact test

* $p < 0.05$ indicates statistical significance;

Results concerning the determination of predictors for salivary flow rate

Robust regression analysis results related to the determination of predictors of salivary flow rate are given in Table 3. The salivary flow rate value was 0.099 lower in the 3rd trimester group when the 1st trimester was taken as reference ($p = 0.017$). Salivary flow rates in the 2nd trimester and control groups did not differ from those in the 1st trimester group. As a result of the model created, the R2 value of the salivary flow rate value was determined as 7.06%.

Results concerning the determination of predictors for CPI scores

The results of Robust Regression analysis for determining the predictors of CPI score are given in Table 4. It was found that Increasing age increased the CPI score by 0.029 and the value obtained was statistically significant ($p = 0.004$). When those in the 1st trimester group were taken as reference, the CPI scores of those in the 2nd trimester and 3rd trimester groups did not differ compared to those in the 1st trimester group, whereas the CPI score value was 0.204 points lower in the control group compared to those in the 1st trimester group ($p = 0.042$). The CPI score of floss interface brush users was 0.278 points lower than non-users ($p < 0{,}001$). As a result of the model, the R2 value of the CPI score was determined as 16.43%.

Results concerning the determination of predictors for DMFT index

The results of Poisson Regression analyses for the determination of predictors of DMFT are given in Table 5. It was found that the increase in age and sugary acidic foods consumed per day increased the DMFT index.

Discussion

Significant pathological changes occur in the oral cavity of women during pregnancy. The influence of sex hormones on the vascular alterations observed in the gums during this time has been recognized for quite some time. Additionally, issues such as dental caries, tooth mobility, aphthous ulcers, erosion of tooth surfaces

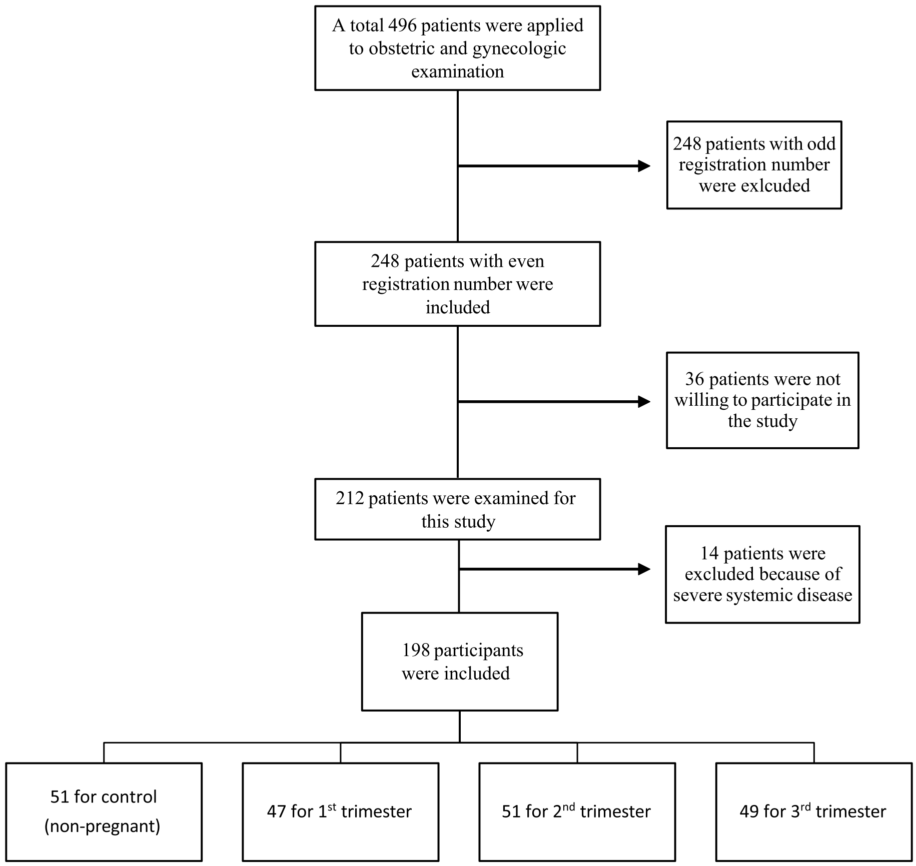

Fig. 1 Flow diagram

Table 2 Robust Regression analysis results concerning the determination of predictors for pH

	βa (%95 CI)	SE	βb	t	*p*
Age	-0.011 (-0.021: -0.001)	0.005	-0.135	-2.124	**0.035**
Group (reference: 1st trimester)					
2nd trimester	-0.217 (-0.317: -0.116)	0.051	-0.316	-4.250	**< 0.001**
3rd trimester	-0.243 (-0.345: -0.140)	0.052	-0.354	-4.661	**< 0.001**
Control	0.363 (0.259: 0.468)	0.053	0.543	6.851	**< 0.001**
Education level (reference: primary school)					
High school	-0.036 (-0.157: 0.086)	0.061	-0.053	-0.579	0.563
University	-0.107 (-0.215: 0.001)	0.055	-0.182	-1.960	0.052
MSc-Phd	0.364 (0.134: 0.593)	0.116	0.374	3.125	**0.002**
Usage of mouthwash (yes)	0.107 (0.018: 0.196)	0.045	0.148	2.371	**0.019**

$F(10.182) = 8.808$; $p < 0.001$; $R2 = \%32.61$

[a] Unstandardized Coefficient

[b] Standardized Coefficient

due to vomiting, and facial hyperpigmentation are also commonly observed.

The composition and secretion of saliva are influenced by various hormones; however, the precise mechanisms through which these hormones effect these changes remain largely unclear [12].

Unstimulated saliva is one of the most important indicators of oral health since it reflects the function of the

Table 3 Robust Regression analysis results concerning the determination of predictors for salivary flow rate

	β[a] (%95 CI)	SE	β[b]	t	*p*
Group (reference: 1st trimester)					
2nd trimester	0.058 (-0.022: 0.138)	0.041	0.119	1.429	0.155
3rd trimester	-0.099 (-0.179: -0.018)	0.041	-0.202	-2.420	**0.017**
Control	-0.018 (-0.098: 0.062)	0.041	-0.036	-0.433	0.665

$F(4.193) = 3.665$; $p = 0.007$; $R^2 = \%7.06$

[a] Unstandardized Coefficient

[b] Standardized Coefficient

Table 4 Robust Regression analysis results concerning the determination of predictors for CPI scores

	β[a] (%95 CI)	SE	β[b]	t	*p*
Age	0.029 (0.010: 0.049)	0.010	0.197	2.924	**0.004**
Group (reference: 1st trimester)					
2nd trimester	0.039 (-0.152: 0.230)	0.097	0.032	0.402	0.688
3rd trimester	0.100 (-0.096: 0.295)	0.099	0.082	1.006	0.316
Control	-0.204 (-0.401: -0.007)	0.100	-0.169	-2.046	**0.042**
Usage of dental floss/interface brush (yes)	-0.278 (-0.430: -0.126)	0.077	-0.249	-3.606	**< 0.001**

$F(6.190) = 6.226$; $p < 0.001$; $R^2 = \%16.43$

[a] Unstandardized Coefficient

[b] Standardized Coefficient

Table 5 Poisson Regression analysis results regarding the determination of predictors of DMFT

	β[a] (%95 CI)	SE	Wald's Chisquare	*p*
Age	0.024 (0.012: 0.036)	0.006	15.1	**< 0.001**
Acidic food with sugar consumed daily	0.140 (0.046: 0.234)	0.048	8.57	**0.003**

R2 = %9.91

[a] Regression Coefficient

salivary glands at rest. When it is not stimulated, it is secreted intermittently throughout the day and reflects the physiological state of the oral cavity and the whole body [13–16]. Therefore, in this study, unstimulated saliva was used to examine salivary changes. However, various studies have examined both stimulated and unstimulated saliva in the literature [13, 17]. Kullander and Soneson [18] and Migliario et al. [19] reported that salivary pH decreased during pregnancy. Rockenbach et al. [20] reported that the pH of unstimulated saliva during pregnancy was 6.7, while it was 7.5 in non-pregnant women. Similarly, when referencing the 1st trimester, the pH value was found to be 0.217 lower in the 2nd trimester, and, it was 0.243 lower in the 3rd trimester. In comparison, the control group had a pH value that was 0.363 higher than those in the 1st trimester in this study ($p < 0.001$). This significant decrease can be explained as follows. During gastroesophageal reflux, which is commonly observed in pregnancy, there is a decrease in salivary pH due to the relationship between pH and the volume of saliva and the esophagus [21, 22]. Some investigators have reported lower salivary pH as a result of the effect of progesterone on plasma bicarbonate levels during pregnancy [17]. Increased frequency of eating, differences in oral hygiene habits, and taste changes may also be reasons for lower salivary pH during pregnancy [23–25]. It was also reported that the decrease in pH was directly related to the saliva collection method [13]. Differences in pH were not significant in stimulated saliva in the third trimester compared to the first, whereas a significant association and decreased heterogeneity were reported in unstimulated saliva in all trimesters compared to the control [13]. Similarly, in this study, when the 1st trimester was taken as a reference, the unsitumulated pH value was 0.217 lower in the 2nd trimester and 0.243 lower in the 3rd trimester, while it was 0.363 higher in the control group than in the 1st trimester ($p < 0.001$). These results showed that pregnancy significantly decreased unsitumulated salivary pH.

In this study, it was found that unstimulated saliva pH was significantly affected by age, education level, and mouthwash and interdental floss use, also. In the literature, it was reported that regarding the morphology of salivary glands and the composition of saliva, age-related changes have been observed in healthy individuals similar to this study [26]. It is anticipated that individuals with higher education levels and those who use mouthwash and interdental floss have a lower risk of caries than.

others. In an oral environment with a low risk of caries, a higher salivary pH is expected as a result. When changes in the salivary flow rate during pregnancy are evaluated in studies, different results emerge. While some researchers have reported a decrease in the salivary flow rate during pregnancy [16, 19, 27, 28], Naveen et al. have reported an increase [17]. On the other hand, it was reported that no statistically significant difference was found between pregnant and non-pregnant women with respect to salivary flow rate [29]. In this study, it was determined that unsitumulated salivary flow rate of the pregnants in their 3rd trimester was lower than the pregnants in their 1st trimester. In a previous study supporting this study, it was reported that there was a significant decrease in salivary flow rate in the last trimester of pregnancy [30]. This phenomenon can be attributed to the rise in human chorionic gonadotropin levels in the body, resulting in reduced saliva production during pregnancy. Moreover, saliva's composition and flow rate are modified during pregnancy, menstruation, and menopause due to variations in steroid hormone levels. These modifications may arise from the hormonal shifts that happen during pregnancy. Although saliva secretion and its components are regulated by multiple hormones, the specific processes by which these hormones induce such changes are not well understood.

Although an increase in the probability of being affected by caries during pregnancy seems to be generally accepted, some conflicting results have been reported in the literature [13]. According to Quock [31], changes in the structure and quality of saliva, pH, flow rate, and time play important roles in caries formation [16], and the greatest changes occur in the 3rd trimester of pregnancy [31]. In fact, since the experience of caries is a long-term and multifactorial etiological condition, it cannot be said that the prevelance of caries affecting individuals increases only according to their pregnancy period. In this study, there was no statistically significant difference between the DMFT values of the study and control groups. Past studies have also reported that no significant change in the DMFT index is expected during pregnancy [31]. However, increasing age and daily consumption of sugary and acidic foods caused an increase in the DMFT index in this study. The impact of cariogenic nutrition on dental caries is a well-established fact in the literature [32–34]. On the other hand, Kunin et al. [35] reported that caries prevelance varies with age, often beginning shortly after tooth eruption but becoming less common in adulthood age in contrast to this study. It is thought that higher DMFT index data is obtained with increasing age in this study because the number of not only decayed but also missing and filled teeth increase the DMFT Index.

Female sex hormones (estrogen, progesterone, and human gonadotropin) secreted mainly by the placenta are responsible for physiological changes during pregnancy, such as changes in saliva flow, composition, pH, and hormone levels. During pregnancy, conditions such as gingival bleeding, increased gingival infection, and periodontal pocket formation, known as pregnancy gingivitis, may occur without specific plaque accumulation [36]. Although it is thought that this condition is due to hormonal changes, its etiology is still unclear [36]. Gestational gingivitis usually begins to appear in the 1st trimester of pregnancy [37]. CPI, developed by WHO, is the screening method for measuring community periodontal health. In the literature, an increase in the CPI score has been reported, reflecting the worsening of the periodontal condition with the progression of pregnancy [37–39]. In this study, although a numerical increase was observed in CPI scores from the 1st to the 3rd trimester, there was no statistically difference among trimester groups in pregnants. However, the CPI scores of pregnant women were found to be significantly greater than those of non-pregnant women similar to prior studies. According to the data obtained from the regression analysis in this study, it was found that CPI scores were affected not only by pregnancy status, but also by age and the use of dental floss and interdental brushes. Accordingly, a significant increase in CPI scores was observed with increasing age. Chellappa et al. [40] found a significant association between age and CPITN (community periodontal index and treatment needs) index similar to this study. In their research, bleeding was noted to be more common in the 18 to 35 age group, while calculus was more frequently observed in the 36 to 50 and 51 to 80 age groups [40]. It is believed that the decline in periodontal health with advancing age is related to individuals' difficulty in maintaining proper oral hygiene as they age, along with a reduction in dental visits. Indeed, participants who did not use dental floss or interproximal brushes showed an increase in CPI scores compared to those who did. In addition to toothbrushes, the use of dental floss or interproximal brushes helps mechanically clean the spaces between teeth and areas that toothbrushes cannot reach, thus maintaining the health of periodontal tissues. A current study reported that those who do not use dental floss had a higher rate of periodontal disease while there were no significant differences by interdental brush use [41]. Similarly, it has been reported that enhancing the interdental cleaning routine with dental floss leads to a reduction in gingivitis and plaque in other studies [42, 43].

The inclusion of different participants in the 1st, 2nd, and 3rd trimesters is a limitation of this study. By including different participants at each stage of pregnancy (1st, 2nd, and 3rd trimesters), results may be affected by individual differences among these participants. Each individual may have unique factors such as genetics, health conditions, lifestyle, and other variables that can influence the outcomes being measured. To minimize this issue and evaluate the effects of variables as a whole, multiple regression analysis was conducted. However, future studies that prospectively assess the same participant throughout their pregnancy will help minimize variations due to individual differences.

Conclusion

In this study, the effects of pregnancy on saliva pH, flow rate, DMFT, and CPI scores were evaluated, and other factors that could influence saliva and oral health were also assessed using multiple regression models. Changes in the salivary flow rate and pH and dental caries and periodontal diseases are the most common problems worldwide and are multifactorial. Changes in environmental factors such as sociodemographic characteristics, physiological individual factors, and general systemic health make individuals prone to oral diseases. Although pregnancy alone is not effective, it is among the etiological factors that causes periodontsal diseases and salivary disorders. In conclusion a significant decrease was found in the salivary pH during pregnancy and flow rate in the third trimester of pregnanacy. Furthermore, it was found that CPI scores of pregnant women were higher than that of non-pregnants while there was no difference between pregnant and non-pregnants according to the DMFT index.

Abbreviations

DMFT Total number of decayed, missing, and filled teeth
CPI Community Periodontal Index

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12903-024-05057-0.

Supplementary Material 1.

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Authors' contributions

FY: Conceptualization (equal); data curation (equal); formal analysis (lead); investigation (equal); visualization (equal); writing – original draft preparation (lead). OCD: Conceptualization (equal); data curation (equal); investigation (equal); visualization (equal); writing – original draft preparation (supporting). SEH: Conceptualization (equal); data curation (equal); investigation (equal); visualization (equal); writing – review and editing. BK: Conceptualization (equal); methodology (supporting); resources (equal); validation (equal); AD: Conceptualization (equal); methodology (lead); resources (equal); supervision (lead); validation (equal). All authors have read and approved the final manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was received for this research from the Ethics Committee of Health Sciences of Mugla Sitki Kocman University (Report no: 2021/21-VII). Written informed consent was obtained from the participants before they participated.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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