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Clinical Significance of Serum C-Reactive Protein Levels in Oral Premalignancies and Oral Squamous Cell Carcinoma

Adeena Abid, Muhammad Ishaq, Nabeel Hafeez

Abstract

Objective: Assessing serum C-reactive protein (CRP) levels in healthy controls, individuals with oral premalignant disorders, and patients with oral squamous cell carcinoma (OSCC) in order to determine its potential as a screening and diagnostic biomarker.

Study Design and Setting: A cross-sectional study was carried out at PNS Shifa Hospital, Karachi over one-year period using consecutive sampling.

Methodology: Seventy-eight participants were equally divided into three groups: healthy controls (n=26), patients with oral premalignant disorders (n=26) and OSCC patients (n=26). Serum CRP levels were measured using immunoturbidimetry. Statistical analysis was carried out using one-way ANOVA, chi-square test, receiver operating characteristic (ROC) analysis, and multiple regression.

Results: The mean serum CRP level showed significantly higher levels in OSCC patients compared with premalignant and healthy groups ($p<0.001$). There was a progressively increasing trend in CRP levels from healthy controls to premalignant lesions and OSCC. ROC analysis showed acceptable discriminative ability of serum CRP in distinguishing OSCC and premalignant conditions from healthy individuals.

Conclusion: Serum CRP levels show promising ability as a diagnostic and screening tool for oral premalignant and malignant conditions with increasing levels correlating with disease progression. However larger longitudinal studies are recommended to validate these findings.

Keywords: Biomarker; C-reactive protein; CRP; Oral premalignant disorders; OPMD; Oral squamous cell carcinoma

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INTRODUCTION

Oral squamous cell carcinoma (OSCC) is one of the most common malignancies affecting the head and neck region and continues to remain as a major public health concern worldwide. Global Cancer Observatory (GLOBOCAN 2020) reports that oral cancer contributes significantly to cancer-related morbidity and mortality, especially in lower and middle-class countries.[1,2] Despite advances in diagnostic techniques and treatment strategies, the overall survival rate of OSCC has not improved substantially over the past decades. This is largely due to delayed diagnosis and advanced-stage presentation. Oral potentially malignant disorders (OPMDs) including leukoplakia, oral submucous fibrosis, and oral lichen planus are some of the well-known precursors of OSCC. These lesions often precede invasive carcinoma; therefore, they provide an opportunity for early detection along with early intervention. However, predicting malignant transformation is still challenging, as clinical examination and histopathological assessment alone may not reliably identify high-risk lesions.[3] Pakistan has one of the highest burdens of oral cancer globally. This is primarily due to widespread use of smokeless tobacco, betel quid, areca nut, gutka, and naswar. These addictions play a central role in disease development as well as progression. Studies from tertiary care hospitals in Pakistan report that most patients present at an advanced stage, resulting in poor treatment outcomes and reduced overall survival rate.[4,5] This highlights the urgent need for simple, affordable, and non-invasive screening tools suitable for resource-limited healthcare settings such as in countries like Pakistan. Chronic inflammation is now widely known as a key contributor to the process of carcinogenesis. When inflammation continues to persist over time, it promotes cellular proliferation,

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genomic instability, angiogenesis, and tumor invasion.[6,7] C-reactive protein (CRP) is known as an acute-phase protein synthesized by the liver in response to inflammatory cytokines and it serves as a reliable marker of systemic inflammation. Elevated CRP levels have been known to be associated with tumor progression and advanced disease stage It has also been associated with poor prognosis in several malignancies.[8-10]

Recent studies have focused on the role of CRP in oral premalignant and malignant conditions. Raised serum and salivary CRP levels have been seen in patients with OPMDs and OSCC when compared with healthy individuals.[11-14] These findings suggest that CRP reflects the inflammatory microenvironment associated with oral carcinogenesis. However, data from Pakistani populations remain limited, and few studies have evaluated CRP levels across the full spectrum from healthy person to premalignant and carcinoma patients. In lower- and middle-class countries, such as Pakistan, access to advanced diagnostic facilities remains limited, particularly in rural and public-sector healthcare settings. Many patients present at a later stage due to lack of awareness, delayed referral, and absence of affordable screening tools. Blood-based biomarkers are particularly useful in such settings because they are minimally invasive, affordable, and can be measured even in basic laboratory facilities. Among these, systemic inflammatory biomarkers are especially relevant, as chronic inflammation has been known to play a key role in process of oral carcinogenesis. Apart from establishing key risk factors for OSCC, there is an increasing interest in identifying simple and readily available biomarkers that can aid in early detection and diagnosis. In routine clinical settings, especially where advanced diagnostic tools are not easily available, such markers may provide additional information to further support clinical judgment and improve risk stratification. A simple laboratory marker that reflects this inflammatory burden could help clinicians in early identification of individuals at higher risk and decide more quickly which patients should be referred for further assessment. Therefore, exploring the clinical utility of routinely available inflammatory markers may help bridge the gap between early suspicion and definitive diagnosis in resource-constrained environments such as Pakistan. Given the higher prevalence of oral cancer in Pakistan and the limitations associated with the existing screening approaches, this study was designed to evaluate serum CRP levels among healthy individuals, patients with oral premalignant disorders, and those diagnosed with OSCC. The objective was to evaluate the potential role of serum CRP levels as a screening and diagnostic tool and to examine its association with the progression of the disease.

METHODOLOGY

A cross-sectional study was done at the Dental Department of PNS Shifa Hospital, Karachi. Study period was of 6 months from 1st June 2025 to 1st Nov 2025. Sampling technique was non-probability consecutive sampling. Random sampling was not done. The study was reviewed and approved by the Institutional Review Board of the Ethical Committee, PNS Shifa Hospital with ERC approval number Ref# ERC/2022/DENTAL/21 dated 13 July 2022. Written informed consent was taken from all the study participants before enrollment. The study was done according to the principles of the Declaration of Helsinki. Sample size of 78 patients was calculated from WHO sample size calculator by taking standard deviation of CRP levels as 4.50, margin of error as 1 and 95% confidence interval. A total of 78 participants were included and divided equally into three groups (n = 26 each):

Group I: Healthy controls with no history of oral lesions, malignancy, or systemic inflammatory disease.

Group II: Patients diagnosed with oral premalignant disorders, including leukoplakia, oral submucous fibrosis, and oral lichen planus.

Group III: Patients with histopathologically confirmed oral squamous cell carcinoma.

Individuals aged 18 years and above were eligible for inclusion including healthy cohorts, those with OPMDs and those with OSCC. Patients with any acute or chronic infections, autoimmune disorders, systemic inflammatory diseases, cardiovascular disease, hepatic disease, or those receiving anti-inflammatory or immunosuppressive therapy were excluded to avoid confounding effects on serum CRP levels. Pregnant and lactating women were also excluded. The inclusion and exclusion criteria were based specifically on the study design. Venous blood samples were taken under aseptic conditions from all study participants. Serum was separated by centrifugation and analyzed for CRP levels using the immunoturbidimetric method in the hospital laboratory after following standard operating procedures. The assay was performed using commercially available kits according to the instructions given by the manufacturer. The lower detection limit of the CRP assay was set at 0.1 mg/L.

Data was analyzed using SPSS version 26. Quantitative data were reported as mean values with standard deviations. The Qualitative data were described using frequencies and percentages. One-way ANOVA was used to compare mean CRP levels among the three study groups. This was followed by post-hoc analysis where appropriate. The chi-square test was applied to assess the associations between categorical variables. Receiver operating characteristic (ROC) curve analysis was performed to evaluate the diagnostic performance of serum CRP. Multiple regression analysis was performed with serum CRP as the dependent variable and disease group, age, and gender as independent variables. A p-value of <0.05 was considered statistically significant.

RESULTS

78 participants were enrolled in the study, with 26 individuals in each group. The key demographic features of the study participants are presented in Table 1. The mean age of participants increased progressively across the three groups and was highest in Oral squamous cell carcinoma (OSCC) patients. A significant variation in age distribution was found between the groups ($p = 0.008$). A male predominance was noted in the OSCC group in comparison to the premalignant and the healthy control group. This difference was noted to be statistically significant ($p = 0.025$). Socioeconomic status also differed significantly among the groups, with a higher proportion of OSCC patients belonging to the lower socioeconomic class ($p = 0.018$). The mean serum CRP levels of the three study groups are presented in Table 2. Serum CRP levels demonstrated a clear progressive increase moving from the healthy control group to patients with oral premalignant disorders and were highest among OSCC patients. One-way analysis of variance revealed a statistically significant difference in mean CRP levels among the groups ($p < 0.001$). Post-hoc analysis showed that CRP levels in OSCC patients were significantly higher than those in both premalignant cases and healthy controls.

Subgroup analysis of oral premalignant disorders was performed to evaluate differences in serum CRP levels among various premalignant lesions (Table 3). Patients with oral submucous fibrosis showed relatively higher mean CRP levels compared to those with leukoplakia and oral lichen planus. However, the observed differences among premalignant subgroups were not statistically significant ($p > 0.05$). (Table 4) Receiver operating characteristic (ROC) curve analysis showed that serum C-reactive protein (CRP) had acceptable diagnostic accuracy in differentiating oral squamous cell carcinoma (OSCC) from healthy controls, with an AUC of 0.82 (95% CI: 0.72–0.91). At a cut-off value of 4.5 mg/L, CRP demonstrated a sensitivity of 80.8% and specificity of 76.9% (Table 5). Moderate discriminative ability was observed when OSCC was compared with oral premalignant disorders (AUC: 0.71), while CRP showed modest performance in distinguishing premalignant disorders from healthy controls (AUC: 0.69). These findings are in support of the potential role of serum CRP as an adjunctive screening biomarker when used alongside clinical assessment. In addition to the primary comparisons, variability in CRP values was observed within each study group. Although mean levels differed significantly, individual measurements showed a degree of overlap, particularly between the premalignant and malignant groups. This finding reflects the biological diversity of inflammatory responses among patients and emphasizes that CRP should be interpreted in conjunction with clinical features rather than as an isolated indicator. Overall, the results showed a noticeable difference between the groups, with higher values generally seen in the malignant cases compared to the premalignant and control groups. It is also important to note that some participants did not strictly follow the overall trend of increasing values. This is to be expected in clinical data as it usually is reflective of individual variability. In some of the cases, values were slightly higher or lower than the

Table 1. Demographic Characteristics of Study Population (n=78)

Parameter	Group I: Healthy Controls (n=26)	Group II: Oral PMDs (n=26)	Group III: OSCC (n=26)	p-value
Age (Years)				
Mean	36.2 ± 9.4	42.8 ± 10.1	54.6 ± 11.3	**0.008***
Range	(20–55)	(20–65)	38-76	
Gender, n(%)				
Male	13 (50.0%)	17 (65.4%)	22 (84.6%)	**0.025***
Female	13 (50.0%)	9 (34.6)	4 (15.4%)	
Socioeconomic Status, n (%)				
Lower	8 (30.8)	15 (57.7%)	18 (69.2%)	**0.018***
Middle	12 (46.2%)	9 (34.6%)	7 (26.9%)	
Upper	6(23.1%)	2 (7.7%)	1 (3.8%)	

Table 2: Serum CRP Levels Across Study Groups (n = 78)

CRP Levels (mg/L)	Group I: Healthy Controls	Group II: OPMDs	Group III: OSCC
N	26	26	26
Mean ± SD	5.12 ± 2.48	5.12 ± 2.48	8.87 ± 3.41
Median (IQR)	4.90 (3.4–6.8)	4.90 (3.4–6.8)	8.60 (6.2–11.4)
Range	1.2–10.9	1.2–10.9	3.3–16.8

One-way ANOVA; Post-hoc analysis (Tukey's HSD): Group III > Group II > Group I ($p < 0.001$)

Table 3. CRP Levels in Different Types of Oral Premalignant Disorders

OPMD Type	N (%)	Mean CRP ± SD (mg/L)	Median (IQR)	Range
Oral Leukoplakia	9 (34.6)	4.61 ± 2.12	4.40 (3.1–5.8)	1.2–8.9
Oral Submucous Fibrosis	10 (38.5)	5.74 ± 2.63	5.60 (3.9–7.1)	2.1–10.9
Oral Lichen Planus	7 (26.9)	4.89 ± 2.21	4.70 (3.2–6.3)	1.5–9.4

Table 4. Pairwise Comparison of CRP Levels Among OPMDs (Independent t-t

Comparison	p-value	Significance
Oral Leukoplakia vs Oral Submucous Fibrosis	0.315	Not Significant
Oral Leukoplakia vs Oral Lichen Planus	0.802	Not Significant
Oral Submucous Fibrosis vs Oral Lichen Planus	0.482	Not Significant

p-values obtained using independent t-test; p < 0.05 considered statistically significant

Table 5. ROC Analysis for CRP as Diagnostic Marker

Group Comparison	AUC (95% CI)	Cut-off Value (mg/L)	Sensitivity (%)	Specificity (%)	p-value
OSCC vs Healthy Controls	0.82 (0.72–0.91)	4.5	80.8	76.9	<0.001
OSCC vs OPMDs	0.71 (0.60–0.82)	6.3	73.1	65.4	<0.002
OPMDs vs Healthy Controls	0.69 (0.58–0.80)	3.2	69.2	64.0	<0.006

AUC = Area under the curve; OSCC = Oral squamous cell carcinoma; OPMDs = Oral Premalignant disorders. ROC analysis was done evaluate the diagnostic accuracy of serum CRP. An AUC value between 0.7 and 0.9 indicates acceptable diagnostic performance

DISCUSSION

Oral squamous cell carcinoma continues to be a major public health challenge in Pakistan due to late-stage presentation, limited screening strategies, and a high prevalence of associated risk factors. Identifying biomarkers that are both simple and widely available is therefore of clinical importance, especially for improving early detection and risk stratification. The present study evaluated serum C-reactive protein levels across healthy individuals, patients with oral premalignant disorders, and those with OSCC. It demonstrated a clear and progressive rise in CRP levels with increasing disease severity. The most notable finding of this study was the significant elevation of serum CRP levels in OSCC patients when compared with both healthy controls and patients with oral premalignant disorders. This finding was consistent with those of Metgud et al and Vankadara et al.[15,16] This observation is in support of the role of chronic systemic inflammation in process of oral carcinogenesis.[7]

CRP is a well-established acute-phase reactant produced by hepatocytes in response to inflammatory cytokines such as interleukin-6. Persistently raised CRP levels may reflect ongoing inflammatory and immune disturbances within the tumor microenvironment, which can contribute to both the development and progression of cancer.[7,8] Patients with oral premalignant disorders exhibited intermediate CRP levels, which were significantly higher than those of healthy controls but lower than those observed in patients with OSCC. This graded increase suggests that systemic inflammation may begin early in the disease process, even before malignant transformation takes place. This closely aligns with the findings of Singh et al.[11] Similar findings have been reported in previous studies, which demonstrated elevated serum and salivary CRP levels in patients with leukoplakia, oral submucous fibrosis, and oral lichen planus.[16] These findings are collectively in the support of the concept that CRP may serve as an early indicator of malignant potential. Subgroup analysis of premalignant disorders showed higher CRP levels in patients with oral submucous fibrosis compared to leukoplakia and oral lichen planus, However the differences were not found to be statistically significant. This trend may be explained by the chronic inflammatory nature of oral submucous fibrosis, which is already known to carry a higher risk of malignant transformation as discussed by Gossavi et al and Tang et al.[14,17] The lack of statistical significance may be due to the relatively small sample size within each premalignant subgroup. This is a limitation commonly encountered in single-center studies. Demographic analysis revealed a higher mean age and a marked male predominance among OSCC patients. These findings are consistent with the local and regional epidemiological data from Pakistan as explored by Saeed et al.[18] The higher prevalence of OSCC in males may be linked to greater exposure to known risk factors such as tobacco, betel quid, areca nut, and smokeless tobacco products. Additionally, a significant association between advanced stage presentation was observed as similarly reported by Memon et al.[19] This highlights the role of social determinants of health, limited access to healthcare, and delayed diagnosis in disease progression. These findings are consistent with findings of Yuktha et al.[20] Receiver operating characteristic analysis demonstrated acceptable discriminative ability of serum CRP in distinguishing OSCC patients from healthy controls, suggesting potential utility as a screening adjunct. While CRP lacks disease specificity, its low cost, wide availability, and ease of measurement make it an attractive candidate for use in resource-limited settings such as Pakistan. When used alongside clinical examination and histopathological findings, CRP may help identify individuals at higher risk who would benefit from closer follow-up and surveillance.[21,22]

The major challenge for clinicians is not just to diagnose the disease but to decide which patient is going to need urgent attention. At the time of presentation, many patients have oral lesions that appear mild or non-specific, yet they may carry significant malignant potential. This leads to an uncertainty for both the clinicians and patients, especially when access to specialized tests is limited. In such cases

serum CRP levels could provide additional context while being easily affordable and accessible. While it may not confirm malignancy, an elevated level may warrant a need for a detailed evaluation or an earlier referral.[3,8] Many oral potentially malignant disorders do not always behave uniformly. Some lesions may remain stable for years, while others may spread aggressively. Clinical appearance alone may not be sufficient enough to predict this behavior.[3] Use of a simple blood test that mirrors ongoing inflammation and tissue injury can help to identify lesions that are more active biologically. Corelating clinical examination with CRP levels could contribute to a more accurate risk assessment. These findings suggest a more structured approach of integrating laboratory markers with clinical assessment rather than simply relying on a single parameter. While individual values may vary, the overall trend helps in studying disease behavior. This combination approach may help further in enhancing clinical decision-making and support a more tailored patient management strategies in everyday practice. The actual value of serum CRP levels lies in its simplicity rather than its specificity. Although CRP alone may not replace the need of a histopathological diagnosis, it can still be considered as an adjunctive marker and may be particularly useful in settings where access to specialized testing is limited. As CRP testing is already part of routine medical practice, there is no need for additional training or equipment. In populations where there is a high prevalence of tobacco and areca nut usage, we can identify high risk patients and improve clinical decision making simply by incorporating such a readily available test into initial assessment protocols. By observing the rise in CRP levels across disease stages, we can also interpret this finding from a biological perspective. The process of Oral carcinogenesis is accompanied by ongoing tissue injury, immune system activation, and the increased release of inflammatory mediators. With the intensification of these processes there is a gradual rise in systemic makers such as CRP levels. These changes also mirror the transition from premalignant change to invasive malignancy.

Inflammation in general is not specific to cancer; however, its persistence and magnitude may reflect disease activity. Therefore, by measuring CRP levels we can get a glimpse into the broader physiological response associated with tumour progression. With careful interpretation we can use this information to get a more comprehensive assessment of patients who present with suspicious oral lesions. The observed overlap in the CRP values across the premalignant and malignant cases in this study are clinically meaningful as it indicates that CRP alone cannot be used to make clinical decisions, rather it suggests that its usage should be as a supportive adjuvant alongside clinical examination and histopathological evaluation. Patients who are presenting with borderline or moderately elevated CRP levels may benefit from closer follow-up and timely reassessment, especially when their lesions appear suspicious or seem to be progressing over time. When viewing from a healthcare system perspective, by using routinely available laboratory parameter, we are optimizing resource allocation. When it comes to settings where advanced imaging and specialist referral are limited, such as in the rural areas of Pakistan, we may be able to prioritize patients requiring urgent diagnostic workup simply with the use of readily available blood test such as serum CRP levels. By using this approach, we are not replacing definitive diagnostic procedures, rather this approach will contribute to earlier recognition of high-risk cases. When viewed together, these observations reinforce the potential value of CRP as a simple adjunctive tool that supports clinical judgment. It also enhances the overall assessment of patients with oral lesions. Study Limitations: This study has several limitations that need consideration. The small sample size that was drawn from a single center limits the generalizability of the data to broader populations. The study design was cross sectional which hinders the ability to establish a casual relationship between CRP levels and disease progression. As Serum CRP levels is a non-specific inflammatory marker it can easily be influenced by systemic factors and conditions even though efforts were made to exclude known confounders. Variability within study groups and overlap in CRP values also show that CRP should not be used alone for diagnosis. Further studies with larger sample size and conducted at multiple centers along with a longitudinal follow up are needed to better identify the usefulness of serum CRP levels.

CONCLUSION

Serum C-reactive protein levels show a progressively increasing trend from healthy individuals to patients with oral premalignant disorders and are the highest in oral squamous cell carcinoma patients. This pattern is suggestive of the role of systemic inflammation in process of oral carcinogenesis. As serum CRP levels are easily accessible and affordable, they may serve as a useful tool for screening and risk stratification in populations with a high burden of oral cancer especially in countries such as Pakistan. However, larger prospective studies are needed to establish standardized cut-off values and confirm its prognostic significance. This highlights the importance of involving simple laboratory investigations into routine dental appointments, this can lead to earlier recognition of disease and timely intervention. The findings suggest that CRP levels can play an important role as a screening and diagnostic tool for earlier detection of Oral cancer as the results show an increasing trend of Serum CRP levels as the disease progresses.

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Authors Contribution:
Adeena Abid: Conceptualization, literature review, manuscript writing, final approval study design, data collection, data analysis and interpretation
Muhammad Ishaq: Overall supervision, data interpretation, Proof reading.
Nabeel Hafeez: Initial supervision, conceptual development and study design

REFERENCES

1. Bray F, Laversanne M, Weiderpass E, Soerjomataram I. The ever-increasing importance of cancer as a leading cause of premature death worldwide. Cancer. 2021;127(16):3029–3030. DOI: https://doi.org/10.1002/cncr.33587
2. Ferlay J, Ervik M, Lam F, et al. Global Cancer Observatory: Cancer Today. Lyon: International Agency for Research on Cancer; 2020. Available from: https://gco.iarc.fr/today [cited 2026 Jan 17].
3. Warnakulasuriya S, Kujan O, Aguirre-Urizar JM, et al. Oral potentially malignant disorders: a consensus report from an international seminar on nomenclature and classification. Oral Dis. 2021;27(8):1862–1880. DOI: https://doi.org/10.1111/odi.13704
4. Farooq U, Khan AH, Ali S, et al. Clinical presentation and staging of oral squamous cell carcinoma in a tertiary care hospital of Pakistan. Pak J Med Sci. 2019;35(6):1612–1617. DOI: https://doi.org/10.12669/pjms.35.6.742
5. Khan S, Alamgir MM. Oral carcinogenesis and non-invasive biomarkers for the diagnosis of oral squamous cell carcinoma. J Pak Med Assoc. 2024;74(2):370–373. DOI: https://doi.org/10.47391/JPMA.9020
6. Greten FR, Grivennikov SI. Inflammation and cancer: Triggers, mechanisms, and consequences. Immunity. 2019;51(1):27–41. DOI: https://doi.org/10.1016/j.immuni.2019.06.025
7. Wang M, Chen S, He X, et al. Targeting inflammation as cancer therapy. J Hematol Oncol. 2024;17(1):13. DOI: https://doi.org/10.1186/s13045-024-01528-7
8. Kim ES, Kim SY, Moon A. C-reactive protein signaling pathways in tumor progression. Biomol Ther (Seoul). 2023;31(5):473–483. DOI: https://doi.org/10.4062/ biomolther.2023.132
9. Gwenzi T, Zhu A, Schrotz-King P, et al. Prognostic value of post-operative C-reactive protein-based inflammatory biomarkers in colorectal cancer patients: a systematic review and meta-analysis. Clin Epidemiol. 2023;15:795–809. DOI: https://doi.org/10.2147/CLEP.S415171
10. Zhang W, Zhang Z, Qian L. Prognostic and clinicopathological significance of C-reactive protein in patients with ovarian cancer: a meta-analysis. World J Surg Oncol. 2024;22:8. DOI: https://doi.org/10.1186/s12957-023-03290-5
11. Singh P, Gupta ND, Bey A, et al. Evaluation of serum C-reactive protein levels in patients with oral premalignant disorders and oral squamous cell carcinoma: a case–control study. J Oral Biol Craniofac Res. 2022;12(3):402–406. DOI: https://doi.org/10.1016/j.jobcr.2022.03.012
12. Kaur J, Srivastava A, Kaur R, et al. Comparative evaluation of salivary and serum C-reactive protein levels in oral premalignant disorders and oral squamous cell carcinoma. J Oral Maxillofac Pathol. 2021;25(2):271–276. DOI: https://doi.org/10.4103/jomfp.JOMFP_276_20
13. Sharma M, Singh S, Sood S, et al. Serum C-reactive protein levels in oral squamous cell carcinoma: correlation with clinicopathological parameters. Asian Pac J Cancer Prev. 2022;23(5):1617–1622. DOI: https://doi.org/10.31557 /APJCP.2022.23.5.1617
14. Gosavi SR, Torkadi AA. Serum C-reactive protein in oral submucous fibrosis and oral squamous cell carcinoma: a cross-sectional study. J Oral Maxillofac Pathol. 2020;24(1):46–51. DOI: https://doi.org/10.4103/jomfp.JOMFP_215_19
15. Metgud R, Bajaj S. Altered serum and salivary C-reactive protein levels in patients with oral premalignant lesions and oral squamous cell carcinoma. Biotechnic Histochem. 2016;91(2):96–101. DOI: https://doi.org/10.3109/10520295.2015.1084023
16. Vankadara S, Padmaja K, Balmuri PK, Naresh G, Vikas Reddy G. Evaluation of serum C-reactive protein levels in oral premalignancies and malignancies: a comparative study. J Dent (Tehran). 2018;15(6):358–364. DOI: https://doi.org/10.18502/jdt.v15i6.329
17. Tang J, Liu J, Zhou Z, et al. Oral submucous fibrosis: pathogenesis and therapeutic approaches. Int J Oral Sci. 2025;17:8. DOI: https://doi.org/10.1038/s41368-024-00344-6
18. Saeed M, Khan MU, Qureshi SM, et al. Clinicodemographic profile of oral squamous cell carcinoma patients presenting to a tertiary care hospital in Pakistan. J Pak Med Assoc. 2022;72(9):1765–1769. DOI: https://doi.org/10.47391/JPMA.4105
19. Memon Z, Shaikh S, Panhwar MS, et al. Oral cancer: clinicopathological features and associated risk factors in a high-risk population presenting to a major tertiary care center in Pakistan. PLoS One. 2020;15(8):e0236359. DOI: https://doi.org/10.1371/journal.pone.0236359
20. Yuktha A, Bandari SC, Fathima SJH, et al.Determinants of diagnostic delays in oral squamous cell carcinoma: insights from demographic and socio-economic factors. Asian Pac J Cancer Prev. 2024;25(11):3997–4003. DOI: https://doi.org/10.31557/APJCP.2024.25.11.3997
21. Zhang Z, Li Y, Yan X, et al. Diagnostic and prognostic value of C-reactive protein in patients with solid tumors: a systematic review and meta-analysis. Front Oncol. 2022;12:849800. DOI: https://doi.org/10.3389/fonc.2022.849800
22. Sproston NR, Ashworth JJ. Role of C-reactive protein at sites of inflammation and infection. Front Immunol. 2018;9:754. DOI: https://doi.org/10.3389/fimmu.2018.00754