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Research Article

Association of Periodontal Disease with Serum C - Reactive protein Levels in Systemically Healthy Individuals: A Case-Control Study

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Abstract

Introduction: In addition to harming the gums and teeth, periodontal disease may also result in inflammation in other body areas. Finding out whether there is a connection between periodontal disease and CRP in healthy individuals' blood was the goal.

Methodology: A total of 101 patients were included in this case-control research conducted at Khyber College of Dentistry (KCD) Peshawar, 50 of whom had moderate to severe periodontitis and 51 of whom were in excellent dental health. The clinician used BOP, CAL, and PPD to evaluate periodontal health. An ELISA test was used to determine the serum's CRP levels. Chi-square tests, Pearson's correlation, and t-tests for independent samples were used to examine the data.

Results: The CRP levels of study participants in the case group were significantly higher (12.4 ± 4.6 mg/L) than those in the control group (3.1 ± 1.2 mg/L). There was a direct [positive] correlation between CRP and CAL ($r = 0.75$, $p < 0.001$) as well as PPD ($r = 0.82$, $p < 0.001$). As a test for periodontitis, CRP has 80.4% specificity and an 85.7% sensitivity. This implies that periodontal disease may be detected by CRP.

Conclusion: CRP is regarded as a biomarker for detecting and monitoring periodontal disease and has a good correlation with periodontitis. To confirm the findings, this research must be conducted again with a bigger sample size and a longer study design.

Introduction

Periodontal disease often develops into a chronic infection that depends on the surrounding tissues of the teeth, namely the gingiva, periodontal ligament, cementum and alveolar bone [1]. There is a range, from small conditions like gingivitis to very serious periodontitis which might cause teeth to become loose and eventually fall out if not treated [2]. The main reason periodontal disease develops is due to bacterial groups called biofilms forming close to the gums and resulting in an immune response that destroys tissue [3].

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In the last few decades, attention has grown towards finding out how periodontal disease can affect the entire body [4]. Thus far, C - reactive protein has been found to be the most useful biomarker for assessing general body inflammation [5]. Liver cells produce CRP when cytokines such as IL-6 and TNF-α are present in the blood [6]. An increased amount of CRP is usually connected to many serious systemic conditions, among them cardiovascular diseases, diabetes mellitus and metabolic syndrome [7]. This connection has led researchers to investigate whether localized infections such as periodontitis can elevate serum CRP levels even in systemically healthy individuals.

According to a number of studies, people with periodontal disease had higher blood CRP levels than those with healthy periodontal tissue, which may indicate a connection between systemic inflammation and oral health [8]. It is challenging to separate the independent effects of periodontal disease on systemic inflammatory markers, nevertheless, since the majority of current research either includes participants with underlying systemic diseases or does not sufficiently account for confounding variables [9].

In light of this, it is essential to investigate the relationship between periodontal disease and serum CRP levels in people who are otherwise healthy in order to comprehend how periodontal inflammation affects systemic immune responses. The establishment of this connection may provide further proof that maintaining periodontal health is crucial for both avoiding systemic inflammatory diseases and preserving oral function [10].

This study intends to assess the relationship between periodontal disease and serum C-reactive protein levels in systemically healthy individuals because, despite the body of literature on the topic, there are still insufficient case-control studies that exclusively focus on systemically healthy individuals to ascertain the isolated effect of periodontal disease on serum CRP levels.

Materials and Methods

Study Design and Setting

The Department of Periodontology at Khyber College of Dentistry (KCD), Peshawar, was the site of this case-control investigation. The research ran from January 2023 to December 2023, for a total of 12 months. This research looked at CRP as a possible diagnostic biomarker for periodontitis and evaluated the relationship between blood CRP levels and periodontal disease in people who were otherwise healthy.

Sample Size Calculation

The number of samples was determined with a 95% confidence level, 80% power and by expecting a difference in CRP levels between the cases and controls based on research from prior studies. It was decided that the study would need a minimum of 101 participants, of which 50 had the disease and 51 were without it.

Study Population

All participants of the study were healthy adults aged 18 to 55 and had visited KCD outpatient department for regular dental care or to have periodontal health checked. People in the case group had generalized moderate to severe chronic periodontitis, while the control group consisted of those with a healthy mouth and showed no symptoms of gingivitis or periodontitis. Clinical guidelines from 2023 were followed to determine the diagnosis of periodontal disease, with PPD, CAL and BOP being the major parameters taken into account.

Inclusion Exclusion Criteria

Participants were included in the study if they were 18 to 55 years in age, healthy people confirmed by their medical history and physical examinations and they had not received periodontal treatment within the past six months. Moreover, each participant was expected to agree to take part and sign written informed consent. Participants whose medical history revealed diabetes mellitus, cardiovascular disease, an autoimmune disorder or who were currently pregnant or lactating, taking antibiotics, anti-inflammatory or immunosuppressive medications in the last three months, were smokers or chewers or had an acute infection or surgery recently were excluded from the study.

Clinical Examination and Data Collection

A well-calibrated periodontist used a UNC-15 probe to conduct a thorough periodontal examination. Probing Pocket Depth (PPD), Clinical Attachment

Loss (CAL) and Bleeding on Probing (BOP) were part of the information collected. All people whose clinical signs of periodontitis were generalized moderate to severe (CAL ≥3 mm in 30% or more teeth) were placed in the case group and those without any signs of gingival inflammation or attachment loss were put in the control group. Each participant's venous blood (5 ml) was collected under clean conditions. Serum was separated from the samples using centrifugation and stored at -20°C until it was analyzed.

Laboratory Analysis

A "high-sensitivity CRP (hs-CRP) enzyme-linked immunosorbent assay (ELISA) kit" was used to quantify serum CRP levels in accordance with the manufacturer's instructions. All laboratory work was carried out at KCD's Department of Biochemistry, guaranteeing consistent sample handling and processing.

Data Analysis

IBM SPSS version 26.0 was used to do statistical analysis. For every variable, descriptive statistics were calculated. While frequencies and percentages were used to summarize categorical data like gender and group distribution (case vs. control), mean and standard deviation were computed for continuous variables like age and serum CRP levels. The mean CRP levels in the "case and control groups were compared using the independent sample t-test. To evaluate relationships between categorical data, a chi-square test was used. P-values below 0.05 were regarded as statistically significant".

Ethical Consideration

The Institutional Review Board of the College granted ethical clearance before to the study's start. All participants provided written informed permission after being fully told about the study's objectives, methods, and confidentiality. Participants were free to leave the research at any moment without facing any repercussions since participation was entirely voluntary.

Results

A total of 101 participants were enrolled in the study, consisting of 50 individuals in the case group (moderate to severe periodontitis) and 51 individuals in the control group (clinically healthy periodontium). The mean age of participants was 35.2 ± 8.3 years, with the age distribution detailed in Table 1. In terms of gender, there were 40 males (39.6%) and 61 females (60.4%) in the study population. The age distribution of participants in each group is as follows: in the case group, 12 individuals (24.0%) were in the 18-25 years age range, 18 individuals (36.0%) in the 26-35 years range, 10 individuals (20.0%) in the 36-45 years range, and 10 individuals (20.0%) in the 46-55 years range. In the control group, 15 individuals (29.4%) were in the 18-25 years age range, 20 individuals (39.2%) in the 26-35 years range, 10 individuals (19.6%) in the 36-45 years range, and 6 individuals (11.8%) in the 46-55 years range. These demographic details provided a comprehensive overview of the study population.

Table 1: Age Distribution of Participants

Age Group (Years)	Case Group (n=50)	Case Group Percentage	Control Group (n=51)	Control Group Percentage	Total (n=101)	Total Percentage
18-25	12	24.0%	15	29.4%	27	26.7%
26-35	18	36.0%	20	39.2%	38	37.6%
36-45	10	20.0%	10	19.6%	20	19.8%
46-55	10	20.0%	6	11.8%	16	15.8%

Analysis of the gums in the groups revealed that the case group had noticeably different clinical characteristics compared to the control group. The PPD was higher in the case group at 5.6 ± 1.2 mm compared to 2.1 ± 0.4 mm in the control group ($p < 0.001$). It was found that the mean CAL was 4.3 mm with a standard deviation of 1.0 in the case group, compared to only 0.8 mm and 0.3 mm for the control group (both $p < 0.001$). The percentage of BOP in the case group (84.0%) was very different from the control group (9.8%) which proved to be significant ($p < 0.001$). Researchers have found that people with

diabetes tend to have worse periodontal health. The information is presented in table 2.

Table 2: Clinical Parameters Comparison between Case and Control Groups

Parameter	Case Group (n=50)	Control Group (n=51)	p-value
Probing Pocket Depth (PPD) (mm)	5.6 ± 1.2	2.1 ± 0.4	< 0.001
Clinical Attachment Loss (CAL) (mm)	4.3 ± 1.0	0.8 ± 0.3	< 0.001
Bleeding on Probing (BOP) (%)	84.0%	9.8%	< 0.001

People in the case group had much higher levels of serum C - reactive protein than those in the control group. Schoolchildren in the case group had a mean CRP level of 12.4 ± 4.6 mg/L which was much higher than that in the control group (mean CRP level was 3.1 ± 1.2 mg/L; $p < 0.001$). Because of this difference, doctors can link periodontal disease to higher levels of systemic inflammation. The levels of CRP in each group can be seen in table 3.

Table 3: Serum CRP Levels in Case and Control Groups

Group	Mean ± SD (mg/L)
Case Group	12.4 ± 4.6
Control Group	3.1 ± 1.2

A t-test was performed to analyze the average CRP levels in the serum of both groups. As shown by the test, there was a meaningful difference in the case group's CRP level which was 12.4 ± 4.6 mg/L, compared to the control group's level of 3.1 ± 1.2 mg/L ($t = 10.85$, $p < 0.001$). Therefore, the amount of CRP was much higher in those with periodontal disease than in those with healthy gums. A chi-square analysis was done to check how gender is related to periodontal conditions. The study revealed that gender and periodontitis are unrelated, since the chi-square value was 0.236 and the p-value was 0.627. The results imply that periodontitis affected both genders in this study group about the same. It can be seen from table 4.

Table 4: Gender Distribution and Periodontal Status

Gender	Case Group (n=50)	Percentage	Control Group (n=51)	Percentage	Total (n=101)	χ^2- value	p-value
Male	24	48.0%	16	31.4%	40	0.236	0.627
Female	26	52.0%	35	68.6%	61		

The association between serum CRP levels and clinical periodontal markers was evaluated using Pearson's correlation coefficient. Probing Pocket Depth (PPD) and CRP levels showed a substantial positive connection ($r = 0.82$, $p < 0.001$), indicating that greater CRP levels were linked to deeper probing, a sign of more severe periodontal disease. Clinical Attachment Loss (CAL) and CRP levels also showed a strong positive connection ($r = 0.75$, $p < 0.001$), suggesting that higher CRP levels were associated with more attachment loss, which is another symptom of severe periodontal disease, as seen in Figure 1.

The diagnostic accuracy of serum C - reactive protein levels as a biomarker for moderate to severe periodontitis was evaluated using a cut-off value of 6.0 mg/L. The analysis revealed a sensitivity of 85.7%, indicating that CRP effectively identified the majority of individuals with periodontitis.

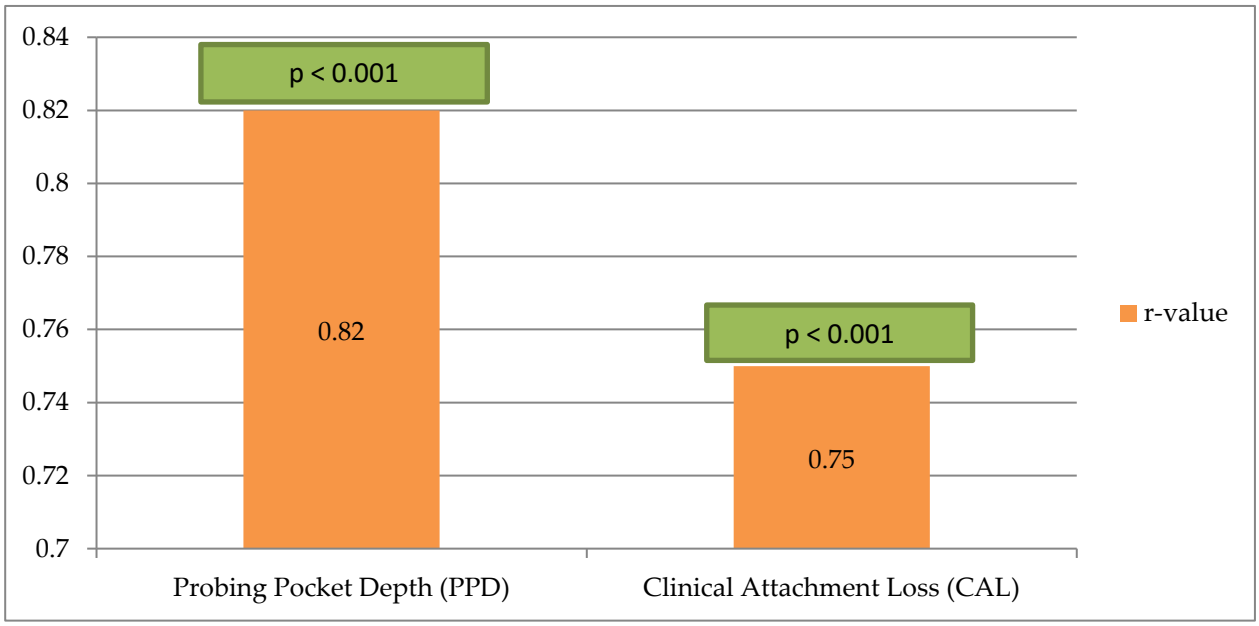
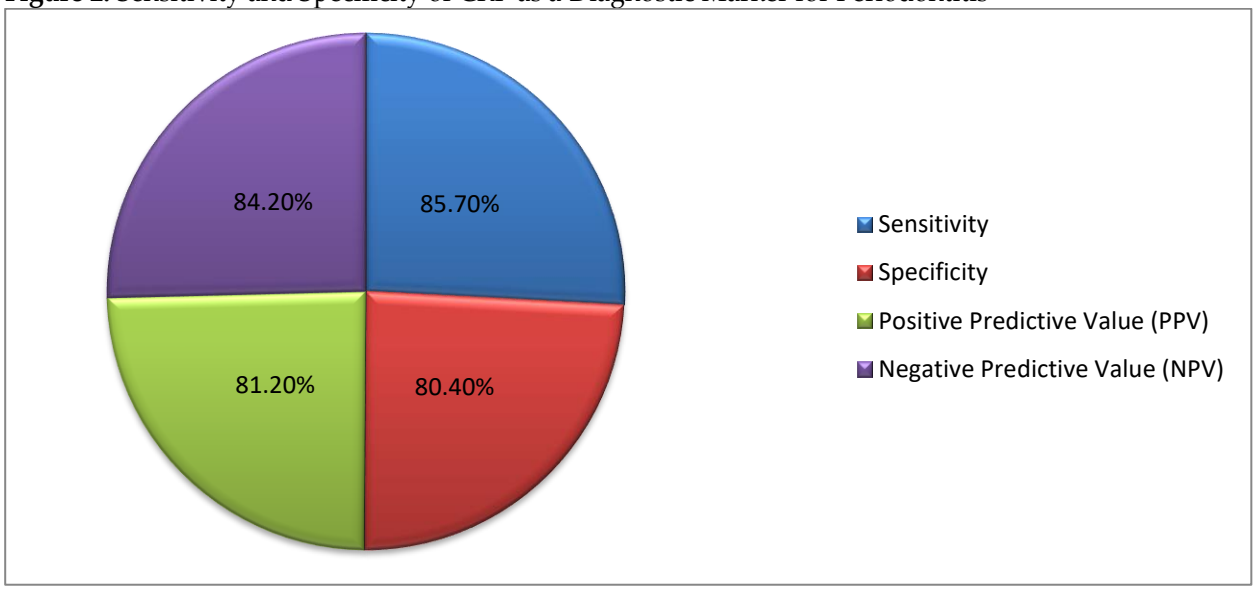


Figure 1: Correlation between Serum CRP Levels and Periodontal Parameters

The specificity was 80.4%, demonstrating a high ability to correctly classify individuals without the disease. Additionally, the positive predictive value (PPV) was 81.2%, suggesting that most individuals with elevated CRP levels truly had periodontitis, while the negative predictive value (NPV) was 84.2%, meaning a majority of individuals with CRP levels below the threshold were indeed periodontal healthy. These results highlight the potential utility of serum CRP as a reliable diagnostic marker for periodontitis, as illustrated in Figure 2.

Figure 2: Sensitivity and Specificity of CRP as a Diagnostic Marker for Periodontitis



Discussion

The purpose of this study was to examine the link between periodontitis and the level of C-reactive protein in healthy individuals. The study found that people suffering from moderate to severe periodontitis had increased levels of serum CRP which hints that periodontal inflammation might be a trigger for general inflammation in other systems. Higher CRP levels are associated with periodontal

disease factors such as PPD and CAL. It appears that periodontal disease can cause health problems not only in the mouth but also throughout the body by increasing inflammation. We found serum CRP to be highly accurate in detecting moderate to severe cases, proving that CRP can be used to easily determine which individuals have a high risk of periodontal disease. Furthermore, the strong correlation between CRP levels and periodontal disease severity highlights the potential of CRP as a predictive tool for monitoring periodontal inflammation and its possible role in systemic conditions.

Previous studies have shown a strong correlation between systemic inflammation and periodontal disease, and they also show that people with periodontitis have much higher blood CRP levels than healthy controls [11]. Consistent with our results, other research has demonstrated elevated CRP levels in patients with severe periodontal disease, indicating that systemic inflammation is exacerbated by periodontal inflammation [12]. The development of certain systemic diseases, such as diabetes, rheumatoid arthritis, and cardiovascular disease, has been connected to elevated CRP levels [13]. The idea that systemic inflammation may be stored in periodontal disease is supported by this body of research [14].

Our study's connection between CRP and clinical periodontal measures like PPD and CAL is consistent with other studies that show greater systemic inflammatory markers are linked to more severe periodontal diseases [15]. The notion that systemic inflammation is a reflection of the degree of inflammation and periodontal damage, is supported by our results of a positive connection between CRP levels and both PPD and CAL [16].

The diagnostic potential of CRP for detecting periodontal disease has been explored in several studies, and our results are consistent with previous reports [17]. The sensitivity and specificity values in our study suggest that CRP could be a useful biomarker for screening individuals at risk of periodontal disease, potentially offering a non-invasive and cost-effective means of early detection. However, while CRP is a promising biomarker, its role in diagnosing periodontal disease is still under investigation, with some studies suggesting that other inflammatory markers might offer even better diagnostic accuracy [18].

Limitation and Future suggestions

It is important to take into account the many limitations of this research. The results may not be as broadly applicable due to the comparatively small sample size. Furthermore, the cross-sectional form makes it more difficult to prove a link between CRP levels and periodontal disease. Unmeasured variables including genetics, nutrition, and dental hygiene may have affected the findings even when systemically healthy people were included to minimize confounding. Not all of the biological aspects of periodontitis are always captured by clinical diagnostics. We can learn a great deal more by using imaging methods or microbiological instruments. To observe how systemic inflammation and periodontal disease evolve over time, further research should use a longitudinal design and study a greater number of people. Additional inflammatory and periodontal biomarkers may help us better understand the disease's impact.

Conclusion

This research suggests that people with periodontal disease tend to have high levels of C-reactive protein even if they are healthy. It is suggested that inflammation in the gums can cause disorders in other parts of the body, especially when CRP is high. Since CRP is accurate and affordable, it can make it easier to identify people with a higher chance of severe periodontal disease. It is necessary to examine these findings with bigger examples of participants and look over a longer period to understand the wider effects of periodontal disease on the body.

Authors' contributions

Conceptualization and supervision: MA, SN; Methodology: SN; Investigation, writing original draft and review: MA, MR, NU; Data collection: MR, MA; Data analysis: NU.

Conflict of interest

The authors declared no conflict of interest.

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