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# The Association Of Hemoglobin Levels With Gingivitis And Periodontitis: A Correlational Study

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**Abstract**

**Background:** Periodontitis is a chronic inflammatory disease affecting periodontal tissues, linked to systemic health conditions such as diabetes and cardiovascular diseases. Hemoglobin levels have been explored as potential indicators of systemic effects of periodontal disease, but limited data exist on their association with gingivitis and periodontitis.

**Objective:** This study investigates the correlation between hemoglobin levels and periodontal disease severity, focusing on gingivitis and stage II and III periodontitis.

**Methods:** A correlational study was conducted on 225 systemically healthy participants at the Department of Periodontology, People's College of Dental Sciences & Research Centre, Bhopal. Participants were categorized into three groups—gingivitis, stage II periodontitis, and stage III periodontitis—based on the 2017 classification of periodontal diseases. Hemoglobin levels were measured using automated hematology analyzers. Clinical parameters, including Bleeding on Probing (BoP), Probing Pocket Depth (PPD), and Clinical Attachment Level (CAL), were recorded. Statistical analysis was performed using SPSS Version 23, with a p-value of $<0.05$ considered significant.

**Results:** Hemoglobin levels were significantly lower in patients with stage III periodontitis (12.42 ± 0.49 mg/dL) compared to gingivitis (13.53 ± 0.57 mg/dL) and stage II periodontitis (13.60 ± 0.49 mg/dL) ($p = 0.000$). BoP, PPD, and CAL values indicated a progressive increase in periodontal destruction with disease severity.

**Conclusion:** A significant association was found between declining hemoglobin levels and the progression of periodontal disease. The findings suggest that chronic inflammation in periodontitis may contribute to anemia. Further longitudinal studies are required to explore whether anemia is a cause or consequence of periodontitis and to assess the impact of periodontal therapy on hemoglobin levels.

**Keywords:** Hemoglobin levels, Gingivitis, Periodontitis, Chronic inflammation, Anemia, Periodontal disease

## I. INTRODUCTION:

Periodontitis, a common inflammatory disease affecting periodontal tissues, results from a complex mix of anaerobic, Gram-negative bacteria in dental plaque(1,2). Symptoms include gum redness, swelling, bleeding, pus formation, periodontal pockets, gum recession, and alveolar bone loss(2). Its prevalence varies globally, affecting 40% and 15% of adults in the U.S. and Europe, respectively(3,4), 23.4% in Japan(5), and 68% in Saudi Arabia(6).

Bacterial infiltration through ulcerated pocket epithelium can enter systemic circulation, triggering immune responses linked to conditions like diabetes and cardiovascular diseases(7-9). Periodontal pathogens may contribute to systemic health issues via endothelial dysfunction and cytokine activation(10-12). Studies indicate bacteremia severity correlates with periodontal inflammation(11,12).

Blood, a key diagnostic fluid, has been studied for its association with periodontitis, particularly in leukocytes(13-15), thrombocytes(16), CRP(17,18), IL-6(19,20), fibrinogen(13,21), ESR(22), Von Willebrand factor(15), and RBCs(23). Elevated leukocyte counts and CRP levels in periodontitis patients have also been linked to cardiovascular diseases(24-27).

Anemia, characterized by reduced hemoglobin and oxygen-carrying capacity, is often caused by iron deficiency, blood loss, chronic infections, and inflammation(1). Recent studies suggest periodontitis patients exhibit altered blood cell counts, with some showing lower erythrocyte counts, indicating potential anemia of chronic disease(1). However, limited data exist on Hb levels in gingivitis and chronic periodontitis patients(1,2).

This study aims to investigate the association between blood hemoglobin levels and the presence of gingivitis and periodontitis. The objectives include examining the correlation between hemoglobin levels and gingivitis, as well as assessing its relationship with stage II and stage III periodontitis. Additionally, the study seeks to evaluate the impact of hemoglobin levels on the occurrence and severity of both gingivitis and periodontitis.

## II. MATERIALS AND METHODOLOGY:

A correlational study was conducted at the Department of Periodontology, People's College of Dental Sciences & Research Centre, Bhopal, to assess the relationship between periodontal health status and hemoglobin levels in 225 subjects. Ethical clearance was obtained from designated authority (EC202126). Participants were categorized into three groups—gingivitis, Stage II periodontitis, and Stage III periodontitis—based on the 2017 classification of Periodontal and Peri-implant Diseases and Conditions. The sample size was determined using a 16.9% prevalence of severe periodontitis (Hind A. Aljohani et al.). Subjects aged 35–55 years with at least 20 teeth, diagnosed with gingivitis or periodontitis, and free from systemic diseases, smoking, recent periodontal therapy, pregnancy, and lactation were included. After obtaining informed consent, clinical parameters (Bleeding on Probing, Probing Pocket Depth, and Clinical Attachment Level) were recorded using standard instruments. Venous blood samples (5 mL) were collected from the antecubital fossa using a 21-gauge syringe, stored in EDTA bulbs, and analyzed using automated hematology analyzers based on WHO reference values (Adult males: 13.5–17.5 g/dL, Adult females: 12.0–15.5 g/dL).
Data analysis was performed using SPSS Version 23. Normality was assessed via the Kolmogorov-Smirnov and Shapiro-Wilk tests, confirming a normal distribution. Descriptive statistics, including mean, percentages, and standard deviation, were used for comparison. The Chi-square test was applied to assess differences in proportions for BOP, PPD, CAL, and hemoglobin levels, while ANOVA was used to compare mean values across groups. A p-value of $<0.05$ was considered statistically significant.

## III. RESULTS:

The study population consisted of 225 participants, distributed equally across three groups: gingivitis (n = 75), stage II periodontitis (n = 75), and stage III periodontitis (n = 75).

**Table 1: Age distribution of the study population**

| Age Group (Years) | Gingivitis (n = 75) | Stage II Periodontitis (n = 75) | Stage III Periodontitis (n = 75) | Total (N = 225) |
|---|---|---|---|---|
| 35–40 | 22 (29.33%) | 15 (20%) | 10 (13.33%) | 47 (20.89%) |
| 41–45 | 25 (33.33%) | 20 (26.67%) | 15 (20%) | 60 (26.67%) |
| 46–50 | 18 (24%) | 22 (29.33%) | 25 (33.33%) | 65 (28.89%) |
| 51–55 | 10 (13.33%) | 18 (24%) | 25 (33.33%) | 48 (21.33%) |

Table 1 presents the age distribution across the three study groups, categorized into four age ranges: 35–40, 41–45, 46–50, and 51–55 years. In the gingivitis group, most participants were aged 41–45 years (33.33%), followed by 35–40 years (29.33%), 46–50 years (24%), and 51–55 years (13.33%), suggesting a lower prevalence in older individuals.
For stage II periodontitis, the highest proportion was in the 46–50 years group (29.33%), followed by 41–45 years (26.67%), 35–40 years (20%), and 51–55 years (24%), indicating its prevalence in middle-aged adults. In stage III periodontitis, 33.33% were in the 46–50 and 51–55 years groups, while only 13.33% were aged

35–40 years, reflecting the progressive nature of periodontal disease.
Overall, the highest representation was in the 46–50 years group (28.89%), followed by 41–45 years (26.67%), 51–55 years (21.33%), and 35–40 years (20.89%), reinforcing the association between advancing age and increased severity of periodontal disease.

**Graph 1: Age distribution of the study population**

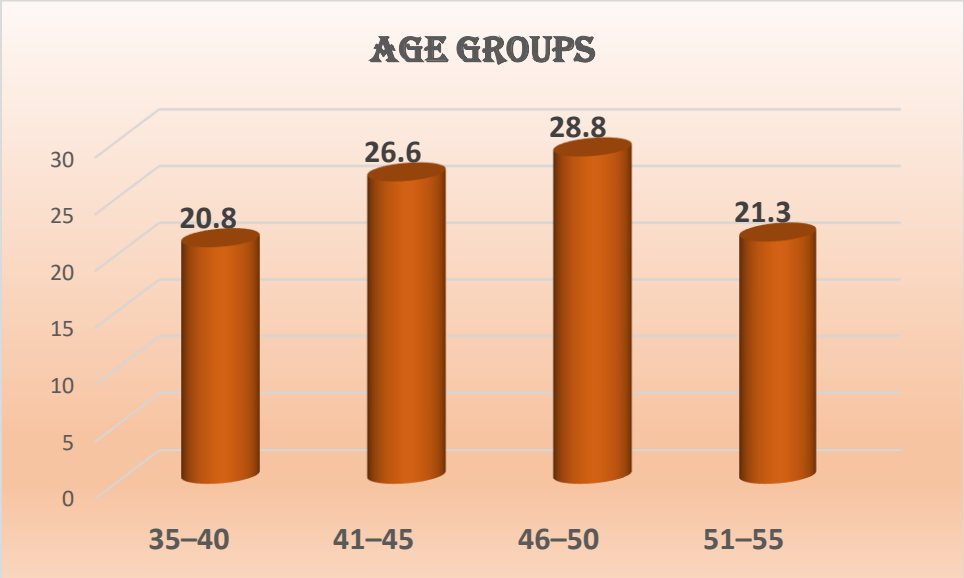



**Table 2: Gender distribution of the study population**

| Gender | Gingivitis (n = 75) | Stage II Periodontitis (n = 75) | Stage III Periodontitis (n = 75) | Total (N = 225) |
|---|---|---|---|---|
| Male | 40 (53.33%) | 45 (60%) | 50 (66.67%) | 135 (60%) |
| Female | 35 (46.67%) | 30 (40%) | 25 (33.33%) | 90 (40%) |

Table 2 illustrates the gender distribution across the three study groups, with 135 males (60%) and 90 females (40%) in the total study population. In the gingivitis group, males comprised 53.33% and females 46.67%, indicating a relatively balanced distribution.
In stage II periodontitis, males accounted for 60% and females 40%, suggesting a potential gender-related predisposition, possibly due to lifestyle factors like smoking or oral hygiene variations. The male predominance increased in stage III periodontitis, with 66.67% males and 33.33% females, reflecting a higher occurrence of severe periodontal disease among men.

**Graph 2: Gender distribution of the study population**

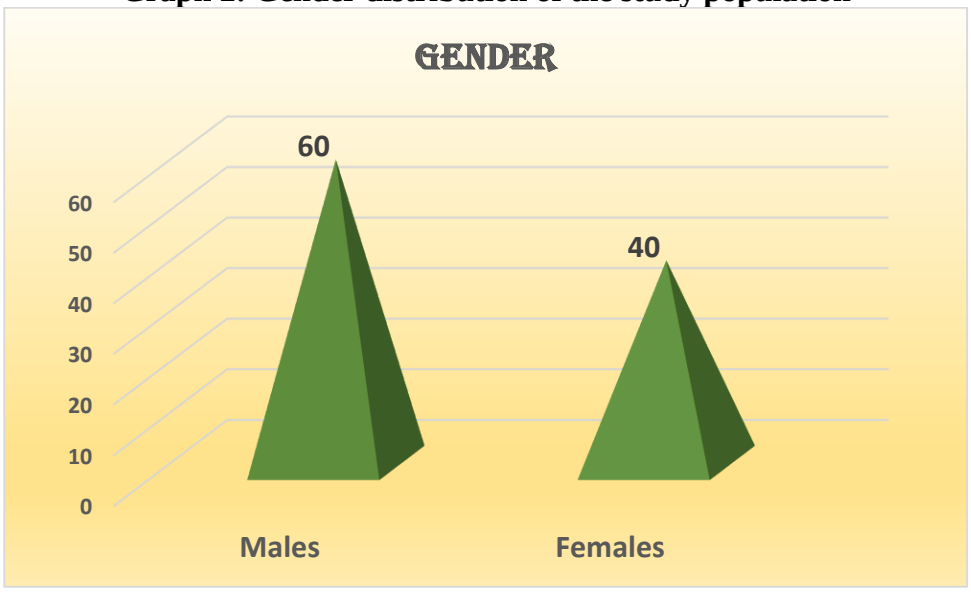


**Table 3: Comparative evaluation of hemoglobin levels between groups**

| Group | N | Hb Levels (9-11 mg/dL) | Hb Levels (12-14 mg/dL) | Hb Levels (15-17 mg/dL) | Mean ± SD (mg/dL) | Lower bound | Upper bound |
|---|---|---|---|---|---|---|---|
| Gingivitis | 75 | 17 (22.67%) | 36 (48%) | 22 (29.33%) | 13.53 ± 0.57 | 13.40 | 13.66 |
| Stage II Periodontitis | 75 | 9 (12%) | 46 (61.33%) | 20 (26.67%) | 13.60 ± 0.49 | 13.48 | 13.71 |
| Stage III Periodontitis | 75 | 11 (14.67%) | 50 (66.67%) | 14 (18.67%) | 12.42 ± 0.49 | 12.31 | 12.54 |
| Statistical test value | | Chi square statistic = 10.71 | | | F = 118.520 | | |
| P value | | 0.03* | | | 0.000* | | |

*=Significant; NS = Not Significant

Table 3 presents a comparative analysis of hemoglobin (Hb) levels across gingivitis, stage II periodontitis, and stage III periodontitis groups, each with 75 participants. Hb levels were categorized into three ranges (9–11 mg/dL, 12–14 mg/dL, and 15–17 mg/dL), with mean values and standard deviations analyzed using Chi-square and ANOVA tests.

In the gingivitis group, most participants had Hb levels of 12–14 mg/dL (48%), followed by 15–17 mg/dL (29.33%) and 9–11 mg/dL (22.67%), with a mean Hb level of 13.53 ± 0.57 mg/dL. The stage II periodontitis group showed a similar trend, with 61.33% in the 12–14 mg/dL range, 26.67% in 15–17 mg/dL, and 12% in 9–11 mg/dL, yielding a mean Hb level of 13.60 ± 0.49 mg/dL. In stage III periodontitis, 66.67% had Hb levels in the 12–14 mg/dL range, 18.67% in 15–17 mg/dL, and 14.67% in 9–11 mg/dL, with a significantly lower mean Hb level of 12.42 ± 0.49 mg/dL.

Chi-square analysis ($\chi^2 = 10.71$, $p = 0.03$) showed a significant association between Hb levels and periodontal disease severity, while ANOVA ($F = 118.520$, $p = 0.000$) confirmed statistically significant differences in mean Hb levels. Post hoc analysis further indicated significantly lower Hb levels in the stage III periodontitis group, emphasizing the impact of periodontal inflammation on systemic health.

**Graph 3: Comparative evaluation of hemoglobin levels between groups**

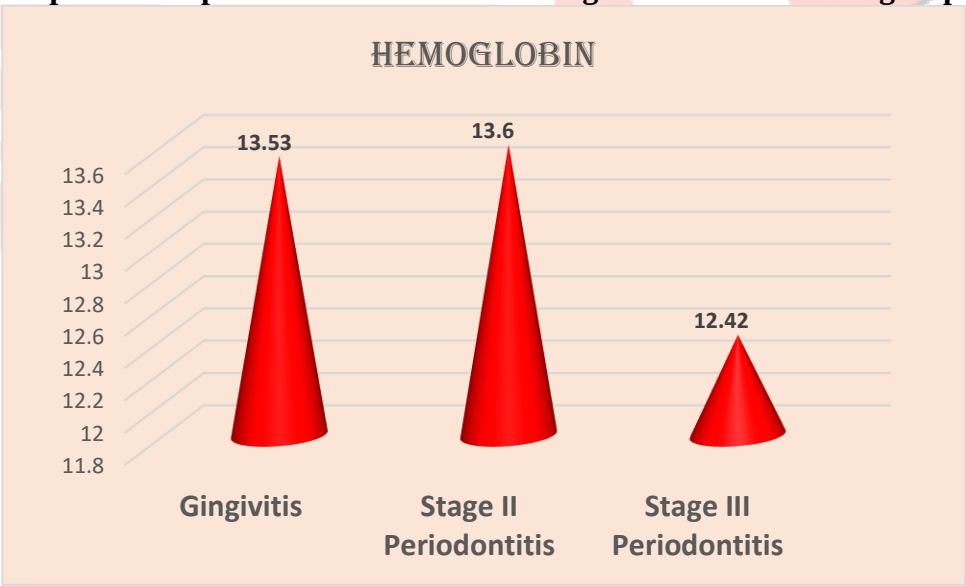



**Table 4: Comparative evaluation of Bleeding on Probing (BoP) levels between groups**

| Group | N | BoP Sites (%) | Lower bound | Upper bound | Mean ± SD (%) |
|---|---|---|---|---|---|
| Gingivitis | 75 | 82.02 ± 2.88 | 81.36 | 82.68 | High |
| Stage II Periodontitis | 75 | 64.66 ± 2.47 | 64.09 | 65.23 | Moderate |
| Stage III Periodontitis | 75 | 51.41 ± 2.40 | 50.85 | 51.96 | Low |
| 'F' statistic | 2625.365 | | | | |
| P value | 0.000* | | | | |

*=Significant; NS = Not Significant

Table 4 evaluates bleeding on probing (BoP) levels across gingivitis, stage II periodontitis, and stage III periodontitis groups, each with 75 participants. BoP levels are reported as mean percentages with standard deviations, confidence intervals, and qualitative descriptions.

In the gingivitis group, the mean BoP percentage was 82.02 ± 2.88%, with confidence intervals of 81.36%–82.68%, indicating high gingival inflammation typical of gingivitis. The stage II periodontitis group showed a moderate BoP level of 64.66 ± 2.47%, with confidence intervals of 64.09%–65.23%, reflecting deeper tissue inflammation and pocket formation. In stage III periodontitis, the mean BoP was lowest at 51.41 ± 2.40%, with confidence intervals of 50.85%–51.96%, suggesting reduced active inflammation due to chronic fibrosis and vascular changes in advanced disease.

ANOVA analysis (F = 2625.365, p = 0.000) confirmed statistically significant differences in BoP levels among the three groups, highlighting the progressive decline in bleeding response as periodontal disease severity increases.

**Graph 4: Comparative evaluation of Bleeding on Probing (BoP) levels between groups**

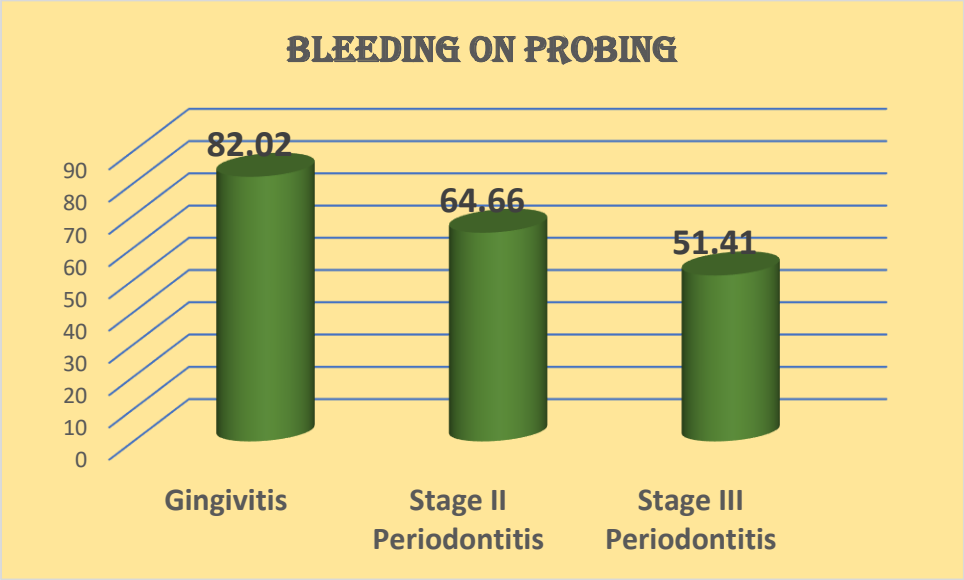



**Table 5: Comparative evaluation of Probing Pocket Depth (PPD) levels between groups**

| Group | PPD ≤ 3 mm (%) | PPD 4-7 mm (%) | PPD ≥ 8 mm (%) | Mean ± SD (mm) | Lower Bound | Upper bound |
|---|---|---|---|---|---|---|
| Gingivitis | 70 (93.33%) | 5 (6.67%) | 0 (0%) | 2.5 ± 0.5 | 2.41 | 2.64 |
| Stage II Periodontitis | 25 (33.33%) | 40 (53.33%) | 10 (13.33%) | 5.6 ± 1.1 | 5.61 | 5.95 |
| Stage III Periodontitis | 15 (20%) | 35 (46.67%) | 25 (33.33%) | 7.2 ± 1.4 | 7.24 | 7.71 |
| Statistical test value | Chi square statistic = 85.62 | | | F = 785.462 | | |
| P value | 0.000* | | | 0.000* | | |

*=Significant; NS = Not Significant

Table 5 compares probing pocket depth (PPD) distributions across gingivitis, stage II periodontitis, and stage III periodontitis groups. PPD levels are categorized into three ranges (≤ 3 mm, 4–7 mm, and ≥ 8 mm) with mean values, standard deviations, and confidence intervals.

In the gingivitis group, 93.33% of sites had PPD ≤ 3 mm, 6.67% were in the 4–7 mm range, and none had PPD ≥ 8 mm. The mean PPD was 2.5 ± 0.5 mm (95% CI: 2.41–2.64 mm), indicating mild inflammation without significant attachment loss. In stage II periodontitis, 33.33% of sites had shallow pockets, 53.33% were in the 4–7 mm range, and 13.33% had PPD ≥ 8 mm, with a mean PPD of 5.6 ± 1.1 mm (95% CI: 5.61–5.95 mm), reflecting disease progression. Stage III periodontitis showed the most advanced destruction, with 20% of sites having PPD ≤ 3 mm, 46.67% in the 4–7 mm range, and 33.33% with PPD ≥ 8 mm. The mean PPD was 7.2 ± 1.4 mm (95% CI: 7.24–7.71 mm).

Chi-square analysis ($\chi^2$ = 85.62, p = 0.000) confirmed a significant association between periodontal disease severity and PPD distribution. ANOVA (F = 785.462, p = 0.000) demonstrated statistically significant differences in mean PPD values, reinforcing the progression from shallow to deep pockets with disease

severity.

**Graph 5: Comparative evaluation of Probing Pocket Depth (PPD) levels between groups**

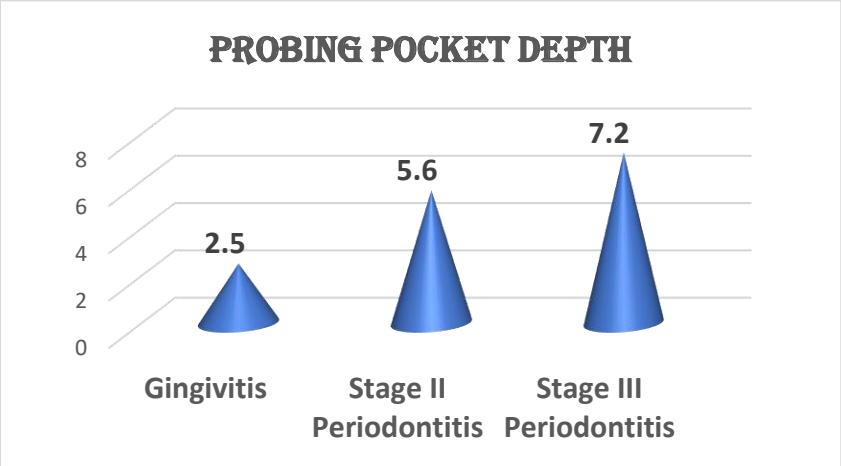



**Table 6: Comparative evaluation of Clinical Attachment Loss (CAL) levels between groups**

| Group | PPD ≤ 3 mm (%) | PPD 4-7 mm (%) | PPD ≥ 8 mm (%) | Mean ± SD (mm) | Lower Bound | Upper bound |
|---|---|---|---|---|---|---|
| Gingivitis | 75 (100%) | 0 (0%) | 0 (0%) | 0.37 ± 0.48 | .2613 | .4854 |
| Stage II Periodontitis | 17 (22.67%) | 48 (64%) | 10 (13.33%) | 3.93 ± 0.66 | 3.7805 | 4.0862 |
| Stage III Periodontitis | 5 (6.67%) | 20 (26.67%) | 50 (66.67%) | 6.98 ± 0.72 | 6.8197 | 7.1537 |
| Statistical test value | Chi square statistic = 206.83 | | | F = 2044.993 | | |
| P value | 0.000* | | | 0.000* | | |

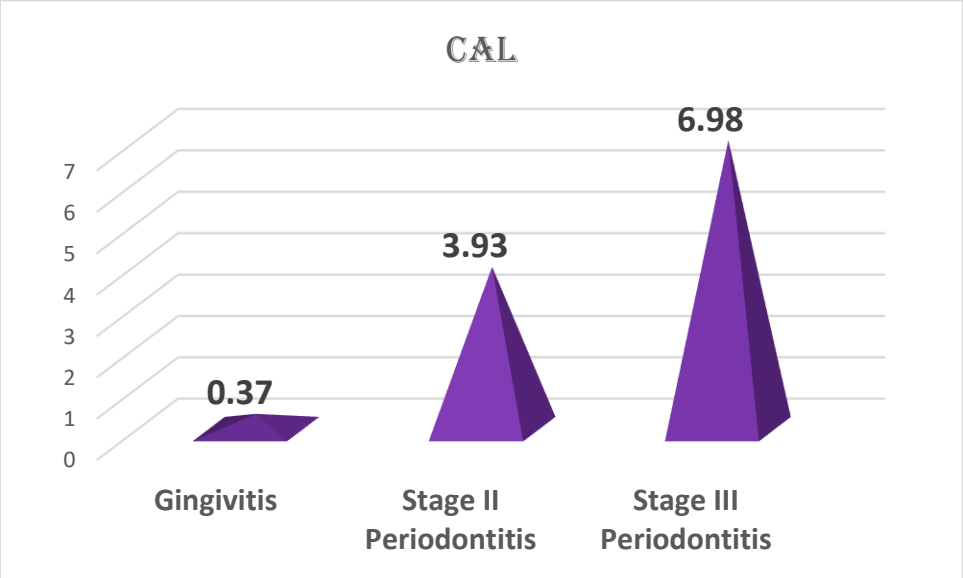
*=Significant; NS = Not Significant

Table 6 analyzes clinical attachment loss (CAL) levels across gingivitis, stage II periodontitis, and stage III periodontitis groups, categorizing sites into three ranges (≤ 3 mm, 4–7 mm, and ≥ 8 mm) with mean values, standard deviations, and confidence intervals.

In the gingivitis group, all sites (100%) had CAL ≤ 3 mm, indicating no significant attachment loss. The mean CAL was 0.37 ± 0.48 mm (95% CI: 0.26–0.49 mm). In stage II periodontitis, 22.67% of sites had CAL ≤ 3 mm, 64% fell in the 4–7 mm range, and 13.33% had CAL ≥ 8 mm. The mean CAL was 3.93 ± 0.66 mm (95% CI: 3.78–4.09 mm), indicating moderate attachment loss. Stage III periodontitis showed severe progression, with 66.67% of sites exhibiting CAL ≥ 8 mm, 26.67% in the 4–7 mm range, and only 6.67% with CAL ≤ 3 mm. The mean CAL was 6.98 ± 0.72 mm (95% CI: 6.82–7.15 mm).

Chi-square analysis ($\chi^2 = 206.83$, $p = 0.000$) confirmed a significant association between CAL levels and disease severity. ANOVA ($F = 2044.993$, $p = 0.000$) demonstrated statistically significant differences in mean CAL values, reinforcing the progressive attachment loss with worsening periodontal disease.

**Graph 6: Comparative evaluation of Clinical Attachment Loss (CAL) levels between groups**




## IV. DISCUSSION

The study revealed that most participants were aged 41–50 years, with a higher proportion of older individuals in more severe periodontal groups. Males predominated across all groups, with their proportion increasing in stage III periodontitis. Hemoglobin levels were highest in gingivitis patients and declined progressively in stage II and stage III periodontitis. Bleeding on probing (BoP) was significantly higher in gingivitis and decreased as periodontal disease severity increased. Both probing pocket depth (PPD) and clinical attachment loss (CAL) showed a clear progression from gingivitis to stage III periodontitis, highlighting the worsening periodontal destruction with disease advancement**.**

This study investigates the correlation between hemoglobin levels and periodontal disease severity in systemically healthy individuals. Previous research by Goldstein(31), Siegel(32), Lainson et al.(33), and Chawala et al.(34) suggested that anemia contributes to periodontitis rather than resulting from it. However, studies by Hutter et al.(4) and Thomas et al.(35) found lower hemoglobin levels in periodontitis patients, with improvements observed after periodontal treatment (Rai and Kharb(36), Agarwal et al.(37)). Contrarily, Aljohani et al.(2) and Wakai et al.(5) found no correlation between hemoglobin levels and periodontal health, while Havemose-Poulsen et al.(38) reported no association in patients with aggressive periodontitis or arthritis. Our findings indicate significantly lower hemoglobin levels in the stage III periodontitis group, supporting the role of periodontal inflammation in systemic health. Patel et al.(39) reported similar trends, suggesting that chronic inflammation may contribute to anemia. Yamamoto et al.(40) found a decline in erythrocyte count with worsening periodontal disease. Siddeshappa et al.(41) noted that periodontal therapy reduced hematological risk factors for cardiovascular disease, while Anumolu et al.(42) reported improvements in hematocrit after treatment. Since this study lacked treatment interventions and follow-up, it remains unclear whether anemia is a cause or consequence of periodontitis, warranting further longitudinal research.

## V. CONCLUSION:

This study establishes a significant correlation between declining hemoglobin levels and the progression of periodontal disease. The findings suggest that chronic inflammation in periodontitis may contribute to anemia. However, without treatment interventions or follow-up, it remains unclear whether anemia is a cause or consequence of periodontitis. Further longitudinal studies are needed to explore this relationship and assess the impact of periodontal therapy on hemoglobin levels.

## VI. REFERENCES:


1. Ovia, M., Priya Lochana Gajendran, Karthikeyan Murthykumar, and Dhanraj Ganapathy. 2022. "Association of Hemoglobin Levels Among Patients with Gingivitis, Chronic & Aggressive Periodontitis—A Retrospective Study." *Journal of Pharmaceutical Negative Results* 13 (S04): 871. https://doi.org/10.47750/pnr.2022.13.S04.103.
2. Aljohani, Hind A. 2010. "Association between Hemoglobin Level and Severity of Chronic Periodontitis." *JKAU: Medical Sciences* 17 (1): 53–64. https://doi.org/10.4197/Med.17-1.6.
3. Brown LJ, Oliver RC, Loe H. Evaluating periodontal status of US employed adults. J Am Dent Assoc 1990; 121(2): 226-232
4. Hutter JW, van der Velden U, Varoufaki A, Huffels RA, Hoek FJ, Loos BG. Lower numbers of erythrocytes and lower levels of hemoglobin in periodontitis patients compared to control subjects. J Clin Periodontol 2001; 28(10): 930-936.
5. Wakai K, Kawamura T, Umemura O, Hara Y, Machida J, Anno T, et al. Associations of medical status and physical fitness with periodontal disease. J Clin Periodontol 1999; 26(10): 664-672.
6. Al-Zahrani MS, Kayal RA. Alveolar bone loss and reported medical status among a sample of patients at a Saudi dental school. Oral Health Prev Dent 2006; 4(2): 113-118.
7. Michel J-P. Prevention of Chronic Diseases and Age-Related Disability. Springer; 2018. 199 p.
8. Dung S-Z. Asian Aspects of Periodontology and Implantology、臺灣牙周病醫學會&Airiti Press: 2017. 354 p.
9. Beck JD, Offenbacher S. The Association Between Periodontal Diseases and Cardiovascular Diseases: A State-of-the-Science Review [Internet). Vol. 6. Annals of Periodontology. 2001. p. 9-15. Available from: http://dx.doi.org/10.1902/annals.2001.6.1.9
10. Kim J, Amar S. Periodontal disease and systemic conditions: A bidirectional relationship. Odontology 2006; 94(1):10-21. doi: 10.1007/s10266-006-0060-6.
11. Scannapieco FA. Position paper of The American Academy of Periodontology: periodontal disease as a potential risk factor for systemic diseases. J Periodontol 1998; 69(7):841-50.
12. Lowe GD. The relationship between infection, inflammation, and cardiovascular disease: An overview. Ann Periodontol 2001; 6(1):1-8. doi: 10.1902/annals.2001.6.1.1.
13. Kweider M, Lowe GD, Murray GD, Kinane DF, McGowan DA. Dental disease, fibrinogen and white cell count; links with myocardial infarction? Scott Med J 1993; 38(3): 73-74.
14. Loos BG, Craandijk J, Hoek FJ, Wertheim-van Dillen PM, van der Velden U. Elevation of systemic markers related to cardiovascular diseases in the peripheral blood of periodontitis patients. J Periodontol 2000; 71(10): 1528-1534.
15. Loos BG. Systemic markers of inflammation in periodontitis. J Periodontol 2005; 76(11 Suppl): 2106-2115.
16. Christan C, Dietrich T, Hagewald S, Kage A, Bernimoulin JP. White blood cell count in generalized aggressive periodontitis after non-surgical therapy. J Clin Periodontol 2002; 29(3): 201-206.
17. Ebersole JL, Machen RL, Steffen MJ, Willmann DE. Systemic acute-phase reactants, C reactive protein and haptoglobin, in adult periodontitis. Clin Exp Immunol 1997; 107(2): 347-352.
18. Noack B, Genco RJ, Trevisan M, Grossi S, Zambon JJ, De Nardin E. Periodontal infections contribute to elevated systemic C-reactive protein level. J Periodontol 2001; 72(9): 1221-1227.
19. Mengel R, Bacher M, Flores-De-Jacoby L. Interactions between stress, interleukin-1beta, interleukin-6 and cortisol in periodontally diseased patients. J Clin Periodontol 2002; 29(11): 1012-1022.
20. D'Aiuto F, Ready D, Tonetti MS. Periodontal disease and C-reactive protein-associated cardiovascular risk. J Periodontal Res 2004; 39(4): 236-241.
21. Sahingur SE, Sharma A, Genco RJ, De Nardin E. Association of increased levels of fibrinogen and the -455G/A fibrinogen gene polymorphism with chronic periodontitis. J Periodontol 2003; 74(3): 329-337.
22. Mercado FB, Marshall RI, Klestov AC, Bartold PM. Relationship between rheumatoid arthritis and periodontitis. J Periodontol 2001; 72(6): 779-787.
23. Salvi GE, Lawrence HP, Offenbacher S, Beck JD. Influence of risk factors on the pathogenesis of periodontitis. Periodontol 2000 1997; 14: 173-201.
24. Albert MA, Ridker PM. Inflammatory biomarkers in African Americans: a potential link to accelerated atherosclerosis. Rev Cardiovasc Med 2004; 5 Suppl 3: S22-7.
25. Danesh J, Collins R, Appleby P, Peto R. Association of fibrinogen, C-reactive protein, albumin, or leukocyte count with coronary heart disease: meta-analyses of prospective studies. JAMA 1998;

279(18): 1477-82. 62 H.A. Aljohani
26. Ridker PM, Brown NJ, Vaughan DE, Harrison DG, Mehta JL. Established and emerging plasma biomarkers in the prediction of first atherothrombotic events. Circulation 2004; 109(25 Suppl 1): IV6-19.
27. Rosenson RS, Koenig W. Utility of inflammatory markers in the management of coronary artery disease. Am J Cardiol 2003; 92(1A): 10i-8i.
28. Vardaan Singh Mann1, Monica Subramanyam1, Rakesh Kumar Verma1, Anand Ajey Jha1, James Rufus John : Estimation and Comparison of Erythrocyte and Hemoglobin Levels in Subjects with Healthy Periodontium and Chronic Periodontitis. Pesquisa Brasileira em Odontopediatria e Clinica Integrada 2017, 17(1):e3761 DOI: http://dx.doi.org/10.4034/PBOCI.2017.171.41
29. Shishir Shah et. al.: Establishment of a Casual Relationship between Hemoglobin and Chronic Periodontitis. Indian Journal of Dental Education, Volume 10 Number 2, April - June 2017, DOI: https://dx.doi.org/10.21088/ijde.0974.6099.10217.
30. Suzan Ali: The correlation between hemoglobin level and generalized moderate chronic periodontitis. J Bagh College Dentistry Vol. 24(special issue 1), 2012
31. Goldstein H. Systemic and blood-picture findings in several hundred periclasia-free and periclasia-involved individuals. J Den Res 1937; 16: 320.
32. Siegel EH. Total erythrocyte, leukocyte and differential white cell counts of blood in chronic periodontal disease. J Den Res 1945; 24: 270-271
33. Lainson PA, Brady PP, Fraleign CM. Anemia, a systemic cause of periodontal disease? J Periodontol 1968; 39(1): 35-8.
34. Chawla TN, Kapoor KK, Teotia SP, Singh NK. Anaemia and periodontal disease--a correlative study. J Indian Dent Assoc 1971; 43(4): 67-78.
35. Thomas B, Ramesh A, Ritesh K. Relationship between periodontitis and erythrocyte count. JISP 2006;10:288-91
36. Rai B, Kharb S. Effect of Scaling and Root Planning in Periodontitis on Peripheral Blood. IJDS 2008; 6(1). http://www.ispub.com/ostia/index.php?xmlFilePath=journals/ijds/archives.xml
37. Agarwal N, Kumar VS, Gujjari SA. Effect of periodontal therapy on hemoglobin and erythrocyte levels in chronic generalized periodontitis patients: An interventional study. J Indian Soc Periodontol 2009; 13(1): 6-11.
38. Havemose-Poulsen A, Westergaard J, Stoltze K, Skjødt H, Danneskiold-Samsøe B, Locht H, Bendtzen K, Holmstrup P. Periodontal and hematological characteristics associated with aggressive periodontitis, juvenile idiopathic arthritis, and rheumatoid arthritis. J Periodontol 2006; 77(2): 280-288.
39. Patel M, Shakir Q. Shetty A. Interrelationship between chronic periodontitis and anemia: A 6-month follow-up study [Internet]. Vol. 18. Journal of Indian Society of Periodontology. 2014. p. 19. Available from: http://dx.doi.org/10.4103/0972-124x.128194
40. Yamamoto T, Tsuneishi M, Furuta M, Ekuni D, Morita M, Hirata Y. Relationship between decrease of erythrocyte count and progression of periodontal disease in a rural Japanese population. J Periodontol 2011;82:106- 13.
41. Siddesnappa ST, Nagdeve S, Yelliwar RK, Parvez H, Deonani S, Diwan V. Evaluation of various hematological parameters in patients with periodontitis after nonsurgical therapy at different intervals. J Indian Soc Periodontol. 2016 Mar:20(2):180-3.
42. Anumolu VNSH, Srikanth A, Paidi K. Evaluation of the relation between anemia and periodontitis by estimation of blood parameters: A cross-sectional study. J Indian Soc Periodontol. 2016 May:20(3):265-72.