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ORIGINAL RESEARCH **OPEN ACCESS**

Periodontal disease and preterm birth in Piura, Peru: a case–control study

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ABSTRACT

Background: The association between maternal periodontal disease and preterm birth varies across populations and periodontal case definitions. **Objective:** To evaluate the association between periodontal disease and preterm birth among postpartum women in Piura, Peru, and explore associations with maternal age and student status. **Methods:** A facility-based case–control study included 25 women with preterm delivery and 25 controls with term delivery, recruited by convenience sampling. Periodontal examinations assessed probing depth and clinical attachment loss. Sociodemographic characteristics were described, and associations were evaluated using two-sided Fisher exact tests. Crude odds ratios (ORs) and 95% confidence intervals (CIs) were calculated, applying the Haldane–Anscombe correction to the periodontal comparison because one cell contained zero observations. **Results:** Periodontal disease was present in 25 cases (100.0%) and seven controls (28.0%). The continuity-corrected OR was 125.80 (95% CI 6.75–2343.30; $p < 0.001$). Women aged 27–36 years had higher odds of preterm delivery than those aged 18–26 years (OR 8.14; 95% CI 2.29–28.90; $p = 0.0016$). No statistically significant association was observed for student status ($p = 0.609$). Secondary education was the most common educational level (70.0%), and 66.0% were homemakers. **Conclusions:** Periodontal disease and the older maternal age category were associated with preterm birth in this sample. The periodontal estimate was imprecise and unadjusted. These findings support further prospective investigation of periodontal health within maternal care without establishing causality.

Keywords: Orthodontics; Elastomers; Dental Materials; Beverages; Mechanical Properties.

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Introduction

Preterm birth remains a major challenge for maternal and neonatal care. In a global analysis, approximately 13.4 million infants were born before 37 completed weeks of gestation in 2020, representing 9.9% of live births. The estimated global rate changed little over the preceding decade. Its multiple causes and substantial consequences for neonatal survival and subsequent development justify investigating potentially modifiable maternal conditions.[1]

Periodontal health is relevant to this discussion because pregnancy can alter the gingival inflammatory response and because periodontal care is often considered separately from antenatal care. In a prospective Spanish cohort, periodontal and gingival disease became more frequent as pregnancy progressed, with early oral hygiene and periodontal status helping to identify women at higher risk of deterioration. The PERISCOPE study also showed that periodontal disease can be present during the first trimester without conspicuous external signs. These findings support clinical examination rather than relying exclusively on symptoms reported by the patient. [2,3]

Observational evidence has linked maternal periodontal disease with preterm delivery, although the estimated magnitude differs considerably. A nationwide Taiwanese cohort found modest increases in adjusted odds across periodontal severity categories, and a large United States claims study reported a similar positive association. Clinical studies in Sudan and Ivory Coast observed larger associations using direct periodontal assessment. Differences in population selection, exposure measurement, case definitions, and adjustment for obstetric characteristics complicate comparisons between these estimates. [4-7]

The evidence is not uniform. A prospective cohort in Spain found no statistically significant relationship between the periodontal measurements examined and preterm birth or low birth weight. A recent meta-analysis restricted to studies with clinical periodontal examinations nevertheless found an overall association, while emphasizing methodological variation and the contribution of confounding factors. [8]

A separate assessment of unmeasured confounding suggested that some pooled associations were robust under its assumptions; this does not remove the need to assess bias and confounding in each individual study. [8-10]

Evidence from clinical services in northern Peru can help describe how maternal periodontal disease and preterm birth coexist in the local care setting. The present study evaluated the association between periodontal disease and preterm birth among postpartum women attending a primary health center in Piura. Secondary objectives were to describe the participants' sociodemographic characteristics and examine the associations of maternal age category and student status with preterm birth. The study tested whether periodontal disease was more frequent among women with preterm delivery than among controls with term delivery. Its clinical purpose was to inform the assessment of maternal oral health.

Materials and methods

Study design and setting

A facility-based case–control study was conducted at a level I-4 primary health center in Piura, Peru, during 2024. The study population comprised postpartum women attending the center during that year. Cases and controls were selected according to delivery status, and periodontal status was assessed after delivery. The report was prepared with reference to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations for case–control studies.[11]

Participants and sampling

Cases were women who had delivered before 37 completed weeks of gestation; controls were women with term delivery, classified at 37 completed weeks or later. The eligibility criteria specified women older than 18 years and younger than 36 years. Participants were selected through non-probability convenience sampling, with a target of 25 cases and 25 controls. The final sample comprised 50 women in a 1:1 case-to-control ratio. Participation was voluntary and required written informed consent.

The exclusion criteria comprised diabetes mellitus, multiple pregnancy, hypertension, systemic immunosuppression, smoking, alcohol or illicit drug use, cardiac or neurological disease, placental or cervico-uterine abnormalities, fewer than 15 teeth, and systemic antibiotic use during the last trimester of pregnancy. Medically indicated preterm delivery for maternal or fetal reasons was also excluded. Women who declined participation or requested withdrawal were not included.

Periodontal assessment

The researcher performed a clinical periodontal examination using a World Health Organization periodontal probe manufactured by Hu-Friedy and recorded the findings in a periodontal chart. The operational disease definition required at least four teeth with a probing depth of at least 4 mm at one site and clinical attachment loss of at least 3 mm in at least one tooth. The examination form distinguished no periodontal disease and mild, moderate, or severe disease, using attachment-loss thresholds of 3, 4, and 5 mm, respectively, in addition to the probing-depth requirement. The present analysis compared periodontal disease present versus absent.

These operational severity categories were not treated as the stages or grades of the 2017 World Workshop classification. That classification incorporates disease extent, complexity, and progression in addition to attachment loss; therefore, its terminology was not substituted for the categories used in the study. [12]

Before the principal examinations, inter-examiner calibration was conducted with an experienced periodontist in 15 postpartum women. Agreement across the four periodontal categories was 86.7%, and Cohen's kappa was 0.818. The same clinical assessment procedure was used for cases and controls.

Clinical records and sociodemographic variables

A standardized data collection form combined information from the clinical record with the periodontal examination. The form included general participant characteristics, obstetric information, delivery status, and periodontal findings. Maternal age was analyzed using the tabulated categories of 18–26 and 27–36 years. Educational attainment was categorized as no formal schooling, primary education, secondary education, or higher education. Occupation was recorded as no occupation, homemaker, student, or employed. Educational attainment was summarized descriptively. Secondary association analyses examined age and student status. For the latter comparison, homemakers and employed women were combined into a nonstudent category.

Statistical Analysis

Categorical variables were summarized as counts and percentages. Percentages in the descriptive table used all 50 participants as the denominator. In the case–control comparisons, percentages were calculated separately within the 25 cases and the 25 controls. Associations of periodontal disease, maternal age category, and student status with preterm birth were assessed using two-sided Fisher exact tests, with a significance threshold of 0.05.

Crude odds ratios and 95% confidence intervals were calculated from the 2 × 2 tables. The periodontal table contained no disease-free cases, so a Haldane–Anscombe correction of 0.5 was added to each cell for estimation of the odds ratio and its log-Wald confidence interval. The observed counts and percentages were retained unchanged, and the Fisher exact test used the original counts. The age and student-status odds ratios used the uncorrected counts, with the younger age category and nonstudents as the respective reference groups. All estimates were crude odds ratios. The magnitude of the periodontal estimate was interpreted cautiously because sparse cells can produce large and unstable odds ratios. [13]

Data processing used IBM SPSS Statistics version 27. The contingency-table calculations and confidence intervals presented here were computed using Python with SciPy version 1.17.0. All 50 participants contributed to both association tables.

Ethical considerations

The Comité de Bioética en Investigación of Universidad Privada Antenor Orrego approved the project through Resolution No. 0996-2024-UPAO, dated March 22, 2024. Authorization was obtained from the participating health center. The ethical procedures addressed informed consent, voluntary participation, and confidentiality in accordance with the principles of the Declaration of Helsinki. Participants received information on the purpose and procedures of the investigation, provided written informed consent, and could decline participation or withdraw voluntarily. Personal information was handled confidentially, and only aggregate results are presented.

Results

The study included 25 women with preterm delivery and 25 controls with term delivery. The descriptive and association analyses included all 50 participants.

The two maternal age categories were similarly represented. Secondary education was the most frequent educational level, while homemaking was the most common occupation. No participants were classified as

having no formal schooling, primary education only, or no occupation (Table 1).

Table 1. Sociodemographic characteristics of the postpartum women

Characteristic	n	%
Age group (years)		
18–26	26	52.0
27–36	24	48.0
Educational attainment		
No formal schooling	0	0.0
Primary education	0	0.0
Secondary education	35	70.0
Higher education	15	30.0
Occupation		
No occupation	0	0.0
Homemaker	33	66.0
Student	4	8.0
Employed	13	26.0
Total participants	50	100.0

Percentages were calculated using the total sample of 50 women. Higher education includes education beyond secondary school. Categories with zero participants are retained to show the full classification used in the data collection form. This table describes the selected case–control sample and does not estimate population prevalence.

Periodontal disease was identified in every woman with preterm delivery and in seven controls. All 18 women without periodontal disease belonged to the term-delivery group. The exact test identified a statistically significant association between periodontal disease and delivery status (Table 2).

Women aged 27–36 years accounted for 72.0% of cases and 24.0% of controls. The odds of preterm delivery were higher in this category than in women aged 18–26 years. The student-status comparison was not statistically significant (OR 0.31; 95% CI 0.03–3.16; p = 0.609), with only four students in the sample (Table 3).

Discussion

The principal finding was the higher frequency of periodontal disease among women with preterm delivery than among controls with term delivery. The association was supported by the exact test, but its magnitude requires careful interpretation: all cases had periodontal disease, and the continuity-corrected odds ratio had a very wide confidence interval. The estimate therefore describes a marked contrast in this small selected sample, rather than a precise increase in the probability of preterm birth. The maternal age comparison also identified an association, which should be considered when interpreting the periodontal result.

The direction of the periodontal association was consistent with clinical studies conducted in other settings. Shaggag and colleagues found periodontitis in 30.3% of cases and 18.2% of controls in Sudan, with an adjusted OR of 2.05. In Ivory Coast, Pockpa and colleagues reported an OR of 3.62 in a cohort assessed during pregnancy. These estimates were considerably smaller than the corrected estimate in the present study. Selection, periodontal thresholds, sample size, and the distinction between crude and adjusted analyses can contribute to this difference. [6,7]

Larger studies also support this distinction between the presence and the magnitude of an association. Lee and colleagues reported adjusted odds ratios of 1.05 and 1.09 for mild and advanced periodontal disease in Taiwan, whereas Choi and colleagues found an OR of 1.15 for preterm birth in United States claims data. Clinical investigations have used different periodontal measures: Bhavsar and colleagues associated a mean probing depth of at least 4 mm with preterm birth, and Lima and colleagues found periodontitis more frequently among preterm cases than controls in Brazil. These measures

Table 2. Periodontal disease according to delivery status

Periodontal disease	Term delivery n = 25 n (%)	Preterm delivery n = 25 n (%)	Total n (%)
Present	7 (28.0)	25 (100.0)	32 (64.0)
Absent	18 (72.0)	0 (0.0)	18 (36.0)
Total	**25 (100.0)**	**25 (100.0)**	**50 (100.0)**
Continuity-corrected OR (95% CI)		125.80 (6.75–2343.30)	
Fisher exact p-value		5.33×10^{-8}	

OR, odds ratio; CI, confidence interval. Group percentages use 25 women as the denominator; total-column percentages use 50. The OR compares periodontal disease present versus absent. A Haldane–Anscombe correction of 0.5 per cell was used for OR and CI estimation. The two-sided Fisher exact test used the observed counts.

Table 3. Maternal age and student status according to delivery status

Characteristic	Term delivery n = 25 n (%)	Preterm delivery n = 25 n (%)	Total n (%)
Age group (years)			
18–26	19 (76.0)	7 (28.0)	26 (52.0)
27–36	6 (24.0)	18 (72.0)	24 (48.0)
Crude OR (95% CI)		8.14 (2.29–28.90)	
Fisher exact p-value		0.0016	
Student status			
Student	3 (12.0)	1 (4.0)	4 (8.0)
Nonstudent	22 (88.0)	24 (96.0)	46 (92.0)
Crude OR (95% CI)		0.31 (0.03–3.16)	
Fisher exact p-value		0.609	
Total participants	25 (100.0)	25 (100.0)	50 (100.0)

OR, odds ratio; CI, confidence interval. Group percentages use 25 women as the denominator; total-column percentages use 50. Age OR: older versus younger category. Student-status OR: student versus nonstudent. Nonstudents comprised homemakers and employed women. CIs were calculated on the logarithmic scale; p-values correspond to two-sided Fisher exact tests.

and populations are not interchangeable with the binary operational definition used here. [4,5,14,15]

Contrasting findings remain relevant. Gallagher-Cobos and colleagues did not identify a statistically significant association between their periodontal measurements and preterm birth or low birth weight in a Spanish cohort. The meta-analysis by Sokos and colleagues estimated an overall crude OR of 2.38, with variability related to case definitions and study methods. The present findings fit within this heterogeneous evidence base but do not resolve its methodological differences. Clinical definitions and the timing of examination should therefore remain explicit when results are compared across studies. [8,9]

Microbiological observations offer possible explanations for a relationship without demonstrating the mechanism in this sample. Lima and colleagues found higher proportions of Fusobacterium nucleatum and Prevotella intermedia in the subgingival biofilm of women with preterm delivery. The MOHEPI study also detected differences in maternal subgingival microbiome composition between preterm and term groups, together with an association involving gingival inflammation. These findings are compatible with an oral inflammatory contribution to pregnancy outcomes, but microbial detection, systemic inflammatory activity, and placental involvement were not outcomes of the present study. [15,16]

Women in the 27–36-year category were overrepresented among cases, although this category differs from the conventional definition of advanced maternal age. Age-related differences in maternal or obstetric characteristics could influence the crude periodontal association. The student-status estimate was inconclusive, reflecting the small number of students. The predominance of secondary education and homemaking further describes the population served by the center and provides context for planning accessible oral health information.

Clinical implications should also distinguish periodontal care from proven prevention of preterm birth. In a multicenter randomized study, an advanced oral hygiene program did not significantly reduce spontaneous preterm birth overall, although oral hygiene education improved gingival inflammation in the associated dental evaluation. The PPaX trial in Malawi found fewer preterm births with periconception and antenatal xylitol chewing gum, an intervention and setting different from conventional periodontal therapy. Such findings suggest that the timing and content of care matter, but they do not justify assuming that any periodontal treatment will produce the same obstetric benefit. [17-19]

Syntheses of treatment trials reinforce that caution. Merchant and colleagues found a signal of benefit in studies combining scaling and root planing with chlorhexidine, whereas the 2024 review by Montoya-Carralero and colleagues did not establish a statistically significant preventive effect. A more recent meta-analysis of 14 trials estimated a risk ratio of 0.85, with a 95% CI of 0.71–1.02, indicating that the evidence remained compatible with no reduction. The current

observational findings support attention to maternal periodontal health but cannot identify an effective obstetric preventive intervention. [20-22]

Integrating oral assessment into maternal care has a direct rationale in maintaining oral health, even when the obstetric benefit remains uncertain. The PERISCOPE findings show why an apparently asymptomatic mouth does not exclude periodontal disease, while longitudinal evidence indicates that periodontal status can worsen during pregnancy. Access also matters: a study of barriers to dental attendance identified cost, competing priorities, time and energy constraints, absence of perceived dental problems, and dental fear. These considerations support coordinated counseling and referral, with attention to the practical circumstances of women attending primary care. [2,3,23]

Several features constrain interpretation. Convenience sampling from one health center limits generalizability, and the fixed case-to-control ratio prevents estimation of the incidence or absolute risk of preterm birth. Periodontal assessment after delivery does not establish when the measured disease began or its trajectory during pregnancy. The small sample and zero cell reduced precision, and continuity correction does not remove sparse-data bias. The analyses were unadjusted, so confounding by maternal and obstetric characteristics remains possible. The operational periodontal categories also differ from contemporary staging and grading. A larger prospective study using standardized prenatal examinations, clearly defined obstetric outcomes, and planned confounder adjustment would provide a stronger test of the observed association. [12,13]

Conclusions

Periodontal disease was more frequent among women with preterm delivery than among controls with term delivery in this case–control sample from Piura. Women aged 27–36 years also had higher crude odds of preterm delivery than those aged 18–26 years. These associations support prospective investigation of maternal periodontal health alongside established obstetric determinants.

Author Contributions Statement (CrediT)

LYB: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Visualization, Project administration, Writing – original draft, Writing – review and editing.

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Conflict of Interest

The author declares no financial or non-financial conflicts of interest related to this work.

Data Availability

The participant data are not publicly deposited because they contain confidential maternal and clinical information. Requests for access to de-identified data may be directed to the corresponding author and are subject to institutional authorization and applicable ethical and confidentiality restrictions.

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