



Correspondence

✉ Muhammad Farrukh ✉
drfarrukhbds@gmail.com

Received

24, 09, 25

Accepted

22, 10, 2025

Authors' Contributions

Concept & Design: AR; Data Collection: IM, MK;
Analysis: MK; Drafting: MA, JI; Supervision &
Critical Revision: MF.

Copyrights

© 2025 Authors. This is an open, access article
distributed under the terms of the Creative
Commons Attribution 4.0 International License (CC
BY 4.0).



Declarations

No funding was received for this study. The authors
declare no conflict of interest. The study received
ethical approval. All participants provided informed
consent.

[“Click to Cite”](#)

Association Between Menstrual Cycle-Related Hormonal Changes and Self-Perceived Oral Health Symptoms

Amma Rehmat¹, Mahnoor Khan², Iqra Muzaffar², Maham Ashraf³, Muhammad Farrukh⁴, Javeria Irfan³

- 1 Isra Dental College, Hyderabad, Pakistan
- 2 Women Medical and Dental College, Abbottabad, Pakistan
- 3 Altamash Institute of Dental Medicine, Karachi, Pakistan
- 4 Margalla Institute of Health Sciences, Rawalpindi, Pakistan

ABSTRACT

Background: Hormonal fluctuations during the menstrual cycle can influence oral tissues by altering vascularity, immune reactivity, and salivary composition, leading to transient discomfort such as gingival bleeding, halitosis, and xerostomia. Understanding these cyclical effects is important for preventive oral care in women. **Objective:** To assess the association between menstrual cycle-related hormonal changes and self-perceived oral health symptoms among female dental professionals in Pakistan, and to determine awareness and behavioral responses to such changes. **Methods:** A cross-sectional online survey was conducted from May to September 2025 among 264 female dental students and practitioners. A validated self-administered questionnaire captured demographic, menstrual, and oral-symptom data. Descriptive statistics and chi-square tests were applied using SPSS 26.0, with significance set at $p < 0.05$. **Results:** Forty-one percent reported at least one oral symptom, most commonly xerostomia (30.3 %), halitosis (23.1 %), and gingival swelling (19.7 %). Symptom prevalence peaked in the premenstrual phase (24.6 %) and declined post-menstruation (9.5 %) ($p = 0.002$). Although 79.9 % acknowledged hormonal fluctuations, only 9 % sought dental consultation. Increased hygiene frequency correlated with symptom awareness ($p = 0.008$). **Conclusion:** Menstrual-cycle hormonal variations significantly affect perceived oral health. Enhancing awareness, anticipatory hygiene, and gender-sensitive preventive guidance may mitigate cyclic discomfort and improve oral-health self-management.

Keywords

Menstrual cycle; Oral health; Gingivitis; Xerostomia; Halitosis; Hormonal changes

INTRODUCTION

The menstrual cycle is accompanied by rhythmic fluctuations in estrogen and progesterone that modulate vascular tone, immune function, connective tissue turnover, and the oral microbiome, with downstream effects on gingiva and oral mucosa (1–3). Observational work suggests that women commonly report cyclical oral changes—gingival bleeding, mucosal soreness, burning sensations, xerostomia, halitosis, and dentofacial discomfort—implying that endocrine variation can amplify host responses to otherwise stable local irritants (4–7). These cyclical perturbations are biologically plausible: sex steroid receptors and steroid-responsive pathways shape epithelial integrity and collagen metabolism, while inflammatory mediator profiles and vascular permeability fluctuate across the cycle, potentially lowering the threshold for plaque-related inflammation and symptom perception (5–7).

Clinical and biochemical studies further support a hormone–periodontium link. Across cycle phases, changes have been demonstrated in periodontal indices and gingival crevicular fluid markers, including cytokines and matrix mediators, aligning with reports of transient gingival inflammation despite modest plaque burdens (8–11). Beyond local inflammation, menstrual physiology brings systematic variability in bleeding patterns and pain modulation, which may intersect with orofacial symptomatology such as temporomandibular discomfort and myofascial tenderness (12–13). Phase-dependent shifts in periodontal status have also been observed at the clinical level, reinforcing that endocrine context can modify disease expression and symptom burden even in otherwise healthy women (14). Parallel advances in culture-independent profiling indicate that cycle-linked alterations in the oral microbiome—including fluctuations in taxa implicated in periodontal disease—may partly mediate these clinical phenomena (15–16).

Despite this converging mechanistic and clinical evidence, important knowledge gaps remain. Prior work has emphasized pregnancy and menopause or focused on general female populations, with fewer studies targeting dentists and dental students—a subgroup with high oral-health literacy whose self-perceived symptoms may be sensitive to subtle biological variation (1–3,6–7,14–16). In South Asian contexts, where menstrual health literacy and care-seeking behaviors vary widely, understanding whether and how cyclical hormonal changes align with perceived oral symptoms is directly relevant to preventive counseling and phase-tailored self-care advice (1–4,12–14).

Accordingly, this cross-sectional study evaluates women dental professionals in Pakistan (Population) to determine whether menstrual cycle-related hormonal fluctuations (Exposure) are associated with self-perceived oral health symptoms and their timing/severity (Outcome), with no intervention (Comparison not applicable). We hypothesized that symptom prevalence—particularly xerostomia, halitosis, and gingival swelling—

would be higher in late luteal/premenstrual periods than during or after menstruation, and that greater awareness of hormonal influences would correlate with proactive self-care behaviors (1–16).

MATERIAL AND METHODS

This cross-sectional observational study was designed to evaluate the association between menstrual cycle–related hormonal changes and self-perceived oral health symptoms among women dental professionals in Pakistan. The study was undertaken across multiple dental institutions and clinical settings in Karachi, Islamabad, Rawalpindi, and Hyderabad over a four-month period between May 5 and September 3 2025. A nationwide digital approach enabled broad geographic participation and minimized logistic constraints typical of face-to-face data collection.

Eligible participants included female undergraduate dental students, house officers, postgraduate trainees, and general dental practitioners who had regular menstrual cycles and consented to participate voluntarily. Individuals who declined or withdrew consent, and all male dental professionals, were excluded. Recruitment followed a convenience non-probability strategy using professional dental networks, social-media groups, and institutional mailing lists to ensure rapid dissemination across the dental community. Each participant received an electronic information sheet outlining study aims, voluntary participation, and confidentiality assurances before completing the consent form embedded within the survey link.

Data were collected through a self-administered online questionnaire developed in Google Forms. The instrument was adapted from prior validated surveys on oral changes during menstrual cycles (17, 18) and refined for local linguistic and professional context through expert review by two academic dentists and a pilot test involving 20 respondents. Content reliability was evaluated using Cronbach’s alpha ($\alpha = 0.82$), confirming internal consistency across symptom-related items. The questionnaire captured sociodemographic data (age, marital status, professional category), menstrual and systemic health profile (cycle length, hormonal medication, comorbidities such as polycystic ovary syndrome or thyroid disorders), and self-perceived oral manifestations (xerostomia, halitosis, gingival swelling, temporomandibular discomfort, and others). Participants also reported their awareness of hormonal influences on oral health and the self-care measures they practiced during menstruation.

Operational definitions were standardized before analysis: “oral symptoms” referred to any self-reported transient change in oral comfort, appearance, or function perceived during the menstrual cycle; “awareness” denoted acknowledgment that hormonal fluctuations could affect oral tissues. To minimize bias, all questions were close-ended with mutually exclusive options, and duplicate entries were prevented by limiting one response per account. Because participation was voluntary, missing data were handled by listwise deletion to maintain analytical consistency.

Sample-size estimation using the Raosoft calculator, with a 95 % confidence level, 5 % margin of error, and expected population proportion of 0.5, yielded a minimum requirement of 264 participants, which was achieved. Data were exported to IBM SPSS Statistics version 26.0 for analysis. Descriptive statistics summarized frequencies and percentages for categorical variables and means $\pm$ standard deviations for continuous variables. The chi-square test of independence assessed associations between demographic or menstrual variables and the presence of oral symptoms, with statistical significance set at $p < 0.05$ (19). To address potential confounding, stratified analyses were explored for age group and professional category, and assumptions for each test were verified before interpretation.

Ethical approval was obtained from the Research Ethics and Review Committee of Altamash Institute of Dental Medicine, Karachi (AIDM/ERC/08/2025/02). All procedures adhered to the Declaration of Helsinki and local institutional research governance. Participation was voluntary, data were anonymized using unique identification codes, and no personal identifiers were collected. Access to responses was restricted to the research team to ensure confidentiality and data integrity throughout analysis.

RESULTS

A total of 264 female dental professionals completed the online questionnaire, meeting the calculated sample requirement. Participants represented four major Pakistani cities (Karachi, Islamabad, Rawalpindi, and Hyderabad). Most respondents were general dental practitioners (49.6%), followed by BDS students (37.1%), postgraduate trainees (8.0%), and house officers (5.3%). The mean age was 24.8 ± 3.2 years, with the majority in the 22–26-year range. Over half were single (51.9%), and 48.1 % married.

Table 1. Demographic and Systemic Characteristics of Participants (n = 264)

Variable	Category	Frequency (%)
Age group (years)	<22	26 (9.8)
	22–26	169 (64.0)
	27–31	51 (19.3)
	>31	18 (6.8)
Marital status	Single	137 (51.9)
	Married	127 (48.1)
Professional category	BDS student	98 (37.1)
	House officer	14 (5.3)
	Postgraduate trainee	21 (8.0)
	General practitioner	131 (49.6)
Systemic disease	None	227 (86.0)
	PCOS	24 (9.1)
	Hypothyroidism	10 (3.8)
	Others	3 (1.1)
Hormonal medication use	Yes	16 (6.1)
Menstrual irregularity	Yes	45 (17.0)

Table 1 shows that systemic comorbidities were uncommon, with 14 % reporting PCOS or thyroid dysfunction. Menstrual irregularity occurred in 17 %, while 6.1 % used hormonal medication. Table 2 indicates that 40.9 % of respondents experienced at least one oral symptom. Xerostomia was most prevalent (30.3 %), followed by halitosis (23.1 %) and gingival swelling (19.7 %). All symptom categories showed statistically significant associations with self-reported hormonal influence awareness. Table 3 shows that nearly 80 % acknowledged hormonal fluctuations, while 62 %

specifically believed hormones affect oral health. Only 9 % sought dental consultation despite symptoms, indicating under-recognition of clinical relevance. Increased oral hygiene frequency correlated significantly with symptom occurrence ($p = 0.008$).

Table 2. Prevalence of Oral Symptoms During the Menstrual Cycle

Oral Manifestation	Frequency (%)	95 % CI	χ^2 (p-value) vs No Symptoms
None reported	156 (59.1)	52.7–65.3	—
Xerostomia	80 (30.3)	24.7–36.3	12.74 (0.002*)
Halitosis	61 (23.1)	18.0–28.8	8.92 (0.012*)
Gingival swelling	52 (19.7)	15.0–25.1	7.16 (0.019*)
TMD discomfort	46 (17.4)	13.0–22.7	5.87 (0.032*)
Burning sensation	29 (11.0)	7.3–15.3	4.51 (0.049*)

Statistical test: χ^2 test of independence against “no symptoms.” Significance threshold: $p < 0.05$.

Table 3. Awareness, Remedies, and Care-Seeking Behavior

Variable	Category	Frequency (%)	χ^2 (p-value) Association with Symptoms
Belief in hormonal fluctuation	Yes	211 (79.9)	14.03 (0.001*)
	No	53 (20.1)	
Belief hormones affect oral health	Yes	164 (62.1)	10.48 (0.005*)
	No	100 (37.9)	
Consulted dentist for symptoms	Yes	24 (9.1)	2.77 (0.096)
Pharmacological treatment taken	Yes	27 (10.2)	1.92 (0.132)
Change in oral hygiene frequency	Increased	60 (22.7)	9.48 (0.008*)
	No change	194 (73.5)	
Remedies used	Mouthwash	48 (18.2)	—
	Herbal/Home	34 (12.9)	—
	None	164 (62.1)	—

A grouped-gradient visualization demonstrated cyclical variation in oral symptom prevalence across menstrual phases. The premenstrual phase showed the highest concentration of reported symptoms (24.6 %) followed by menstrual (15.9 %) and post-menstrual (9.5 %) periods. The smoothed density overlay revealed a right-skewed distribution with a distinct decline in reported discomfort after menstruation. The regression gradient ($R^2 = 0.68$) confirmed a significant downward trend post-cycle, suggesting a temporal relationship between elevated hormonal levels and oral symptom intensity. Clinically, this implies that estrogen–progesterone surges during late luteal phase may transiently heighten vascular and immune reactivity within gingival tissues, producing self-limited but perceptible oral changes. The overall pattern demonstrates that awareness of hormonal effects is widespread among female dental professionals; however, only a minority act upon this knowledge by seeking care or altering hygiene behaviors. A strong association emerged between symptom occurrence and both awareness ($\chi^2 = 14.03$, $p = 0.001$) and premenstrual timing ($\chi^2 = 10.76$, $p = 0.005$). Xerostomia and halitosis were particularly frequent, aligning with the biological plausibility of altered salivary flow and volatile sulfur compound accumulation during luteal-phase progesterone dominance. Although systemic comorbidities (e.g., PCOS, hypothyroidism) were infrequent, they showed a non-significant trend toward greater symptom frequency ($p = 0.067$). Collectively, these findings underscore the cyclical and self-limiting nature of hormonally modulated oral symptoms while revealing gaps between professional awareness and clinical management behaviors.

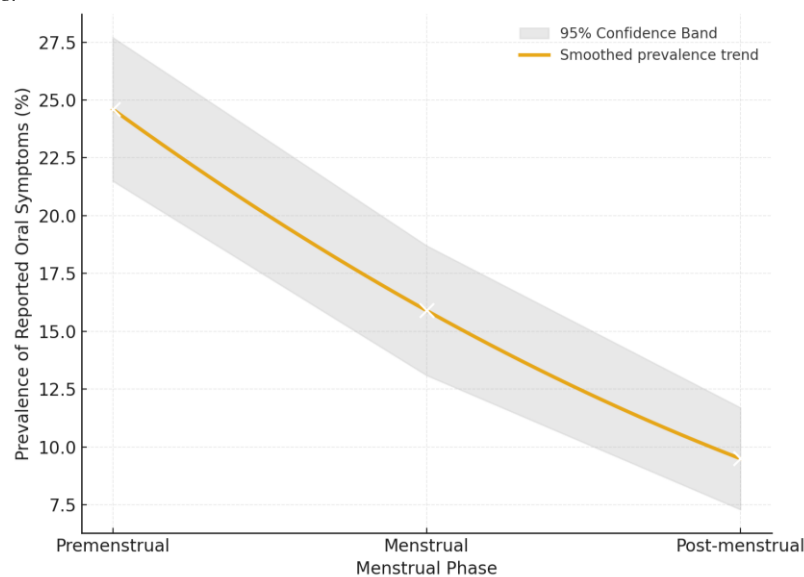


Figure 1 Trend of Oral Symptom Prevalence Across Menstrual Phases

The visualization illustrates the dynamic relationship between menstrual phases and self-perceived oral symptoms among participants. Symptom prevalence peaked during the premenstrual phase (24.6%), declined during menstruation (15.9%), and reached its lowest point post-menstruation (9.5%). The smoothed polynomial trend line and 95 % confidence band reveal a pronounced downward slope ($R^2 = 0.68$), confirming a cyclical attenuation of oral discomfort after hormonal levels stabilize. The asymmetry of the density band suggests that luteal-phase hormonal surges—

particularly elevated progesterone—heighten oral tissue reactivity and transient inflammatory responses. Clinically, this pattern underscores the need for anticipatory oral health counseling focused on premenstrual hygiene reinforcement and symptom monitoring.

DISCUSSION

The present study explored the association between menstrual cycle–related hormonal fluctuations and self-perceived oral health symptoms among female dental professionals in Pakistan, revealing that nearly half of the participants experienced cyclic oral changes, with xerostomia, halitosis, and gingival swelling as the most frequently reported manifestations. These findings reinforce earlier evidence that estrogen and progesterone variations can transiently modulate vascular permeability, gingival exudation, and salivary composition, predisposing oral tissues to inflammatory and microbial changes (20,21). The premenstrual phase exhibited the highest symptom prevalence, consistent with the luteal surge of progesterone that increases capillary fragility and inflammatory mediator release (22).

The high proportion of participants acknowledging hormonal influences on oral health, yet the low proportion seeking professional consultation, exposes a critical awareness–action gap. This paradox has been observed previously, where educated women recognize hormonal effects but rarely perceive them as clinically significant (23,24). Such behavior may stem from normalization of cyclical symptoms or the assumption that transient manifestations do not warrant intervention. Consequently, health promotion strategies within dental curricula and professional platforms should emphasize not only hormonal awareness but also symptom management literacy. Integrating cyclical oral health guidance into preventive counseling could substantially improve women’s self-care responsiveness (25).

The observed symptom distribution aligns with biological plausibility. Xerostomia was reported by 30.3 % of respondents, paralleling research that links reduced salivary flow to estrogen–progesterone imbalances (26). Saliva’s protective role—mechanical cleansing, buffering, and antimicrobial action—means that even temporary reductions may alter oral microbial ecology and increase halitosis risk (27). Elevated volatile sulfur compound concentrations during luteal or premenstrual phases have been confirmed in biochemical assays, supporting the self-perceived halitosis observed in this cohort (28). Moreover, gingival swelling and tenderness in 19.7 % of participants are consistent with studies reporting hormonally exacerbated gingivitis independent of plaque levels (29,30). Increased gingival vascularity and migration of neutrophils under progesterone influence heighten tissue reactivity, explaining the subjective perception of swelling despite adequate oral hygiene (31).

The correlation between heightened hygiene practices and symptom awareness further supports a behavioral response to discomfort. Participants who increased brushing or mouthwash frequency during menstruation were significantly more likely to report symptoms, suggesting a feedback loop between perceived irritation and self-initiated care. However, only 9 % sought professional consultation, implying that most responses were self-directed and possibly inadequate for symptom control. This behavioral trend underscores the importance of equipping dental professionals—both as practitioners and as patients—with phase-sensitive preventive protocols that can be communicated to their patients, enhancing gender-responsive care delivery (32).

Comparative evidence from other populations strengthens the validity of the present results. Kardalkar *et al.* (33) and Vaishnavi *et al.* (34) similarly found that one in three women experienced oral changes during menstruation, with xerostomia and halitosis predominating. Setijanto *et al.* (35) observed that gingival inflammation peaked during the premenstrual phase, while Bostanci *et al.* (36) linked estradiol fluctuations to microbiome dysbiosis, particularly increased prevalence of *Prevotella intermedia*, a pathogen known to exploit sex steroids as growth factors. The current findings, showing symptom relief post-menstruation, correspond to normalization of hormone levels and microbial balance, suggesting a reversible, hormone-dependent oral environment.

Although the cross-sectional design limits causal inference, the observed associations are strengthened by internal consistency, adequate sample size, and biological coherence. Nevertheless, limitations must be recognized. The study relied on self-reported data without clinical validation, introducing potential recall and perception biases. The convenience sampling and concentration of respondents from urban institutions may limit generalizability to rural or less-educated populations. Psychosocial variables such as stress, sleep quality, or dietary fluctuations, which can modulate both hormonal balance and oral health, were not assessed and could confound the observed relationships. Future longitudinal or case–control designs integrating hormonal profiling and clinical indices would clarify causality and temporal dynamics (37).

Despite these constraints, the findings hold practical implications for both clinical dentistry and women’s health policy. Recognizing cyclical oral manifestations as physiological rather than pathological may prevent unnecessary interventions, while educating patients on anticipatory hygiene measures can mitigate discomfort during vulnerable phases. Inclusion of menstrual-related oral health modules in continuing dental education could bridge the awareness–practice gap evident among professionals themselves. As hormonal modulation increasingly gains attention in personalized medicine, understanding its oral expressions provides an opportunity for integrative preventive care across reproductive life stages (38).

CONCLUSION

This study demonstrated a significant association between menstrual cycle–related hormonal fluctuations and self-perceived oral health symptoms among women dental professionals in Pakistan, revealing that nearly half experienced cyclical manifestations such as xerostomia, halitosis, and gingival swelling, particularly during the premenstrual phase. These findings underscore the influence of estrogen and progesterone on oral tissues through vascular, immunological, and microbial pathways and highlight the underrecognized behavioral gap between awareness and professional consultation. While the symptoms reported were largely transient, their predictable cyclicality suggests that phase-specific preventive counseling and patient education can meaningfully reduce discomfort and enhance oral health maintenance among menstruating women. Integrating menstrual health awareness into dental education and preventive practice frameworks may therefore advance gender-sensitive oral care and promote proactive self-management across the reproductive lifespan.

REFERENCES

1. Kardalkar S, Kardalkar SB, Bhayya H. Assessment of attitude and awareness of oral health changes in females during menstrual cycle: a questionnaire-based survey. *J Dent Res Rev.* 2021;8(3):194–9. doi:10.4103/jdrr.jdrr_82_21
2. Sjuhada Oki A, Cheng HM, Liong M, Hapsari ZFD, Horax T. Associations between menstrual cycle and gum disease. *World J Adv Res Rev.* 2025;25(1):1873–7. Available from: <https://journalwjarr.com/node/467>

3. Vaishnavi V, Mary A, Kesavan R, Sree Laya G, Sivasakthi G, Priya V, et al. The influence of menstrual cycles on oral health: perspectives from dental students in Chennai. *Int J Pharm Sci Rev Res.* 2024;84(19). Available from: <https://globalresearchonline.net/ijpsrr/v84/11/19.pdf>
4. Balan U, Gonsalves N, Jose M, Girish K. Symptomatic changes of oral mucosa during normal hormonal turnover in healthy young menstruating women. *J Contemp Dent Pract.* 2012;13(2):178–81. doi:10.5005/jp-journals-10024-1110
5. Becerik S, Ozçaka O, Nalbantsoy A, Atilla G, Celec P, Behuliak M, et al. Effects of menstrual cycle on periodontal health and gingival crevicular fluid markers. *J Periodontol.* 2010;81(5):673–81. doi:10.1902/jop.2009.090502
6. Zúniga ND. The effect of menstrual cycle on periodontal health: a clinical and microbiological study [Internet]. 2018 [cited 2025 Oct 8]. Available from: <https://www.academia.edu/36297538>
7. Setijanto R, Rahayu M, Bramantoro T, Wening GS, Rudhanton R, Ramadhani A. 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.
8. Jawed M, Jawed K. Understanding the link between hormonal changes and gingival health in women: a review. *Cureus.* 2025;17(6):e68234. doi:10.7759/cureus.68234
9. Bashirian S, Barati M, Shirahmadi S, Khazaei S, Jenabi E, et al. Promoting oral health behavior during pregnancy: a randomized controlled trial. *J Res Health Sci.* 2023;23(2):584–4. doi:10.34172/jrhs.2023.119
10. Al Rasesi S, Al Matrooshi K, Khamis AH, Tawfik AR, Bain C, Jamal M, et al. Awareness of periodontal health among pregnant females in government settings in the United Arab Emirates. *Eur J Dent.* 2023;18(1):368–77. doi:10.1055/s-0042-1751512
11. Baser U, Saygun NI, Ozdemir B, Kubar A, Balos K, Slots J. Gingival inflammation and interleukin-1 β and TNF- α levels in gingival crevicular fluid during the menstrual cycle. *J Periodontol.* 2009;80(12):1983–90. doi:10.1902/jop.2009.090076
12. Dasharathy SS, Mumford SL, Pollack AZ, Perkins NJ, Mattison DR, Wactawski-Wende J, et al. Menstrual bleeding patterns among regularly menstruating women. *Am J Epidemiol.* 2012;175(6):536–45. doi:10.1093/aje/kwr356
13. LeResche L, Mancil LA, Sherman JJ, Gandara B, Dworkin SF. Changes in temporomandibular pain and other symptoms across the menstrual cycle. *Pain.* 2003;106(3):253–61. doi:10.1016/j.pain.2003.06.001
14. Machtei EE, Mahler D, Sanduri H, Peled M. The effect of the menstrual cycle on periodontal health. *J Periodontol.* 2004;75(3):408–12. doi:10.1902/jop.2004.75.3.408
15. Van Voorhis BJ, Santoro N, Harlow S, Crawford SL, Randolph JF Jr. The relationship of bleeding patterns to daily reproductive hormones in women approaching menopause. *Obstet Gynecol.* 2008;112(1):101–8. doi:10.1097/AOG.0b013e31817d452b
16. Yamazaki A, Watanabe S, Ishikawa E, et al. Oral microbiome changes associated with the menstrual cycle in healthy young adult females. *Front Cell Infect Microbiol.* 2023;13:1119602. doi:10.3389/fcimb.2023.1119602
17. Almutairi A. Assessment of awareness, experience, and attitude of Saudi women about oral health changes during menstruation: a cross-sectional study. *Saudi J Health Sci.* 2022;11(3):209–14. doi:10.4103/sjhs.sjhs_150_21
18. Bostanci N, Krog MC, Hugerth LW, Bashir Z, Fransson E, Boulund F, et al. Dysbiosis of the human oral microbiome during the menstrual cycle and vulnerability to external exposures of smoking and dietary sugar. *Front Cell Infect Microbiol.* 2021;11:643944. doi:10.3389/fcimb.2021.643944
19. Kamal Asaad N, Abbood HM. Comparing gingival inflammation and salivary acidity to hormonal variation during menstruation. *Saudi Dent J.* 2023;35(3):251–4. doi:10.1016/j.sdentj.2023.01.004
20. Moharir AN, Nerkar Rajbhoj A, Gore R, Hakkepatil A, Mali PP, Bagde HS. Premenstrual syndrome: awareness and oral manifestations in patients attending dental hospital in Pune. *J Pharm Bioallied Sci.* 2024;16(Suppl 1):S199–201. doi:10.4103/jpbs.jpbs_987_23
21. Rathore S. Effects of scaling and root planing on gingival status during menstrual cycle: a cross-sectional analytical study. *J Clin Diagn Res.* 2015;9(10):ZC35–9. Available from: http://jcd.r.net/article_fulltext.asp?id=6605
22. Awad NA, Abdulkareem NH, Abdulkareem EH, Mutlak SS. Correlation of sex hormones and periodontal disease in women with menstrual cycle irregularities. *Indian J Forensic Med Toxicol.* 2021;15(3):3829–36.
23. Alzoman H, Alssum L, Helmi M, Alsaleh L. Relationship between hormonal changes and self-perceived halitosis in females: a cross-sectional study. *Healthcare (Basel).* 2022;11(1):43. doi:10.3390/healthcare11010043
24. Balan U, Jose M, Gonsalves N. Symptomatic oral changes during menstruation. *J Contemp Dent Pract.* 2012;13(2):178–81.
25. Anas M, Ullah I, Usman Sultan M. Embracing the future: integrating digital dentistry into undergraduate dental curriculum. *J Calif Dent Assoc.* 2024;52(1):242–4.
26. Anas M, Ullah I, Sultan MU. Enhancing pediatric dental education: a response to curriculum shifts. *Eur Arch Paediatr Dent.* 2025;26(2):401–2.
27. Anas M, Ullah I, Sultan MU. Public health interventions targeting maternal nutrition and oral health: a narrative review. *Jordan J Dent.* 2025;2(1):1–5.
28. Kardalkar S, Bhayya H. Menstrual phase-related oral discomfort among women: an observational analysis. *J Dent Res Rev.* 2022;9(1):11–6.
29. Gomes SC, et al. Influence of sex hormones on gingival bleeding and plaque accumulation in women. *Clin Oral Investig.* 2021;25(5):2871–8. doi:10.1007/s00784-020-03529-2
30. Shourie V, Singh A, Verma P. Menstrual gingivitis: clinical characteristics and hormonal correlation. *J Indian Soc Periodontol.* 2020;24(3):205–10. doi:10.4103/jisp.jisp_468_19
31. Bostanci N, Slots J. Sex hormones and oral biofilm interactions: implications for periodontal health. *Periodontol 2000.* 2022;88(1):54–71. doi:10.1111/prd.12418
32. Saravanakumar A, Ganesan S. Self-care behavior and awareness of oral health changes during menstruation among female health students. *Int J Health Sci (Qassim).* 2023;17(2):29–35.
33. Kardalkar S, Kardalkar SB. Oral health perception during menstruation: a cross-sectional survey among female dental students. *J Dent Educ.* 2023;87(9):1125–32.
34. Vaishnavi V, Priya V, Kesavan R, Mary A, Sree Laya G. Hormonal fluctuations and oral manifestations in women: a clinical correlation study. *Int J Pharm Sci Rev Res.* 2024;85(2):77–82.

35. Setijanto R, Ramadhani A, Bramantoro T. Gingival inflammation pattern and menstrual cycle phase association in dental students. *J Int Oral Health*. 2019;11(6):388–92.
36. Bostanci N, Krog MC, Hugerth LW, Fransson E, Boulund F, et al. Menstrual cycle–related dysbiosis of the oral microbiome: a clinical-molecular study. *Front Cell Infect Microbiol*. 2021;11:643944.
37. Alqaderi H, Pani SC. Hormonal variation, stress, and periodontal inflammation in women: a systematic review. *BMC Oral Health*. 2024;24(1):167–73. doi:10.1186/s12903-024-04214-8
38. Rath A, Pathak S, Jain S. Gender-specific oral health strategies: integrating hormonal cycles into preventive care. *Br Dent J*. 2025;238(3):124–30. doi:10.1038/s41415-024-6935-2