Indian J. Applied & Pure Bio. Vol. 40(3), 2210-2217 (2025). **ISSN: 0970-2091**
A web of Science Journal

Effect of Cigarette smoking on Haemotologic parameters in Healthy Population

Jyothirmai Koneru[1], Budumuru Ramesh Kumar[2*], Stevesuphal[3], Bhargavi Chinnamurthy[4], Ananda Babu Beeraboina[5] and Pravallika Gottapu[6]

[1-6]Department of Oral Medicine and Radiology, Vishnu Dental College, Bhimavaram - 534202 (India)
Corresponding Author Email ID - rk1001007@gmail.com
Phone number - 9885940250

Abstract

This comparative cross-sectional study was conducted among 60 smokers and 60 non-smokers attending Vishnu Dental College, Bhimavaram, to evaluate the effect of smoking on hematological parameters. Venous blood samples (2.5 ml) were collected, and hemoglobin concentration, red blood cell count, platelet count, total leukocyte count, erythrocyte sedimentation rate (ESR), and differential leukocyte count were analyzed. Statistical analysis using unpaired t-test and ANOVA revealed that smokers exhibited significantly higher red blood cell count and ESR values compared to non-smokers. With increasing smoking intensity, a significant rise in ESR and neutrophil count was observed, whereas eosinophil count, red blood cell count, and hemoglobin concentration declined with advancing age. These findings suggest that smoking has a measurable impact on hematological parameters, and early screening may serve as a valuable diagnostic tool to identify individuals at risk. Preventive interventions, particularly among students, are essential to reduce experimentation with tobacco and to prevent long-term health consequences.

Key words : Blood cells, ESR, Hemoglobin, smokers, non-smokers.

Tobacco is the general term for any product prepared from cured leaves of the plants belonging to the genera of nicotine. Tobacco Smoking is a habit in which tobacco is burned or inhaled. Cigarette smoking is the most common method of consumption of tobacco and other forms include cigar, bidis, pipes, hookahs, vaporizers and bongs. Tobacco smoking is one of the leading preventable causes of disease and death worldwide.[9]

[1] Head of the Department & Professor, [2*]Senior Lecturer, [3]Under Graduate Student, [4]Former Post Graduate, [5]Associate Professor, [6]Post Graduate Student,

It is a major risk factor for four non communicable diseases -cancer, cardiovascular diseases, chronic lung disease and diabetes.[4] The burning tobacco releases more than 4000 chemical compounds in the form of gases, vapors and particulates like carbon monoxide, hydrogen cyanide, phenols, ammonia, formaldehyde, benzene, pyrene, nitrosamines, nicotine and tar.[10] Most of these products are toxic promoting tissue damage secondary to oxidative stress and inflammation which is thought to promote a systemic acute-phase reaction, increasing inflammatory cytokines, C-reactive protein, blood cell count, whole blood viscosity and rouleaux formation, and increasing the ESR.[11]

Smoking is known to increase hemoglobin (Hb) concentration that is believed to be mediated by a by-product carbon monoxide. Carbon monoxide binds to Hb to form carboxy hemoglobin. Studies have observed an association between smoking and red blood cell count, hemoglobin concentration, total leukocyte count, platelet count, differential leukocyte count. But these results are not uniform. Conflicting results have been observed which couldn't be generalized to all the Smoking populations. There is a paucity in the literature on the effect of duration of smoking, frequency of smoking, pack-years, age of the smoker on the various hematological values.

So, a study was designed to evaluate the effect of smoking on various hematological parameters by comparing with non smokers and to assess the influence of intensity of smoking and age on these values. The understanding of these relationships could help to guide the medical work-up in a smoker and hematological reference values might be adjusted for smokers to compensate for the masking effects of smoking and our understanding of how smoking leads to these life-threatening diseases can be broadened.

A comparative cross-sectional study was designed to determine the effects of cigarette smoking on hematological parameters among healthy smokers and compare it with nonsmokers attending Vishnu Dental College, Bhimavaram for various treatment procedures. The study protocol was approved by the institutional ethical review board, Vishnu Dental College, Bhimavaram, Andhra Pradesh(IEC VDC/ 2021/UG01/OMR/IVV/61). Informed consent was obtained from all the subjects and patients who were willing for the usage of their data for the research purpose were only included in the study. Smoking is extremely rare among women in this area, so women were not included in this study. A smoking questionnaire assessed smoking history and current smoking status.

The pack-years calculation remains a commonly used method for estimating life time smoking exposure, which cannot be quantified by the use of other tobacco variables alone. So we followed pack-years for understanding the intensity of smoking. Pack-years smoking was determined using two items where participants were asked, "For how many years, altogether, have you been a regular / daily smoker?" and "Since you started regular / daily smoking, what is the average number of cigarettes you smoke per day?" Consistent with previous research, pack-years was computed as: (cigarettes per day/20) ×years smoking.[6] In this study, Smokers who had a habit of smoking minimum of 10 per day for a

minimum period of 5 years were included and were categorized into mild (2.5-5), moderate (6-10) and heavy smokers (11 and above) based on the pack-years. The number of subjects in each of these categories are 30, 20 and 10 respectively.

The patients in the study were divided in to two groups (group-A- smokers with no systemic diseases, group –B-non-smokers/ control group with no systemic diseases) containing 60 subjects each. The subjects included in the present study were also categorized in to three age groups (group 1-21-30 group B-31-40, group C-41-50) and various hematological parameters were compared and evaluated with age among smokers and non-smokers. 2.5ml of venous blood was collected for evaluation of hematological parameters from 120 subjects (60 –smokers, 60-non-smokers) patients who were advised these investigations for various diagnostic and treatment procedures were only considered. Patients with a history of diabetes, hypertension, cardiac and respiratory diseases, endocrine, hepatic, renal disorders and other systemic diseases and patients on medications were excluded from the study. The hematological parameters tested in the study were hemoglobin concentration, total red cell count, erythrocyte sedimentation rate, platelet count, total leukocyte count and differential leukocyte count. These values of smokers were compared with hematological values of the control group (non-smokers).

Data analysis :

The data obtained was tabulated and subjected to statistical analysis by using SPSS software (version 20). Data analysis was done by using unpaired t test and ANOVA. Results were expressed as mean±SD (Standard Deviation). The p-value of < 0.05 has been considered as significant.

Comparison of hematological parameters between smokers and non-smokers :

When the hematological parameters were compared to non-smokers, statistically significant increase in the RBC count and ESR values was observed in smokers. Also an increase in the HB concentration and neutrophil count was noted in smokers, which was not statistically significant, A non-significant decrease in the platelet count, total leukocyte count, lymphocytes and eosinophils was noted among smokers. (Table-1).

Comparison of hematological parameters between smokers based on their intensity of smoking :

In this study, smokers were categorized based on their intensity (pack/years) as mild, moderate and heavy smokers. As the intensity of the smoking increased, a significant increase in the ESR and neutrophil count was observed. A non-significant variation was noted in the other HB and hematological parameters among mild, moderate and heavy smokers. (Table-2).

Comparison of hematological parameters between smokers based on their age :

There was a statistically significant decrease in the Eosinophil count, HB concentration and RBC count with advancing age, however, group 2 individuals showed a varied presentation with RBC count more than

Table-1. Comparison of Haematological parameters between smokers and nonsmokers

Parameters	Smokers Mean±SD	Nonsmokers Mean±SD	p value
Hb(g/dL)	14.51±1.87	13.93±2.10	**0.28**
RBC (millions/cu.mm)	4.80±0.83	4.76±0.51	**0.02***
Platelet (lakhs/cu.mm)	2.34±0.65	2.66±0.77	**0.38**
ESR (mm/1sthr)	8.95±5.30	8.63±3.19	**0.00***
Total WBC (cells/cu.mm)	8477.50±2731.74	8935.00±2410.06	**0.80**
Neutrophils (%)	64.21±8.76	59.45±9.61	**0.60**
Lymphocytes (%)	31.05±9.99	32.51±9.42	**0.71**
Eosinophil (%)	**4.76±2.66**	**6.71±2.15**	**0.40**

*p<0.05issignificant(unpairedttest)

Table-2. Comparison of Haematological Parameters Between Smokers Based on Their Intensity of Smoking

Parameters	Mild Smokers(n=30)	Moderates mokers(n=20)	Heavy smokers(n=10)	P value
	Mean±SD	Mean±SD	Mean±SD	
Hb (g/dL)	14.75±1.85	14.13±1.79	14.60±2.12	**0.51**
RBC (millions/cu.mm)	4.91±1.01	4.76±0.63	4.54±0.48	**0.45**
Platelet (lakhs/cu.mm)	2.42±0.78	2.30±0.49	2.21±0.57	**0.63**
ESR (mm/1sthr)	7.16±4.78	9.60±3.80	13.00±7.08	**0.07***
Total WBC (cells/cu.mm)	8206.66±2285.62	8085.00±1964.76	10075.00±4529.36	**0.12**
Neutrophils (%)	61.76±9.69	65.05±7.23	69.90±5.72	**0.03***
Lymphocytes (%)	33.86±10.80	29.15±9.08	26.40±6.73	**0.69**
Eosinophil (%)	**5.30±3.14**	**4.50±1.76**	**3.70±2.40**	**0.22**

Table-3. Comparison of Haematological parameters between smokers based on their age

Parameters	Age group 21-30 (n=7)	Age group 31-40 (n=19)	Age group41-50 (n=34)	P value
	Mean±SD	Mean±SD	Mean±SD	
Hb(g/dL)	15.71±1.59	14.91±1.99	14.05±1.73	**0.05***
RBC (millions/cu.mm)	5.12±0.57	5.15±1.06	4.53±0.62	**0.01***
Platelet (lakhs/cu.mm)	2.48±0.33	2.55±0.80	2.20±0.59	**0.15**
ESR (mm/1sthr)	6.57±2.07	9.44±6.30	9.16±5.13	**0.45**
Total WBC (cells/cu.mm)	8128.57±2805.18	9171.05±2918.77	8161.76±2618.93	**0.41**
Neutrophils (%)	59.28±15.67	65.42±8.42	64.55±6.91	**0.27**
Lymphocytes (%)	32.00±12.60	29.36±10.36	31.79±9.40	**0.68**
Eosinophil (%)	**7.85±4.14**	**4.42±2.19**	**4.32±2.15**	**0.03***

*$p<0.05$ is significant (ANOVA test)

group 1. Similar type of non-significant variation was also observed when the platelet count, WBC count, ESR values were compared between the three age groups. (Table-3).

Vapour- phase contains products such as carbon monoxide, ammonia, ketones, formaldehyde, acetaldehyde, and acrolein while particulate matter contains nicotine, heavy metals such as nickel, arsenic, cadmium, lead and other substances such as benzopyrenes. Most of these products are toxic, promoting tissue damage secondary to oxidative stress and inflammation.[4,10]

Nicotine, a component of tobacco is responsible for altering the vascular permeability and lipid accumulations. It is primarily the pharmacologic effects of nicotine that produce the addiction to tobacco and this action of nicotine prevents the patients from quitting the habit. 4 Several studies have reported that the various hematological parameters like Hb concentration, RBC count, ESR, plateletcount, total leukocyte count and differential leukocyte count were altered in apparently healthy smokers.[10,14,16] Also few studies mentioned that smokers are at an increased risk for coronary artery disease (CAD), atherosclerosis, acutemyocardial infarction, hypertension (HTN), clotting disorders, inflammation, respiratory diseases, cancers, etc.[4,13]

The present study is a cross-sectional comparative study done by evaluating the

hematological parameters of 120 subjects visiting a dental hospital. In this study, compared to non-smokers, a statistically significant increase in the RBC count and ESR values have been found in smokers. These findings were similar to the study done by Malenica *et al*.[10] and Boehm *et al*.[16], Waseem SMA *et al*, Thriveni *et al*.[18] These elevated levels can be attributed to the fact that tissue hypoxia caused by the tobacco smoke increases the creation of carboxyhaemoglobin, which leads to an increased secretion of erythropoietin ultimately leading to erythropoiesis.[6]

In the present study, the ESR values were significantly higher in smokers than in non-smokers. Similar observations were also noted in the studies done by Thriveni R *et al*.[18] and Sharma A *et al*.[15] On the contrary, a non-significant difference in the ESR values were observed among both smokers and non-smokers in a study done by Sultana S *et al*.[17] These increase in the ESR values in the smokers may be due to the endothelial damage that is induced by the cigarette smoke which promotes the release of free radicles (nitrous oxide, hydrogen peroxide), thus inducing an acute inflammatory response leading to increased ESR values.[11]

In the study, a non-significant decrease in the hemoglobin concentration was observed in smokers compared to non-smokers. The results of this study were in accordance to the study done by Lakshmi Vs *et al*.[2] On the contrary in the studies done by Waseem *et al*, Tayeb *et al*, Shah BK *et al*.[14] a significant increase in the hemoglobin concentration was found among smokers compared to nonsmokers. Increase in the values could be due to the compensatory mechanism for the tissue hypoxia caused by increased levels of carboxyhaemoglobinin in smokers.[6]

In the current study, a significant increase in the ESR values and neutrophil count was observed with increase in the intensity (pack-years) of smoking. This increase in the neutrophil count was similar to the study done by Lakshmi VS and Ananda LS *et al*.[2] A non-significant increase in the different leukocyte subsets, the neutrophil count was observed in smokers when compared to non-smokers which might be due to the stimulating effect of nicotine on lymphocytes, the disturbance in the function of the adrenal gland under the influence of smoke might also play a role in elevating the lymphocyte count.[4]

In the present study, when compared to non-smokers, the platelet count was marginally decreased. Similar results were seen in the study done by Sandhya *et al.*[13]. Also a decrease in the platelet count was observed with increase in the duration of smoking, a similar pattern was found in the study done by Sandhya *et al*.[13] where the author mentioned that the endothelial damage and oxidative stress induced by nicotine activates thrombin that results in hemorrhage, thrombosis and embolism in smokers. Factors such as release of nitric oxide from the platelets which is affected by the smoke may also contribute to altered hemostasis leading to decrease in the platelet count.[13]

From the present study, we conclude that smoking increases erythrocyte count and erythrocyte sedimentation rate (ESR) among smokers when compared with non smokers. Although some of the values of smokers are altered they fall within the reference ranges but these variations might be associated with a greater risk for developing life threatening cardiovascular diseases. The present study might serve as an early diagnostic tool in screening for systemic diseases and can be helpful in spreading awareness on the deleterious effect of tobacco among smokers. Timely intervention among students can prevent the initial experimentations with tobacco from developing into addiction in adulthood. People should be counseled to avoid all habits of tobacco and undergo nicotine replacement therapy along with antioxidants. Knowledge and awareness about systemic and or ill effects of tobacco should be spread through tobacco control programs in the pursuit for a tobacco-free world.

Financial support and sponsorship: Self - funded Conflicting Interest: None Acknowledgement(If any): None

References :

1. Ahmed OA. (2016). *Imperial J Interdiscip Res*. *2*(9): 887-92.
2. Anandha Lakshmi S, Anandhi Lakshmanan, P Ganesh Kumar and A. Saravanan (2014). *J Clin Diagn Res*. *8*(7): BC11-3.
3. Ata MA, SS Shaikh, and T Iqbal, *et al*. (2015). Inverse correlation between serum C-reactive protein and magnesium levels in smokers and non-smokers. *N Am J Med Sci*. *7*(6): 271-4.
4. Benowitz N L. (2009). *Annu Rev Pharmacol Toxicol. 49:* 57-71.
5. Bernaards CM, J Twisk, J Snel, W van Mechelen, and H. Kemper (2001). *Addiction. 96:* 1653-62.
6. Boehm RE, BD Arbo, D Leal, AW Hansen, RR Pulcinelli, and FV Thiesen, *et al*. (2018). *PLoS One. 13*(9): e0204102.
7. DeVita MJ. (2017). Pack-years of tobacco cigarette smoking as a predictor of spontaneous pain reporting and experimental pain reactivity [thesis]. Syracuse (NY): Syracuse University; p.189. Available from: https://surface.syr.edu/thesis/189
8. Global Adult Tobacco Survey (GATS). (2017). Fact sheet, India 2016–17. World Health Organization; 2017. Availablefrom: http://www.who.int/tobacco/surveillance/survey/gats/GATS_India_201617_FactSheet.pf
9. Islam MS, KM Saif-Ur-Rahman, MMI Bulbul, and D. Singh (2020). *Environ Health Prev Med. 25:* 62.
10. Malenica M, B Prnjavorac, and T Bego, *et al*. (2010). Med Arch. 2017;71:132-6.
11. Piva E, and M Plebani. (2010). *J Med Biochem. 29*(4): 265-8.
12. Pleasants RA, MP Rivera, SL Tilley, and SP. Bhatt (2020), *Ann Am Thorac Soc. 17*(7): 804-6.
13. Sandhya M, U Satyanarayana, S Mohanty, and DR. Basalingappa (2015). *Int J Clin Exp Physiol. 2*(2): 12-6.
14. Shah BK, AK Nepal, M Agrawal and AK. Sinha (2012). *Sunsari Tech Coll J. 1:* 42-4.
15. Sharma A, B Yadav, R Pathak, AK Singh,

M Hussein, and S. Singh (2014). *Natl J Med Allied Sci. 3*(1): 1923.

16. Sharma R, N Martins, A Tripathi, P Caponnetto, N Garg, and E Nepovimova, *et al*. (2020). *India. Int J Environ Res Public Health. 17*(8): 2868.
17. Sultana S, N Afsar, M Jawad, and MAH. Hazari (2019). *Ann Med Physiol. 3*(1): 14-8.
18. Thriveni R, P Manshi, DV Ramesh, B Rachel, A Byatnal, and P. Kempwade (2020). *J Indian Acad Oral Med Radiol. 32:* 103-6.
19. World Health Organization. (2005). *Tob Control. 14:* 141-2.
20. Wood DM, MG Mould, and SB Ong, *et al*. (2005). *Tob Control. 14:* 141-2.