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Oral Diseases in Pregnant Women and Low Birth Weight Risk: A Case-Control Study in Mantikulore Sub-District, Palu City, 2025

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***Abstrack*:** *Low Birth Weight (LBW), defined as birth weight less than 2,500 grams, remains a significant public health problem in Indonesia, including Palu City. Oral diseases during pregnancy are proposed as contributing risk factors. This study aimed to analyze the relationship between oral diseases in pregnant women, dental caries, gingivitis, periodontitis, and stomatitis, with LBW incidence in Mantikulore Sub-District, Palu City, 2025. An observational analytic design with a case-control approach was employed. A total of 114 respondents were recruited (57 cases: mothers delivering LBW infants; 57 controls: mothers delivering normal-weight infants). Oral health examinations were conducted using the DMF-T index (caries), OHI-S index (oral hygiene/gingivitis), and CPITN index (periodontal status); stomatitis history was assessed via questionnaire. Data were analyzed using Chi-Square tests and multiple logistic regression. Results demonstrated significant associations: high DMF-T with LBW (OR=4.14; p=0.001), poor OHI-S with LBW (OR=9.06; p=0.000), severe CPITN with LBW (OR=6.57; p=0.000), and stomatitis with LBW (OR=24.06; p=0.000). Multivariate analysis identified stomatitis as the most dominant factor associated with LBW (OR=20.19; p=0.000), followed by poor OHI-S (OR=6.94; p=0.016). The model explained 67.5% of LBW variation. Oral health of pregnant women is significantly associated with LBW; oral health screening should be integrated into routine antenatal care.*

***Keywords* :** *Pregnant women; oral health; LBW; DMF-T; OHI-S; CPITN; stomatitis; case-control.*

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INTRODUCTION

Low birth weight (LBW), defined as a birth weight below 2,500 grams irrespective of gestational age, remains a key driver of neonatal illness, death, and longer-term developmental impairment. Globally, the World Health Organization estimated about 19.8 million LBW births in 2020, approximately 14.7% of all live births, highlighting LBW as a substantial public-health burden that disproportionately affects low- and middle-income settings. In Indonesia the trend is cause for concern: the 2023 national health profile

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reported that 3.9% of weighed newborns were classified as LBW, up from 2.5% in 2022, signaling a reversal of recent gains and the need for renewed programmatic focus. The provincial picture is even more troubling: Central Sulawesi recorded an LBW rate of 5.5% in 2024, well above the national target of 2.5%, while Palu City reported 4.9% (339 LBW infants), with Mantikulore Sub-District showing an especially high proportion (16.8%, or 57 infants). Together, these data indicate persistent and localized challenges in maternal and newborn health, ranging from antenatal care quality and maternal nutrition to socioeconomic and environmental determinants, that demand targeted prevention efforts and strengthened maternal care strategies tailored to the most affected communities.

Pregnancy itself brings substantial physiological, hormonal, and immunological shifts that alter the oral environment and increase susceptibility to dental disease. Rising estrogen and progesterone levels during pregnancy enhance gingival blood flow and vascular permeability, amplify inflammatory responses, and can promote compositional shifts in the subgingival microbiota toward periodontopathogens such as Prevotella intermedia and Porphyromonas gingivalis. As a result, pregnant women are at elevated risk for dental caries, gingivitis, periodontitis, and stomatitis. Epidemiological research links periodontal disease with adverse pregnancy outcomes, including preterm birth and LBW via systemic inflammatory pathways mediated by molecules such as prostaglandin E_2 (PGE_2), interleukin-6 (IL-6), and tumor necrosis factor-alpha (TNF-α). Together, these maternal oral health changes and their systemic effects provide a plausible biological pathway by which poor periodontal health may contribute to LBW, reinforcing the importance of integrating oral health promotion into antenatal care.

Although international studies increasingly link maternal oral health to adverse birth outcomes, localized evidence for Palu City remains limited. Preliminary checks across eight Puskesmas in Palu during late 2024 found that only one facility conducted routine oral examinations for pregnant women; where screening occurred, prevalence was substantial: 44.9% of examined women had dental caries, 37.3% showed signs of gingivitis, and 17.8% had periodontitis in the fourth quarter of 2024. The uneven practice of oral screening and these high rates of oral disease underscore a gap in routine antenatal care and highlight the potential for undetected oral infections to contribute to poor birth outcomes locally. In response, this study was designed to examine the relationship between four specific maternal oral conditions, dental caries (measured by DMF-T), gingivitis (OHI-S), periodontitis (CPITN), and stomatitis, and low birth weight (LBW) in Mantikulore Sub-District, with the additional aim of identifying which condition most strongly predicts LBW within this community.

METHODOLOGY

This study employed an observational analytic design using a case–control approach, carried out in Mantikulore Sub-District, Palu City, Central Sulawesi, Indonesia, between December 2025 and February 2026. Cases and controls were identified and compared to examine associations between maternal oral diseases and low birth weight, allowing for efficient investigation of relatively uncommon outcomes while controlling for potential confounders. The research protocol emphasized systematic case definition, careful selection of controls from the same population, and standardized data collection to strengthen internal validity within the observational framework.

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The study area is served by two community health centers, Puskesmas Talise and Puskesmas Kawatuna, and covers Mantikulore, the largest sub-district in Palu at approximately 206.8 km². Mantikulore comprises eight villages with heterogeneous geographic profiles, ranging from coastal zones to mountainous terrain, which produce variation in access to health services, dietary patterns, and environmental exposures. These geographic and service-delivery differences were considered in sampling and analysis to ensure findings would reflect the sub-district's diverse contexts and to help identify location-specific factors that might modify the relationship between maternal oral health and birth outcomes.

The study's source population encompassed all live births in Mantikulore Sub-District during 2024 (n = 1,480). From this frame, cases were defined as the 57 mothers who delivered low birth weight (LBW) infants (birth weight < 2,500 g) in 2024, as identified from the Family Health Section annual report of the Palu City Health Office. For each case, one control was selected, 57 mothers who delivered normal-weight infants (≥ 2,500 g), matched on maternal age and residential area to reduce confounding by these factors. Controls were chosen through purposive sampling at a 1:1 ratio, producing a total analytic sample of 114 respondents. This matching strategy and the use of a complete case list aimed to ensure comparability between groups and to increase the study's ability to detect associations between maternal oral conditions and LBW.

Oral examinations were carried out directly by the researcher, a trained dental professional, using standardized clinical instruments (dental mirror, explorer, and periodontal probe) and validated indices to ensure objective measurement. Dental caries was measured with the DMF-T index (Decayed, Missing, Filled Teeth) and categorized as low (DMF-T ≤ 3) or high (DMF-T > 3). Oral hygiene and gingival status were assessed using the OHI-S (Oral Hygiene Index–Simplified), categorized as good (OHI-S ≤ 1.2) or poor (OHI-S > 1.2). Periodontal condition was evaluated with the CPITN (Community Periodontal Index of Treatment Needs), classified as mild (< 3) or severe (≥ 3). In addition, history of stomatitis during pregnancy was measured using a six-item validated questionnaire (Cronbach's alpha = 0.739; KR-20 = 0.672), with scoring thresholds set so that total scores of 6–8 indicated presence of stomatitis and scores of 9–12 indicated absence. These standardized clinical and questionnaire measures provided a robust basis for examining associations between specific oral disease markers and LBW.

Data processing and statistical analysis were performed using SPSS to ensure systematic and reproducible results. First, univariate analysis summarized the sample by reporting frequency distributions and descriptive statistics for all study variables, which provided a clear picture of participant characteristics and the prevalence of each oral condition. For bivariate analysis, associations between each oral disease variable (DMF-T, OHI-S, CPITN, and stomatitis) and low birth weight (LBW) were assessed using Chi-Square tests; effect sizes were expressed as odds ratios (OR) with 95% confidence intervals (CI) to quantify the strength and precision of observed relationships. Variables that met a liberal threshold of $p < 0.25$ in bivariate testing were then entered into a multivariate model to control for confounding and identify independent predictors of LBW. Multiple logistic regression with a backward stepwise Wald method was employed to derive the final set of significant predictors and to determine the most dominant contributing factor among the oral health measures.

Ethical procedures were observed throughout the study: all participants provided informed consent prior to data collection, and measures to safeguard respondent confidentiality and anonymity were maintained during data handling and reporting. Formal research permissions were also secured from the

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relevant health authorities in Palu City, ensuring that the study complied with local regulatory and institutional requirements.

RESULTS AND DISCUSSION

Before detailing the study outcomes, we first present the sample characteristics to contextualize the results and confirm the comparability of cases and controls. The following section describes the demographic profile and birth-weight classification of the 114 respondents, which provides the foundation for interpreting subsequent associations between maternal oral health and low birth weight.

1. *Sample Characteristics*

A total of 114 respondents participated (57 cases, 57 controls). The majority of mothers in both groups were of reproductive age (20–35 years): 71.9% in the case group and 78.9% in the control group. Mothers aged >35 years constituted 21.1% (cases) and 17.5% (controls), while those aged <20 years were the smallest proportion (7.0% cases, 3.5% controls). All 57 case infants had birth weight <2,500 g and all 57 control infants had birth weight ≥2,500 g, confirming balanced case-control allocation (Table 1–2).

Table 1. Distribution of Respondents by Maternal Age and Birth Weight (n=114)

Variable	Case n (%)	Control n (%)	Total n (%)
Maternal Age			
< 20 years	4 (7.0)	2 (3.5)	6 (5.3)
20–35 years	41 (71.9)	45 (78.9)	86 (75.4)
> 35 years	12 (21.1)	10 (17.5)	22 (19.3)
Infant Birth Weight			
< 2,500 g (LBW)	57 (100.0)	0 (0.0)	57 (50.0)
≥ 2,500 g (Normal)	0 (0.0)	57 (100.0)	57 (50.0)
Total	57 (50.0)	57 (50.0)	114 (100.0)

***Source**: Primary data, 2026*

2. *Bivariate Analysis*

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Dental caries (DMF-T) was markedly more common among mothers of LBW infants: of the 35 respondents with high DMF-T scores (>3), 27 (77.1%) were cases and only 8 (22.9%) were controls, whereas among 79 respondents with low DMF-T (≤3), 30 (38.0%) were cases and 49 (62.0%) were controls. Chi-Square analysis demonstrated a significant bivariate association (p = 0.001; OR = 4.14; 95% CI: 2.218–13.701), indicating that women with high cumulative caries experience had over four times the odds of delivering an LBW infant. Biologically, this relationship is plausible: untreated dental caries can progress to pulpal infection, generating chronic local and systemic inflammation with elevated mediators (IL-6, TNF-α, PGE_2) that may impair uteroplacental circulation and fetal growth; furthermore, caries-related pain can disrupt mastication and reduce nutrient intake, indirectly compromising maternal nutritional status. However, dental caries lost significance in the multivariate model (OR = 1.24; p = 0.762), perhaps because DMF-T reflects cumulative past disease rather than active inflammatory burden and therefore its effect is mediated by or confounded with indices more indicative of current oral inflammation, such as OHI-S and stomatitis.

Poor oral hygiene, as measured by the OHI-S, showed an even stronger association with LBW. Among 60 respondents with poor OHI-S (>1.2), 48 (80.0%) were cases compared with 12 (20.0%) controls; conversely, of 54 respondents with good OHI-S (≤1.2), only 9 (16.7%) were cases while 45 (83.3%) were controls. The bivariate association was highly significant (p = 0.000; OR = 9.06; 95% CI: 7.695–51.982), and OHI-S remained a significant independent predictor in multivariate analysis (OR = 6.94; p = 0.016). Poor oral hygiene fosters plaque and calculus accumulation that harbor gram-negative periodontopathogens and elicit production of LPS and proinflammatory cytokines (IL-1, IL-6, TNF-α) and PGE_2; these mediators can reach the systemic circulation, disrupt placental perfusion, and contribute to uterine activity and fetal growth restriction. Local health-system constraints—such as only two dentists serving roughly 60,000 residents in Mantikulore and limited preventive services—likely exacerbated the high prevalence of poor OHI-S observed.

Severe periodontal disease (CPITN ≥ 3) was similarly associated with LBW in bivariate analysis: of 50 respondents with severe CPITN, 40 (80.0%) were cases and 10 (20.0%) were controls, whereas among 64 with mild CPITN, 17 (26.6%) were cases and 47 (73.4%) were controls (p = 0.000; OR = 6.57; 95% CI: 4.552–26.866). Mechanistically, periodontitis may contribute to LBW through hematogenous spread of periodontal pathogens (e.g., Porphyromonas gingivalis, Fusobacterium nucleatum) to placental tissues, by elevating systemic proinflammatory cytokines and PGE_2 that can precipitate preterm labor, and by impairing placental nutrient transfer. Despite a strong bivariate effect, CPITN was not significant in the multivariate model (OR = 2.36; p = 0.282), likely reflecting collinearity with OHI-S (Pearson correlation = –0.580) because poor oral hygiene both predisposes to and correlates with periodontal disease. The absence of routine periodontal probing in local health centers also suggests that periodontitis may be underdetected in routine practice and merits focused attention.

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Stomatitis during pregnancy emerged as the strongest predictor: of 59 respondents reporting stomatitis, 49 (83.1%) were cases and only 10 (16.9%) were controls; among 55 without stomatitis, 8 (14.5%) were cases and 47 (85.5%) were controls. This association was highly significant (p = 0.000; OR = 24.06; 95% CI: 10.462–79.210), indicating that women who experienced stomatitis had more than 24 times the odds of delivering an LBW infant. The magnitude of this effect points to stomatitis as a marker of active oral mucosal inflammation with substantial systemic inflammatory potential, and it highlights the importance of identifying and managing acute oral lesions during pregnancy as part of comprehensive antenatal care.

Table 2. Bivariate Analysis: Oral Disease Variables and LBW (n=114)

Variable	Case n(%)	Control n(%)	Total n(%)	OR	p-value (95% CI)
DMF-T					
High (>3)	27 (77.1)	8 (22.9)	35 (100.0)	4.14	0.001 (2.22–13.70)
Low (≤3)	30 (38.0)	49 (62.0)	79 (100.0)		
OHI-S (Gingivitis)					
Poor (>1.2)	48 (80.0)	12 (20.0)	60 (100.0)	9.06	0.000 (7.70–51.98)
Good (≤1.2)	9 (16.7)	45 (83.3)	54 (100.0)		
CPITN (Periodontitis)					
Severe (≥3)	40 (80.0)	10 (20.0)	50 (100.0)	6.57	0.000 (4.55–26.87)
Mild (<3)	17 (26.6)	47 (73.4)	64 (100.0)		
Stomatitis					
Present	49 (83.1)	10 (16.9)	59 (100.0)	24.06	0.000 (10.46–79.21)
Absent	8 (14.5)	47 (85.5)	55 (100.0)		
Total	57 (50.0)	57 (50.0)	114 (100.0)		

***Source**: Primary data, 2026*

Stomatitis emerged as the most dominant predictor of LBW in both bivariate (OR=24.06; p=0.000) and multivariate analysis (OR=20.19; p=0.000). This finding is clinically significant and has multiple biological explanations. Stomatitis during pregnancy is closely associated with deficiencies in iron, folic acid, vitamin B12, and vitamin C, micronutrients essential for fetal neurodevelopment and growth. Recurrent painful oral lesions reduce food intake frequency and quality, leading to macronutrient and micronutrient

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deficits that directly impair fetal growth and increase LBW risk. Furthermore, mucosal inflammation may trigger systemic inflammatory responses similar to those described for periodontitis, releasing mediators that compromise placental function. In the context of pregnant women in Mantikulore, stomatitis may serve as a readily observable clinical indicator of suboptimal maternal nutritional and immunological status. The model constant (B=-2.981; p=0.000) reinforces that in the absence of all four oral disease risk factors, baseline LBW probability is approximately 4.8%, emphasizing that good oral health is genuinely protective.

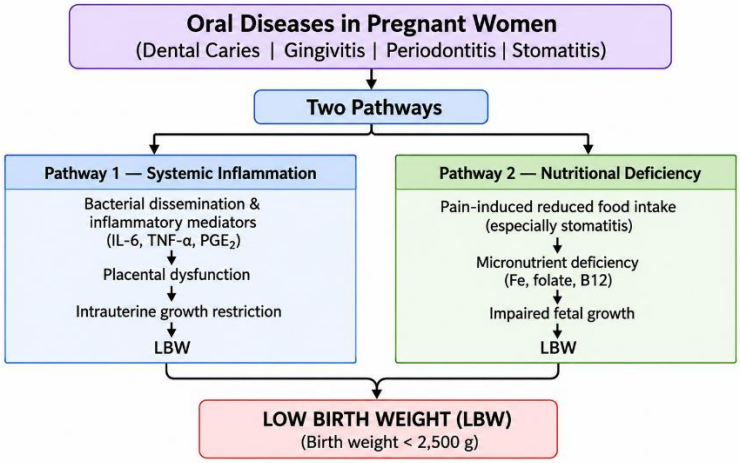

Figure 1. Biological Pathways Linking Oral Diseases in Pregnant Women to LBW

Source: Adapted from Offenbacher (1996) and Miller (1891)

3. Multivariate Analysis

Multiple logistic regression (backward stepwise Wald) was performed with all four oral disease variables. The final model (Step 1, which provides full coefficients for all four variables) showed that stomatitis was the most dominant predictor of LBW (OR=20.19; p=0.000; 95% CI: 6.141–66.377), followed by poor OHI-S (OR=6.94; p=0.016; 95% CI: 1.442–33.367). After controlling for all variables, high DMF-T (OR=1.24; p=0.762) and severe CPITN (OR=2.36; p=0.282) were not statistically significant as independent predictors. The model explained 67.5% of LBW variation (Nagelkerke R^2=0.675). The baseline probability of LBW when all protective oral health conditions are present was only 4.8% (constant B=-2.981; p=0.000), indicating that good overall oral health substantially reduces LBW risk (Table 3).

Table 3. Multiple Logistic Regression: Oral Disease Variables and LBW (n=114)

Variable	B	S.E.	Wald	Sig.	OR	95% CI Lower	95% CI Upper
High DMF-T (>3)	0.212	0.697	0.092	0.762	1.24	0.315	4.847

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Variable	B	S.E.	Wald	Sig.	OR	95% CI Lower	95% CI Upper
Poor OHI-S (>1.2)	1.937	0.801	5.841	0.016*	6.94	1.442	33.367
Severe CPITN (≥3)	0.860	0.799	1.158	0.282	2.36	0.493	11.320
Stomatitis (Yes)	3.005	0.607	24.492	0.000**	20.19	6.141	66.377
Constant	-2.981	0.822	26.118	0.000**	0.051		

***Note**: *p<0.05; **p<0.001; Nagelkerke R^2=0.675. Source: Primary data, 2026.*

CONCLUSIONS

This study confirms that oral diseases in pregnant women are significantly associated with LBW in Mantikulore Sub-District, Palu City. All four oral health variables—high DMF-T (OR=4.14), poor OHI-S (OR=9.06), severe CPITN (OR=6.57), and stomatitis (OR=24.06)—showed significant bivariate associations with LBW. Multivariate analysis identified stomatitis as the most dominant independent predictor (OR=20.19; p=0.000), followed by poor oral hygiene (OHI-S; OR=6.94; p=0.016). The model explained 67.5% of LBW variation. These findings underscore that oral health screening and treatment should be integrated as a standard component of antenatal care to reduce LBW incidence in Indonesia.

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