

## Impact of Female Sex Hormones on Periodontal Health: A Regional Awareness Assessment

Kenji Chen<sup>1</sup>, Hiroshi Yamamoto<sup>1</sup>, Jun K. Li<sup>1\*</sup>, Hao Z. Sato<sup>1</sup>

<sup>1</sup>Department of Periodontology, Faculty of Dentistry, Osaka University, Osaka, Taiwan.

\*E-mail ✉ jun.li@outlook.com

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### ABSTRACT

Periodontal health and disease are significantly influenced by sex hormones. For instance, a woman's periodontal health is impacted by puberty, menstruation, pregnancy, menopause, and the use of oral contraceptives. These events alter the periodontal microbiology by altering the vasculature and function of gingival cells, as well as the local immune system and inflammation process. Consequently, it is crucial to gauge women's knowledge about the impact of hormones on their periodontal health and to inform them of the several ways to mitigate these effects. Accordingly, the current study aims to assess the awareness and knowledge of the female population of Western Maharashtra about the impact of female sex hormones on periodontal health. This cross-sectional study was conducted among women in Western Maharashtra using a questionnaire. 15 pre-tested, validated, closed-ended questions made up this survey, which evaluated respondents' awareness and understanding of the connections between female sex hormones and periodontal health. After the subjects were given the subject information sheet, a completed consent form was obtained before they were enrolled in the study. The completed questionnaire was then collected and analyzed using SPSS 20.0 software. The results showed that the majority of the study population had low awareness (66%) about the effect of hormones on periodontal health, while the rest of the participants had moderate awareness (34%). 43% general female population knew the possible correlation between pregnancy and periodontal health. We concluded that women of Western Maharashtra are not well-informed about female sex hormones and the association between periodontal health and these factors. Therefore, to prevent periodontal diseases, a proper understanding of this association needs to be developed.

**Keywords:** Female sex hormones, Menopause, Periodontal diseases, Pregnancy, Puberty

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### Introduction

A complicated interaction between the mouth cavity's microbiota and host susceptibility leads to periodontal disease. Periodontal diseases can vary in severity and progression depending on several systemic illnesses and causes. The physiology of host-parasite interactions in the oral cavity is influenced by hormonal fluctuation, which makes sex hormones a significant factor in the pathophysiology of periodontal disorders [1]. Hormonal levels in a woman's body fluctuate continuously throughout her life, from the prepubescent, puberty, and menstrual years to the postmenopausal era.

The biological effects of hormonal oscillations on periodontal microbiology, the function and vasculature of gingival cells, the local immune system, and the inflammatory process all have an impact on a woman's periodontal health. Oestrogen promotes the growth of gingival tissue, whereas progesterone promotes vasodilation and the formation of new blood vessels [2]. This may lead to gingivitis and further to periodontitis.

Gingival tissues and the subgingival microbiota are impacted by elevated hormone levels throughout puberty, according to evidence-based findings [3]. Women's levels of *Prevotella intermedia* and *Capnocytophaga* species are reported to increase dramatically during puberty [4]. Prior research has demonstrated that periodontal disorders

can change the course of pregnancy and that pregnancy may affect periodontal health [5]. Females with polycystic ovarian disease (PCOD) have been found to have altered periodontal health [6].

The significance of female sex hormones in periodontal health is not well understood, according to recent studies done among pregnant women and gynecologists. Thus, the goal of the current study was to evaluate the general female community in Western Maharashtra's knowledge and awareness of the effects of female sex hormones on periodontal health. Numerous metabolic systems undergo dynamic changes, including hormone regulation, changes in the distribution of body fat, and changes in insulin and mental sensitivity. Additionally, it is thought that because pregnancy places a lot of strain on the thyroid gland, women who have low thyroid reserve or an iodine shortage may develop hypothyroidism [7].

## Materials and Methods

### *Study design, place of study, and participants*

Women in Western Maharashtra participated in this community-based cross-sectional survey to gauge their knowledge and awareness of the impact of female sex hormones on periodontal health.

The following formula was used to calculate the sample size:  $n = Z_{1-\alpha/2} SD^2 / (M \times \epsilon)^2$ . Participants in the study were chosen using a purposive sampling technique. 538 women in Western Maharashtra, ages 25 to 60, participated in this study. According to the updated Age Standard system (WHO 2015), this age group falls into the young age group category (25–44 years) and the middle age group category (45–60 years).

The study excluded women under 25 and over 60 years, those with communication difficulties, and women with mental disabilities.

The Krishna Institute of Medical Sciences, Deemed to be University (KIMSUDU), Karad, Maharashtra, India's Institutional Ethical Committee granted ethical clearance [Ref. No: KIMSUDU/IEC/2XI/2021]. From January 2022 to March 2022, three months, the study was carried out. Informed consent was obtained before the individuals' enrolment in the study once the subject information sheet was provided.

### *Data sources and collection procedure*

To evaluate respondents' awareness and knowledge of female sex hormones and the relationships between periodontal health and these hormones, a structured questionnaire with 15 closed-ended questions was created. The survey, which had yes/no answers, was created in English and translated into Marathi, the local language. To guarantee the validity and dependability of the questions as well as to avoid ambiguity, they were pre-tested.

Questionnaire forms were distributed by email, Facebook, Instagram, WhatsApp, and other social media sites using a Google form application.

Age, marital status, and educational attainment were among the sociodemographic questions on the data collection tool. Less than basic, basic, intermediate, and advanced education are the categories into which the International Standard Classification of Education (ISCED) divides education. Following data collection, it was determined that the study participants fell into the categories of intermediate and advanced schooling.

To ascertain knowledge and awareness regarding specific variables, such as the impact of fluctuating hormone levels on the frequency of periodontal diseases, we also posed specific questions.

### *Data analysis*

The Statistical Package for Social Sciences (SPSS) version 20.0 was used to statistically analyze the data after it was entered into an Excel sheet. The chi-square test was utilized to examine the intergroup variability after the mean and standard deviation were computed.

## Results and Discussion

The study involved 538 female participants who were between the ages of 25 and 60 years. According to an analysis of general demographic data, the young age group had a higher number of participants in both categories than the middle age group. Of the women in the research, 101 were single and 437 were married (**Table 1**).

**Table 1.** Sociodemographic variables distribution.

	<b>Group I (intermediate education)</b>	<b>Group II (advanced education)</b>
Young age (n (%)) (25-44 years)	204 (68%)	132 (55.5%)
Middle age (n (%)) (45-60 years)	96 (32%)	106 (44.5%)
Mean	29.02	42.72
SD	11.05	9.16
Married N (%)	221 (73.7%)	216 (90.8%)
Unmarried N (%)	79 (26.3%)	22 (9.2%)

SD: Standard deviation, %: Percentage

The current study evaluated the general female community in Western Maharashtra's knowledge and awareness of the impact of female sex hormones on periodontal health. The study's findings were presented as percentages in **Table 2**.

**Table 2.** Distribution of study participants' responses to the questions, presented in percentages.

	<b>Frequency (%)</b>	
	<b>Yes</b>	<b>No</b>
1. Being familiar with common gum issues such as bleeding, swelling, or redness in the gums is important for maintaining oral health.	332 (79.04%)	90 (21.42%)
2. Regularly using tools like toothbrushes, dental floss, mouthwash, or interdental brushes helps in maintaining oral hygiene.	249 (59.28%)	176 (41.90%)
3. Understanding that hormonal fluctuations can affect the condition of your gums is essential for gum care.	144 (34.28%)	278 (66.19%)
4. Knowing that during puberty, gums may become red or more prone to bleeding can help in addressing early gum issues.	146 (34.76%)	276 (65.71%)
5. Recognizing the potential link between oral health and pregnancy is crucial for overall health during this period.	181 (43.09%)	241 (57.38%)
6. Being aware that hormonal changes during pregnancy can lead to bleeding, swelling, and redness in the gums helps in managing oral health effectively.	161 (38.33%)	261 (62.14%)
7. Understanding that hormonal changes during pregnancy can increase the risk of developing a "pregnancy tumor" in the mouth is important for early detection and care.	64 (15.23%)	358 (85.23%)
8. Acknowledging that mild tooth mobility can occur during pregnancy helps in taking preventive measures.	138 (32.85%)	284 (67.61%)
9. Emphasizing the importance of maintaining extra oral hygiene during pregnancy is key to preventing gum-related issues.	275 (65.47%)	145 (34.52%)

10. Addressing gum diseases before or during pregnancy is advisable for better oral and overall health.	332 (79.04%)	90 (21.42%)
11. Noticing significant gum bleeding or redness during the menstrual cycle can indicate hormonal impacts on gum health.	71 (16.90%)	351 (83.57%)
12. Being aware that frequent use of oral contraceptive pills can increase the likelihood of gum swelling and bleeding is important for oral care.	20 (4.76%)	400 (95.23%)
13. Understanding the association between osteoporosis (porous bones) and menopause, and its impact on oral health, is crucial for long-term care.	294 (70.0%)	128 (30.0%)
14. Recognizing that women with Polycystic Ovarian Disease (PCOD) are more likely to develop gum diseases helps in early intervention.	112 (26.66%)	310 (73.80%)
15. Knowing that hormone replacement therapy during menopause can influence gum health is important for managing oral care during this stage.	94 (22.38%)	328 (78.09%)

% : Percentage

In addition to routine toothbrushing, 41% of study participants reported using other oral hygiene maintenance tools, such as floss, mouthwash, and an interdental brush.

A worrying conclusion of the current study was that only 34% of respondents knew about the impact of hormone fluctuations on periodontal health. Gingival hemorrhage during pubertal age and the menstrual period was not well known to the majority of women.

According to our research, 57% of participants were aware of the potential link between dental health and pregnancy. However, 62% of research participants knew too little about how gingivitis develops during pregnancy. Additionally, they knew very little about “pregnancy tumors,” a common clinical finding during pregnancy.

Nearly 80% of respondents said that it is wise to have gum disease treated before or throughout pregnancy, and the majority expressed anxiety about maintaining special attention to oral cleanliness.

According to the survey's findings, just 4% of research participants were aware of the link between regular use of oral contraceptives and gum disease, whilst 74% of all women were not aware of the potential reciprocal relationship between PCOD and gum disease.

73% of the study population had enough awareness of the link between osteoporosis and menopause, however, 78% of participants were not aware of how hormone replacement medication affected gum health.

As shown in **Table 3**, there was no discernible difference between the intermediate and advanced education groups' levels of awareness and knowledge, except for the finding that mild tooth mobility during pregnancy was something about which the advanced education group knew considerably more than another group ( $P = 0.004^*$ ).

**Table 3.** Level of knowledge and awareness of subjects enrolled in the study

	Intermediate education category	Advanced education category	Chi-square test value	P-value, significance
1. Being aware of gum diseases such as bleeding gums, swollen gums, and red gums is essential for maintaining good oral health.	238/300 (79.3%)	190/238 (79.8%)	Chi = 0.001	P = 0.977
2. Regular use of oral hygiene maintenance aids like toothbrushes, dental floss, mouthwash, and interdental brushes plays a significant role in preventing dental issues.	172/300 (57.3%)	146/238 (61.3%)	Chi = 0.883	P = 0.347

3. Understanding that hormonal changes can lead to alterations in gum health is important for addressing potential oral health concerns.	99/300 (33%)	83/238 (34.9%)	Chi = 0.208	P = 0.648
4. Recognizing that during puberty, gums may become red or more prone to bleeding helps in identifying and managing early gum problems.	95/300 (31.7%)	85/238 (35.7%)	Chi = 0.977	P = 0.323
5. Acknowledging the possible correlation between oral health and pregnancy is crucial for ensuring overall well-being during this period.	117/300 (39%)	108/238 (45.6%)	Chi = 2.347	P = 0.125
6. Being aware that pregnancy-related hormonal changes can cause gums to bleed, swell, and turn red is key to managing oral health during pregnancy.	109/300 (36.3%)	90/238 (37.8%)	Chi = 0.125	P = 0.724
7. Understanding that pregnancy-related hormonal changes can increase the likelihood of developing a “pregnancy tumor” in the oral cavity is important for early detection and care.	47/300 (15.7%)	31/238 (13%)	Chi = 0.747	P = 0.387
8. Knowing about mild tooth mobility during pregnancy helps in taking preventive measures to maintain oral health.	79/300 (26.3%)	90/238 (37.8%)	Chi = 8.121	P = 0.004*
9. Emphasizing the need for extra oral hygiene care during pregnancy is vital to prevent gum-related complications.	197/300 (65.7%)	160/237 (67.5%)	Chi = 0.202	P = 0.653
10. Considering it advisable to treat gum diseases before or during pregnancy is important for both maternal and fetal health.	234/300 (78%)	188/237 (79.3%)	Chi = 0.138	P = 0.710
11. Observing prominent gingival bleeding and redness during the menstrual cycle can indicate hormonal influences on gum health.	46/300 (15.3%)	32/238 (13.4%)	Chi = 0.382	P = 0.537
12. Being aware that frequent use of oral contraceptive pills can increase the tendency of gum swelling and bleeding is essential for oral care.	58/300 (19.3%)	47/238 (19.7%)	Chi = 0.015	P = 0.904
13. Understanding the association between osteoporosis (porous bones) and menopause is crucial for addressing its impact on oral health.	206/300 (68.7%)	165/238 (69.3%)	Chi = 0.027	P = 0.869
14. Recognizing that females with PCOD (Polycystic Ovarian Disease) are more likely to develop gum diseases helps in early intervention and management.	64/300 (21.3%)	63/238 (26.5%)	Chi = 1.942	P = 0.163

15. Knowing that hormone replacement therapy during menopause can affect gum health is important for maintaining oral care during this stage of life.	59/300 (19.7%)	55/238 (23.1%)	Chi = 0.942	P = 0.332
% : Percentage				

Only certain groups, such as teenage girls, pregnant women, and gynecologists, have had their knowledge and understanding of the impact of female sex hormones on periodontal health evaluated thus far. With an emphasis on evaluating knowledge and awareness about the impact of female sex hormones on periodontal health, this was the first study to be carried out in Western Maharashtra's general female population.

Swollen gums, aching gums, receding gums, loose teeth, drifting teeth, and foul breath are some of the self-reported symptoms of periodontal disease. In line with a study by Needleman *et al.* [8] and Alzammam and Almalki [9], our research revealed that the majority of study participants were aware of these findings.

The progesterone hormone level rises throughout the luteal phase of the menstrual cycle. This triggers an inflammatory reaction in the gingival tissue, making it more susceptible to plaque in the teeth [10]. According to a 2019 study by Shiba *et al.* just 4% of teenage girls who took part knew that gingival changes during menstruation might be related. 34% of the overall female population in our survey knew that gingival alterations and menstruation may be related.

Because the corpus luteum continuously produces progesterone and estrogen, these hormones are high during pregnancy [11]. Immune system changes during early pregnancy increase susceptibility to infections. These changes can be attributed to hormonal changes during pregnancy [12], inhibition of T-cell activity, reduced phagocytosis and neutrophil chemotaxis, altered lymphocyte responsiveness, reduced antibody synthesis [13], and even long-term maternal stress. 30–100% of pregnant women have pregnancy gingivitis, which is a very typical finding [14]. In a 2019 survey of the general female population in Lagos State, Nigeria, Onigbinde *et al.* [15] found that 24.3% of participants were aware of the connection between pregnancy and periodontal disease. 43% of the general female population in our survey were aware of the potential link between periodontal health and pregnancy. However, according to our research, 62% of participants were unaware of the changes in the gingiva that occur during pregnancy. These findings are comparable to a 2013 poll conducted by Tarannum *et al.* [16].

Numerous unfavorable pregnancy outcomes, including preterm birth, low birth weight, and preeclampsia—the leading causes of maternal morbidity and mortality—are known to result from high hormone levels combined with periodontal disorders. Because keeping good oral hygiene can effectively prevent these negative consequences, pregnant women's health greatly depends on maintaining good oral health during pregnancy [17]. According to several publications, maintaining dental health throughout pregnancy should be prioritized [18]. This is consistent with our research, which found that over 65% of participants expressed concern about practicing proper oral hygiene while pregnant.

During menopause, many women experience changes in their bodies brought on by the effects of estrogen deficiency. Among these alterations is osteoporosis [19]. 60% of pregnant women who participated in a 2019 study by Manickavasagam were aware of postmenopausal osteoporosis [20]. Our study found that 72% of women in the general community knew more about postmenopausal osteoporosis than these studies did.

Hyperandrogenism and polycystic ovaries are two of the hallmarks of PCOS, a complex endocrine, reproductive, and metabolic disorder [21]. Its prevalence ranges from 5 to 15% worldwide. According to a 2020 meta-analysis by Machado *et al.* [22], women with PCOS are 28% more likely to have periodontal disorders, whereas women who have periodontitis are 46% more likely to get PCOS. Gum bleeding, periodontal pocket depth, and clinical attachment loss were all higher in PCOS females with periodontal disorders than in non-PCOS females with the same conditions. The evidence that is currently available suggests that PCOS and periodontal disorders are correlated. Moreover, women with PCOD may be more susceptible to periodontal disease, according to a 2017 study by Kellesarian *et al.* [23]. According to our study, 8% of people were aware of this connection.

Oral contraceptives (OCs) can cause gingival overgrowth in otherwise healthy females and increase periodontal breakdown by decreasing resistance to dental plaque. Chronic OC usage may result in gingival hypertrophy, increased gingival inflammation, and clinical attachment loss (CAL) [24]. In their meta-analysis, Castro *et al.* [25] concluded that the severity of periodontal diseases may be correlated with the usage of hormonal contraceptives. According to 50% of gynecologists in a 2019 Al-Qahtani *et al.* [26] research of hospital gynecologists in the five

districts of Riyadh, long-term usage of oral contraceptives may cause gingival alterations. According to our research, 78% of the participants in the survey were not aware of this connection.

One of the main causes of osteoporosis in women and a potential contributor to bone loss during menopause is estrogen insufficiency. According to a 2017 survey by Ergin and Akçay [19], 90.5% of postmenopausal patients were aware of osteoporosis. In contrast, our study found that 70% of participants were aware of postmenopausal osteoporosis.

Because HRT lessens postmenopausal bone mass loss, it helps prevent osteoporosis [27]. Numerous research have tried to show the connection between HRT and periodontal disease since the condition of the alveolar bone also affects periodontal illnesses [28].

The HRT group had a lower risk of developing periodontal disorders than the non-HRT group, according to an examination of menopausal women between the ages of 45 and 74. However, 91 Italian menopausal women were assessed in a study by Lee *et al.* [29], which found that the group that did not get HRT had a higher level of plaque but that there was no difference in the depth of the periodontal pocket between the two groups. According to our research, most respondents knew very little about the connection between hormone replacement therapy and periodontal disease.

## Conclusion

A lack of information and awareness regarding the connection between female sex hormones and periodontal health among Western Maharashtra women, according to the study's limitations. Consequently, raising knowledge of this connection is essential to preventing periodontal illnesses and enhancing the systemic issues that impact women. Gynecologists, periodontists, and general dentists can work together to accomplish this, which will guarantee a woman's good periodontal health.

### *Future prospective*

The findings would be used as baseline data to pinpoint areas where the women's understanding of the impact of female sex hormones on periodontal health is lacking and to teach them different strategies to mitigate these effects. It would assist in the development of oral health education initiatives targeted at enhancing women's oral health.

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## References

1. Patil SN, Kalburgi NB, Koregol AC, Ward SB, Patil S, Ugale MS, et al. Female sex hormones and periodontal health-awareness among gynecologists - a questionnaire survey. *Saudi Dent J.* 2012;24(2):99-104. doi:10.1016/j.sdentj.2011.12.001
2. Robo I, Heta S, Agrushi E, Kapaj S, Kapaj E, Ostreni V. Gingival changes by hormonal oscillations at female patients *Ital. J Med.* 2019;4:54-65.
3. Jahan SS, Hoque Apu E, Sultana ZZ, Islam MI, Siddika N. Oral healthcare during pregnancy: its importance and challenges in lower-middle-income countries (LMICs). *Int J Environ Res. Public Health.* 2022;19(17):10681.
4. Yokoyama M, Hinode D, Masuda K, Yoshioka M, Grenier D. Effect of female sex hormones on *Campylobacter rectus* and human gingival fibroblasts. *Oral Microbiol Immunol.* 2005;20(4):239-43. doi:10.1111/j.1399-302X.2005.00222.x

5. Komine-Aizawa S, Aizawa S, Hayakawa S. Periodontal diseases and adverse pregnancy outcomes. *J Obstet Gynaecol Res.* 2019;45(1):5-12. doi:10.1111/jog.13782
6. Işık Y, Telatar GY, Neşelioğlu S, Biçer C, Gürlek B. Evaluation of periodontal status in different phenotypes of polycystic ovary syndrome in untreated patients of early reproductive age: a case-control study. *J Obstet Gynaecol Res.* 2020;46(3):459-65. doi:10.1111/jog.14179
7. Hussein K. Hypothyroidism and hypothyroxinemia in pregnancy: an overview in the time of coronavirus disease. 2019. *Pharmacophore.* 2021;12(2):22-31.
8. Needleman I, McGrath C, Floyd P, Biddle A. Impact of oral health on the life quality of periodontal patients. *J. Clin Periodontol.* 2004;31(6):454-7. doi:10.1111/j.1600-051X.2004.00498.x
9. Alzammam N, Almalki A. Knowledge and awareness of periodontal diseases among Jordanian University students: a cross-sectional study. *J Indian Soc Periodontol.* 2019;23(6):574-9. doi:10.4103/jisp.jisp\_424\_18
10. Setijanto RD, Rahayu MV, Bramantoro T, Wening GR, Rudhanton RA, Ramadhani A. et al. Gingival inflammation in 2 phases of menstrual cycle and its relation to oral hygiene of female dentistry students. *J Int Oral Health.* 2019;11(6):388-92. doi:10.4103/jioh.jioh\_232\_18
11. Markou E, Eleana B, Lazaros T, Antonios K. The influence of sex steroid hormones on the gingiva of women. *Open Dent J.* 2009;3(1):114-9. doi:10.2174/1874210600903010114
12. Smith L. Foodborne infections during pregnancy. *J Food Protein.* 1999;62(7):818-29.
13. Zachariasen D. The effect of elevated ovarian hormones on periodontal health: oral contraceptives and pregnancy. *Women Health.* 1993;20(2):21-30. doi:10.1300/J013v20n02\_02
14. Mealey L, Moritz J. Hormonal influences on the periodontium. *Periodontol* 2000. 2003;32(1):59-81. doi:10.1046/j.0906-6713.2002.03206.x
15. Onigbinde OO, Sorunke ME, Adenuga-Taiwo OA, Awotile AA. Awareness of the association between periodontal diseases and adverse pregnancy outcomes among the general female population in Lagos. *Nig J Dent Res.* 2019;4(2):106-12.
16. Tarannum F, Prasad S, Muzammil, Vivekananda L, Jayanthi D, Faizuddin M, et al. Awareness of the association between periodontal disease and pre-term births among general dentists, general medical practitioners, and gynecologists. *Indian J Public Health.* 2013;57(2):92-5. doi:10.4103/0019-557X.114992
17. Penmetsa GS, Meghana K, Bhavana P, Venkata Lakshmi M, Bypalli V, Lakshmi B, et al. Awareness, attitude, and knowledge regarding oral health among pregnant women: a comparative study. *Niger Med J.* 2018;59(6):70-3. doi:10.4103/nmj.NMJ\_151\_18
18. Sajjan P, Pattanshetti JI, Padmini C, Nagathan VM, Sajjanar M, Siddiqui T, et al. Oral health-related awareness and practices among pregnant women in Bagalkot district, Karnataka, India. *J Int Oral Health.* 2015;7(2):1.
19. Ergin A, Akçay G. The Investigation of the awareness of osteoporosis in postmenopausal women. *Glob J Obes Diabetes Metab Syndr.* 2017;4(3):068-071. doi:10.17352/2455-8583.000028
20. Senthilraja M, Cherian KE, Jebasingh FK, Kapoor N, Paul TV, Asha HS, et al. Osteoporosis knowledge and beliefs among postmenopausal women: a cross-sectional study from a teaching hospital in southern India. *J Family Med Prim Care.* 2019;8(4):1374-8. doi:10.4103/jfmprc.jfmprc\_95\_19
21. Rotterdam ESHRE/ASRM-Sponsored PCOS Consensus Workshop Group. Revised 2003 consensus on diagnostic criteria and long-term health risks related to polycystic ovary syndrome. *Fertil Steril.* 2004;81(1):19-25. doi:10.1016/j.fertnstert.2003.10.004
22. Machado V, Escalda C, Proença L, Mendes JJ, Botelho J. Is there a bidirectional association between polycystic ovarian syndrome and periodontitis? A systematic review and meta-analysis. *J Clin Med.* 2020;9(6):1961. doi:10.3390/jcm9061961
23. Kellesarian SV, Malignaggi VR, Kellesarian TV, Al-Kheraif AA, Alwageet MM, Malmstrom H, et al. Association between periodontal disease and polycystic ovary syndrome: a systematic review. *Int J Impot Res.* 2017;29(3):89-95. doi:10.1038/ijir.2017.7
24. Prachi S, Jitender S, Rahul C, Jitendra K, Priyanka M, Disha S, et al. Impact of oral contraceptives on periodontal health. *Afr Health Sci.* 2019;19(1):1795-800. doi:10.4314/ahs.v19i1.56
25. Castro MM, Ferreira MK, Prazeres IE, de Oliveira Nunes PB, Magno MB, Rösing CK, et al. Is the use of contraceptives associated with periodontal diseases? A systematic review and meta-analyses. *BMC Womens Health.* 2021;21(1):1-22.

26. Al-Qahtani A, Altuwaijri SM, Tulbah H, Al-Fouzan A, Abu-Shaheen A. Gynecologists' knowledge of the association between periodontal health and female sex hormones. *Cureus*. 2019;11(4):e4513. doi:10.7759/cureus.4513
27. Levin VA, Jiang X, Kagan R. Estrogen therapy for osteoporosis in the modern era. *Osteoporos Int*. 2018;29(5):1049-55. doi:10.1007/s00198-018-4414-z
28. De Villiers TJ, Gass ML, Haines CJ, Hall JE, Lobo RA, Pierroz DD, et al. Global consensus statement on menopausal hormone therapy. *Climacteric*. 2013;16(2):203-4. doi:10.3109/13697137.2013.771520
29. Lee Y, Kim I, Song J, Hwang KG, Choi B, Hwang SS, et al. The relationship between hormone replacement therapy and periodontal disease in postmenopausal women: a cross-sectional study of the Korea National Health and Nutrition Examination Survey from 2007 to 2012. *BMC Oral Health*. 2019;19(1):151. doi:10.1186/s12903-019-0839-9