



Analysis of White Blood Cell Count and Its Differential Count in Gingival and Periodontal Conditions Associated with Bleeding Gingiva

L. Sai Charan ^a, Palati Sinduja ^{b*} and R. Priyadarshini ^b

^a Saveetha Dental College and Hospital, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University, Chennai-77, Tamil Nadu, India.

^b Department of Pathology, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University, Chennai-77, Tamil Nadu, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JPRI/2021/v33i60A34566

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/78010>

Original Research Article

Received 15 October 2021
Accepted 20 December 2021
Published 21 December 2021

ABSTRACT

Background: Bleeding gingiva is caused primarily due to the accumulation of plaque and calculus which eventually leads to gingivitis or periodontitis. Other causes of bleeding gingiva can be due to improper flossing, over brushing of the teeth and gingiva, hormonal changes due to pregnancy, ill-fitting dentures and any other dental appliances impinging the gingiva. The bleeding gingiva can also indicate serious health problems like leukemia, scurvy, idiopathic thrombocytopenic purpura, vitamin k deficiency and any bleeding disorder. Persistent gingival bleeding is a sign of serious medical problems like leukemia and platelet disorders. Leukemia is a group of cancer where there is an increased number of immature or abnormal white blood cells. In this study, the WBC and their differential count is analyzed in patients with bleeding gingiva to check the possibilities for the patient to get cancer.

Aim: To measure and observe the WBC count and its differentials by testing the blood from patients with bleeding gingiva.

Materials and Methods: The study was conducted in the clinical pathology lab at Saveetha Dental College and Hospitals, Chennai. 100 subjects were subjected to the study. Subjects with chief complaint of bleeding gingiva, without systemic diseases like diabetes, hypertension, and patients with the age of above 10 were included in the study.

Results and Conclusion: This study was conducted to analyze the WBC count and differential count among the patients with bleeding gingiva. No significant correlation was found between bleeding gingiva and white blood cells & their differential count in this study.

Keywords: WBC; differential count; neutrophil; lymphocytes; monocytes; eosinophil; bleeding gingiva; innovative method.

1. INTRODUCTION

Bleeding gingiva is caused primarily due to the accumulation of plaque and calculus, which eventually leads to gingivitis or periodontitis. Other causes of bleeding gingiva can be due to improper flossing, over brushing of the teeth and gingiva, hormonal changes due to pregnancy, ill-fitting dentures, and any other dental appliances impinging the gingiva. The bleeding gingiva can also indicate serious health problems like leukemia, scurvy, idiopathic thrombocytopenic purpura, vitamin k deficiency and any bleeding disorders [1].

The WBC count and differential count is the most basic measure for analyzing bleeding gingiva. White blood cells may be counted manually or with automated counters in specially built chambers (Neubauer). The latter is commonly used because it offers greater precision and speed than manual techniques. A drop of blood is thinly scattered over a glass slide, air-dried, and stained with a Romanowsky stain, most commonly the Wright or May-Grunwald-Giemsa method, to assess the differential. After that, 200 cells are counted and classified. Though machines have been developed to perform automated differential counts, they are not as effective as manual techniques with regards to reliability and ability to discover morphologic abnormalities [2].

Neutrophil chemotaxis and phagocytic activity may be assessed in the laboratory. The skin window method is semi quantitative, but it has the benefit of being easy. An abrasion is produced in the epidermis, which is then sealed with a glass cover slide for a few hours and stained to look for attached granulocytes. More complex in vitro systems have been developed, the majority of which are focused on neutrophils' ability to navigate a specific obstacle to reach an appealing stimulus [2,3].

The white blood cell and its differential count determine the total number and each type of white blood cell present in the blood. Generally, each WBC type has its unique feature. Neutrophils serve as the primary defense against

infection. Eosinophils play a role in allergic disorders and in combating parasitic infections. Basophils digest bacteria and other foreign bodies (phagocytosis) and also have some role in an allergic reaction, monocytes respond to inflammation, infection, and foreign bodies by ingesting and digesting the foreign particles [4]. Lymphocytes play both an immediate and delayed role in response to infection or inflammation [5]. Our team has extensive knowledge and research experience that has translate into high quality publications [6]. [7–20], [21–25]. This study aims to analyze the total WBC count and differential counts in the bleeding gingiva.

2. MATERIALS AND METHODS

This study was conducted in the clinical pathology lab at Saveetha Dental College and Hospitals, Chennai. 100 subjects were included in the study. Prior to the initiation of the study the ethical approval was provided by the institutional ethical committee. Subjects above the age of 10 were included in the study with chief complaint of bleeding gingiva, without any systemic diseases like diabetes, hypertension and with infections. Written consent was obtained from the subjects regarding collection and usage of their blood for our study purposes. A blood sample of about 2ml was collected from each patient in EDTA vacutainer tubes and was fed into 3 part automated colter counter method and analyzed. Only the total WBC count and their differential count were analyzed in this study, these counts were done using the auto- analyzer available in the institution. A Student t-test was performed to find out the significance of WBC and its differential count among patients with bleeding gingiva.

3. RESULTS AND DISCUSSION

Among the 100 patients, 60 were males and 40 were females. WBC count was normal for 97 subjects. WBC count was less than normal (<4000 cells per cubic mm) for 2 subjects and greater than normal (>11000 cells per cubic mm) for 1 subject. Neutrophil count was normal for

almost all the patients. It was less than normal (<40%) for one subject and more than normal (>75%) for 2 patients. Lymphocyte count was normal for 86 subjects, more than normal (>40%) for 13 subjects, and less than normal (<20%) for

1patient. The Eosinophil count was normal (2-6%) for all the subjects. No significant difference was found in the WBC and its differential count between the male and female subjects.

Table 1. Average total count of white blood cells, neutrophils, lymphocytes, eosinophils in males

Age (in years)	Total count WBC	Neutrophils	Lymphocytes	Eosinophil
10-20	9042.9	57.9	38	4.2
20-40	8160.7	62.7	33.9	3.7
>40	8687.5	62.3	33.9	3.7

Table 2. Average total count of white blood cells, neutrophils, lymphocytes, eosinophils in females

Age (in years)	Total count WBC	Neutrophils	Lymphocytes	Eosinophil
10-20	8925	61	35.5	3.5
20-40	7942.9	61.5	34.7	3.7
>40	8633.3	57.8	38.6	3.5

Table 3. Normal value of total white blood cell count, neutrophil, lymphocyte, and eosinophil

Total count WBC	4000-11000 cells/mm ³
Neutrophils	40-75%
Lymphocyte	20-40%
Eosinophil	1-6%

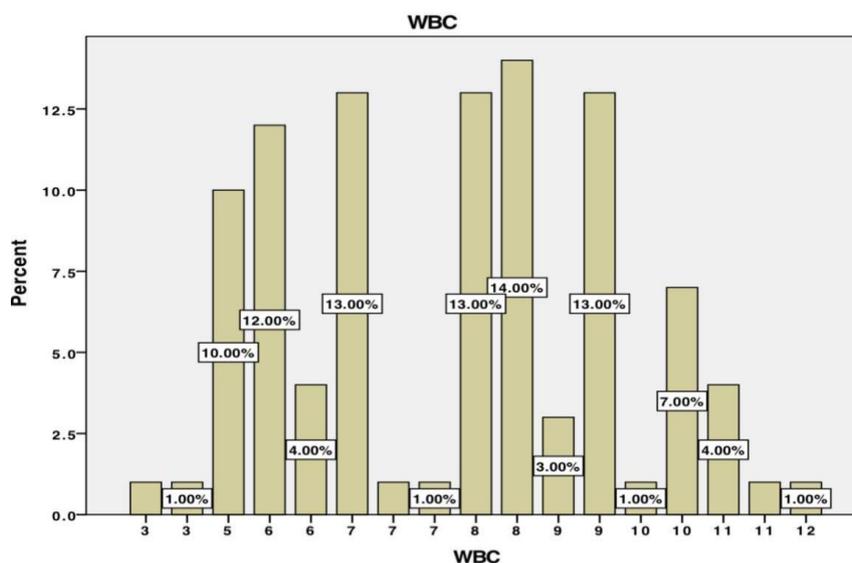


Fig. 1. Percentage distribution of white blood cells in the study subjects, Y-axis representing the percentage of population and X-axis representing WBC count. The least 1% of population have 3000 cells, 7000cells, 10,000 cells and 12,000cells per cubic millimeter of blood, 10% have 5000 cells per cubic millimeter of blood, 16% have 6000 cells per cubic millimeter of blood, 13% of population have both 7000 cells and 9000 cells per cubic millimeter of blood. 14% of the people involved in this study are have around 8,000 cells per cubic millimeter of blood, 3% have 9000 cells per cubic millimeter of blood, 7% of population have 10,000cells per cubic millimeter of blood, 4% of the population have 11,000 cells per cubic millimeter of blood

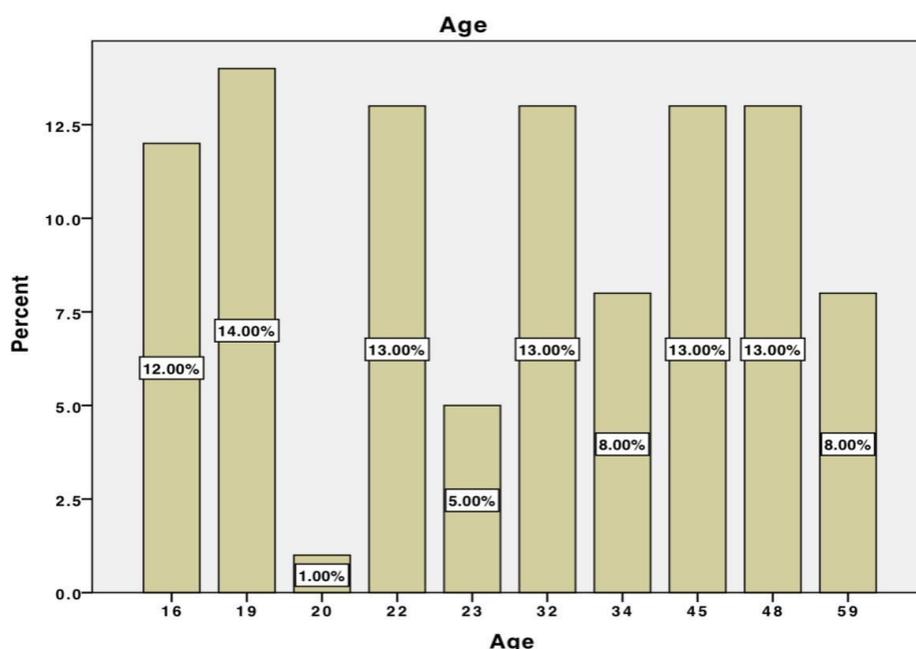


Fig. 2. Percentage population among the various age groups, Y-axis representing the percentage population and X-axis representing the age. 12% of the population in the study belongs to age group of 16 years, 14% belongs to 19 years, 1% belongs to 20 years, 13% belongs 22 years, 5% belongs to 23 years, 13% belongs to 32 years, 8% belongs to 34 years, 13% belongs to 45 years to 48 years, 8% of population belongs to above 50 years of age

This study was conducted to analyze the WBC count and differential count among the patients with bleeding gingiva. Figure 1 shows the Percentage distribution of white blood cells in the study subjects. The highest percentage observed in the graph is 14% of the people involved in this study are having around 8,000 cells per cubic millimeter of blood and the least is 1% of people are involved in this study are having 3,000 and 12,000 cells per cubic millimeter of blood. Fig 2 shows the Percentage population among the various age groups. The highest percentage observed is 14% of the total population are the age group of 19 years and least observed is only 1% of the age group of 20 years.

The research was conducted on 100 patients with chronic periodontitis. In the subjects, there were no evident changes in the values of clinical parameters of periodontitis when compared to normal values [26]. Table 1 shows the average value of the total count of white blood cells, neutrophils, lymphocytes, eosinophils in males. Males with bleeding gingiva, in the age group of 10-20 years showed a mean value of total WBC count was 9042.9 cells/cubic mm, in the age group of 20-40 years have a mean value of total WBC count was 8160.7cells/cubic mm and in the age group of above 40 years showed a mean

value of total WBC count was 8687.5 cells/cubic mm. When we compared all the age groups, the mean value of the WBC count is more in the age group of 10-20 years when compared to other age groups. The chi-square analysis was done to rule out the association, in which we found that there is no significant association between the age group of males with bleeding gingiva and the WBC counts [27,28].

Table 2 shows the average total count of white blood cells, neutrophils, lymphocytes, eosinophils in females. Females with bleeding gingiva, in the age group of 10-20 years showed a mean value of total WBC count was 8925 cells/ cubic mm, in the age group of 20-40 years showed a mean value of total WBC count was 7942.9cells/cubic mm and females of the age group of above 40 years showed a mean value of total WBC count was 8633.5 cells/cubic mm. When we compared the WBC count among the different age groups of females who have bleeding gingiva, males' females with 10-20 years have a higher WBC count than the other age groups. Chisquare analysis showed that there is no significant difference in the age groups of females with bleeding gingiva and WBC counts. A study done by Ajmani et al in 2017, showed that drug-induced pancytopenia leads to bleeding gingiva.

In this study, the author highlighted that WBC count in females with elderly age group had a low total count, which was well correlated with our study [29].

Table 3 shows the value of total white blood cell count, neutrophil, lymphocyte, and eosinophil.

Except for neutrophils, other WBC differentials which are lymphocyte and eosinophil are normal in both males and females in the bleeding gum patients, but when analyzing the neutrophils, a slight increase in the number of neutrophils is observed in the bleeding gum patients in both males and females by comparing table 1 and table 2 with table 3. The mean value of WBC and its differential count was normal in both males and females with bleeding gingiva. It was found correlated with the previous study done in 2021 by Alnor et al. [30].

The mean value of WBC and its differential count was normal in both males and females. The normal value of the WBC is 4000 to 11000 cells/cm [31], the normal value for neutrophils is 40-75%, the normal value of lymphocytes is 20-40% and the normal value of eosinophil is 1-6%. Earlier studies [32] have demonstrated elevation of total leukocyte count in periodontitis [33,34] and lowering of leukocyte levels following periodontal therapy [33,35]. Exaggerated leukocytes and neutrophils of host response are a very important component in the pathogenesis of periodontal disease. Hyper-reactive white blood cells can be induced in patients with infections such as periodontal disease and promote atherosclerosis at distant sites, particularly in areas of disturbed blood flow [36]. This hyper-reactivity might be due to their circulating through the periodontal lesions or might be a constitutive feature of patients with periodontal disease [34]. The minor bleeding from the gingiva, may not alter the WBC counts and differential counts for both males and females. Vice versa, the moderate to severe reduction in WBC counts and differential counts leads to bleeding gingiva in both males and females.

This study included the patients with only bleeding gingiva, no other systemic illnesses were included. These limitations may be overcome in the future by including systemic illnesses which cause bleeding gingiva as defining criteria.

4. CONCLUSION

Within the limitations of the study, we conclude that there is no association between the WBC count and differential counts among the males and females with bleeding gingiva. The statistical analysis also proved the same. Hence, minor bleeding from the gingiva will not produce any changes in the WBC parameters.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Chow AW, Evans GA, Nathens AB, Ball CG, Hansen G, Harding GK, et al. Canadian practice guidelines for surgical intra-abdominal infections. *Can J Infect Dis Med Microbiol.* 2010 Spring;21(1):11–37.
2. Lim E-M, Cembrowski G, Cembrowski M, Clarke G. Race-specific WBC and neutrophil count reference intervals [Internet]. Vol. 32, *International Journal of Laboratory Hematology.* 2010. p. 590–7. Available: <http://dx.doi.org/10.1111/j.1751-553x.2010.01223.x>
3. Hannah R, Ramani P, Brundha MP, Sherlin HJ, Ranjith G, Ramasubramanian A, et al. Liquid Paraffin as a Rehydrant for Air Dried Buccal Smear. *Research Journal of Pharmacy and Technology.* 2019;12(3):1197–200.
4. Improving Diagnosis in Health Care [Internet]. *Military Medicine.* 2016;181: 183–5. Available:<http://dx.doi.org/10.7205/milmed-d-15-00562>
5. Harsha L, Brundha MP. Prevalence of Dental Developmental Anomalies among Men and Women and its Psychological Effect in a Given Population. *Journal of*

- Pharmaceutical Sciences and Research; Cuddalore. 2017 Jun 20;9(6):869–73.
6. Anita R, Paramasivam A, Priyadharsini JV, Chitra S. The m6A readers YTHDF1 and YTHDF3 aberrations associated with metastasis and predict poor prognosis in breast cancer patients. *Am J Cancer Res.* 2020 Aug 1;10(8):2546–54.
 7. Jayaseelan VP, Paramasivam A. Emerging role of NET inhibitors in cardiovascular diseases. *Hypertens Res.* 2020 Dec;43(12):1459–61.
 8. Sivakumar S, Smiline Girija AS, Vijayashree Priyadharsini J. Evaluation of the inhibitory effect of caffeic acid and gallic acid on tetR and tetM efflux pumps mediating tetracycline resistance in *Streptococcus* sp., using computational approach. *Journal of King Saud University - Science.* 2020 Jan 1;32(1):904–9.
 9. Smiline Girija AS. Delineating the Immuno-Dominant Antigenic Vaccine Peptides Against *gacS*-Sensor Kinase in *Acinetobacter baumannii*: An in silico Investigational Approach. *Front Microbiol.* 2020 Sep 8;11:2078.
 10. Iswarya Jaisankar A, Smiline Girija AS, Gunasekaran S, Vijayashree Priyadharsini J. Molecular characterisation of *csgA* gene among ESBL strains of *A. baumannii* and targeting with essential oil compounds from *Azadirachta indica*. *Journal of King Saud University - Science.* 2020 Dec 1;32(8):3380–7.
 11. Girija ASS. Fox3+ CD25+ CD4+ T-regulatory cells may transform the nCoV's final destiny to CNS! *J Med Virol* [Internet]. 2020 Sep 3; Available from: <http://dx.doi.org/10.1002/jmv.26482>
 12. Jayaseelan VP, Ramesh A, Arumugam P. Breast cancer and DDT: putative interactions, associated gene alterations, and molecular pathways. *Environ Sci Pollut Res Int.* 2021 Jun;28(21):27162–73.
 13. Arumugam P, George R, Jayaseelan VP. Aberrations of m6A regulators are associated with tumorigenesis and metastasis in head and neck squamous cell carcinoma. *Arch Oral Biol.* 2021 Feb;122:105030.
 14. Kumar SP, Girija ASS, Priyadharsini JV. Targeting NM23-H1-mediated inhibition of tumour metastasis in viral hepatitis with bioactive compounds from *Ganoderma lucidum*: A computational study. *pharmaceutical-sciences* [Internet]. 2020;82(2). Available: <https://www.ijpsonline.com/article/s/targeting-nm23h1mediated-inhibition-of-tumour-metastasis-in-viral-hepatitis-with-bioactive-compounds-from-ganoderma-lucidum-a-comp-3883.html>
 15. Girija SA, Priyadharsini JV, Paramasivam A. Prevalence of carbapenem-hydrolyzing OXA-type β -lactamases among *Acinetobacter baumannii* in patients with severe urinary tract infection. *Acta Microbiol Immunol Hung.* 2019 Dec 9;67(1):49–55.
 16. Priyadharsini JV, Paramasivam A. RNA editors: key regulators of viral response in cancer patients. *Epigenomics.* 2021 Feb;13(3):165–7.
 17. Mathivadani V, Smiline AS, Priyadharsini JV. Targeting Epstein-Barr virus nuclear antigen 1 (EBNA-1) with *Murraya koengii* bio-compounds: An in-silico approach. *Acta Virol.* 2020;64(1):93–9.
 18. Girija As S, Priyadharsini J V, A P. Prevalence of Acb and non-Acb complex in elderly population with urinary tract infection (UTI). *Acta Clin Belg.* 2021 Apr;76(2):106–12.
 19. Anchana SR, Girija SAS, Gunasekaran S, Priyadharsini VJ. Detection of *csgA* gene in carbapenem-resistant *Acinetobacter baumannii* strains and targeting with *Ocimum sanctum* biocompounds. *Iran J Basic Med Sci.* 2021 May;24(5):690–8.
 20. Girija ASS, Shoba G, Priyadharsini JV. Accessing the T-Cell and B-Cell Immuno-Dominant Peptides from *A.baumannii* Biofilm Associated Protein (bap) as Vaccine Candidates: A Computational Approach. *Int J Pept Res Ther.* 2021 Mar 1;27(1):37–45.
 21. Arvind P TR, Jain RK. Skeletally anchored forsus fatigue resistant device for correction of Class II malocclusions-A systematic review and meta-analysis. *Orthod Craniofac Res.* 2021 Feb;24(1):52–61.
 22. Venugopal A, Vaid N, Bowman SJ. Outstanding, yet redundant? After all, you may be another *Choluteca* Bridge! *Semin Orthod.* 2021 Mar 1;27(1):53–6.
 23. Ramadurai N, Gurunathan D, Samuel AV, Subramanian E, Rodrigues SJL. Effectiveness of 2% Articaine as an anesthetic agent in children: randomized controlled trial. *Clin Oral Investig.* 2019 Sep;23(9):3543–50.
 24. Varghese SS, Ramesh A, Veeraiyan DN. Blended Module-Based Teaching in

- Biostatistics and Research Methodology: A Retrospective Study with Postgraduate Dental Students. *J Dent Educ.* 2019 Apr;83(4):445–50.
25. Mathew MG, Samuel SR, Soni AJ, Roopa KB. Evaluation of adhesion of *Streptococcus mutans*, plaque accumulation on zirconia and stainless steel crowns, and surrounding gingival inflammation in primary molars: randomized controlled trial [Internet]. *Clinical Oral Investigations.* 2020;24:3275–80. Available: <http://dx.doi.org/10.1007/s00784-020-03204-9>
 26. Takatsuki K. *Adult T-cell Leukaemia.* Oxford University Press, USA; 1994:268.
 27. Bokhari SAH, Khan AA, Butt AK, Hanif M, Izhar M, Tatakis DN, et al. Periodontitis in coronary heart disease patients: strong association between bleeding on probing and systemic biomarkers. *J Clin Periodontol.* 2014 Nov;41(11):1048–54.
 28. Timothy CN, Samyuktha PS, Brundha MP. Dental pulp Stem Cells in Regenerative Medicine--A Literature Review. *Research Journal of Pharmacy and Technology.* 2019;12(8):4052–6.
 29. Ajmani S, Preet Singh Y, Prasad S, Chowdhury A, Aggarwal A, Lawrence A, et al. Methotrexate-induced pancytopenia: a case series of 46 patients. *Int J Rheum Dis.* 2017 Jul;20(7):846–51.
 30. Alnor A, Sandberg MB, Toftanes BE, Vinholt PJ. Platelet parameters and leukocyte morphology is altered in COVID-19 patients compared to non-COVID-19 patients with similar symptomatology. *Scand J Clin Lab Invest.* 2021 Mar 9;1–5.
 31. Khajah M. *Role of Neutrophils in Disease Pathogenesis.* BoD – Books on Demand. 2017:180 .
 32. Bain BJ. *Leukaemia Diagnosis: A Guide to the FAB Classification.* Lippincott Williams & Wilkins. 1990:116.
 33. Strange CA, Marnell JH. An assessment of the Ortho ELT-800 WBC and three-part WBC screen [Internet]. Vol. 7, *Clinical & Laboratory Haematology.* 1985. p. 151–6. Available: <http://dx.doi.org/10.1111/j.1365-2257.1985.tb00019.x>
 34. Triulzi DJ, Meyer EM, Donnenberg AD. WBC subset analysis of WBC-reduced platelet components [Internet]. *Transfusion.* 2000;40:771–80. Available: <http://dx.doi.org/10.1046/j.1537-2995.2000.40070771.x>
 35. Nagel R. *Cure Gum Disease Naturally: Heal Gingivitis and Periodontal Disease with Whole Foods.* 2015:242.
 36. Johnstone AM, Koh A, Goldberg MB, Glogauer M. A hyperactive neutrophil phenotype in patients with refractory periodontitis. *J Periodontol.* 2007 Sep; 78(9):1788–94.

© 2021 Charan et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:
<https://www.sdiarticle5.com/review-history/78010>