

RESEARCH ARTICLE

Correlation between anemia and smoking: Study of patients visiting different outpatient departments of Integral Institute of Medical Science and Research, Lucknow

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Received: April 04, 2019; Accepted: December 05, 2019

ABSTRACT

Background: Smoking-induced hypoxia, inflammation, and oxidative stress result in impairment of hematological parameters. Contradictory evidence is found as far as the effect of smoking on blood cells and indices is concerned.

Aims and Objectives: Very few studies have evaluated male smokers for the presence or absence of anemia. Thus, the present study was undertaken to study the hematological parameters in male smokers and find the presence of anemia and find a correlation between the severity of smoking and hemoglobin (Hb), red blood cell (RBC), and white blood cell (WBC). **Materials and Methods:** The present study included 100 male smokers divided into anemic ($n = 34$) and non-anemic ($n = 66$) groups. RBC, WBC, Hb, and blood indices (mean corpuscular volume [MCV] and mean corpuscular Hb concentration [MCHC]) were compared and further evaluation was done on the basis of severity of smoking (as per the pack-years). Correlation between pack-years and RBC, Hb, and WBC was done. Data were analyzed using statistical tests such as unpaired t -test, Chi-square, ANOVA, and Pearson's correlation. $P < 0.05$ was taken as statistically significant.

Results: There were significant differences ($P < 0.05$) in the mean age, MCV, MCHC, and WBC between the two groups and with increase in severity of smoking, the levels of Hb, RBC, MCV and MCHC, and WBC were increased significantly in smokers with anemia when compared to those without anemia. In smokers with anemia, the highest percentage was found in mild smoker category (19/34, i.e., 55.88%) and with increase in smoking severity, the number of anemic subjects decreased. In smokers without anemia, the highest percentage was found in mild smoker category (37/66, i.e., 56.06%). The difference in anemic and non-anemic smokers on the basis of severity of smoking was found to be insignificant ($P > 0.05$). The correlation of pack-years with Hb, RBC, and WBC was found to be significantly ($P < 0.05$) positive.

Conclusion: RBC, Hb, MCV, and MCHC were significantly higher in anemic smokers as compared to non-anemic smokers and with increase in the smoking severity the percentage of anemic subjects declined. It may be concluded that there appears a link between smoking and alterations in hematological parameters.

KEY WORDS: Smoking; Male Gender; Pack-Years; Anemia; Severity; Correlation

Access this article online

Website: www.njppp.com

Quick Response code

DOI: 10.5455/njppp.2019.9.0412805122019



INTRODUCTION

Anemia and smoking have emerged as major public health problems in India.^[1] It is estimated that around 30% of the population consumes tobacco in one form or other in India. As per the recent health survey, around 44.5% of males and 6.8% of females consume tobacco

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products and 14% consume smoked tobacco in India. On the other hand in the age group of 15–49 years, 53.1% of females and 22.7% of males suffer from anemia.^[2,3] Interestingly, there appears a link between smoking and levels of hemoglobin (Hb).^[4] Association between smoking and anemia has been documented in earlier researches.^[5] However, there is evidence suggestive of protective role of tobacco against anemia.^[6] Smoking decreases the levels of Vitamin C which, in turn, predisposes the individual to iron deficiency anemia due to decrease in the absorption of iron. Smoking is known to cause macrocytosis mainly by altering the levels of Vitamin B12 and folic acid. Oxidative stress, inflammation, bone marrow depression, and gastritis caused by smoking also result in anemia. Interestingly, there appears an elevated level of Hb in smokers due to erythropoietin-stimulating influence of smoking-induced increase in carbon monoxide. However, there are studies which have shown that the levels of Hb are low in smokers.^[7-11] Smoking-induced changes in hematological parameters act as predisposing factors for multisystem diseases.^[12] The significance of study lies in the fact that there is possible link between smoking-induced alteration in hematological parameters and various diseases such as cardiovascular, chronic lung disease, and atherosclerosis which increases with an increase in the smoking severity.^[13-15] Thus, it is important that the smokers should be evaluated for the presence of hematological parameter derangement early so that the future possible complications can be halted by giving early intervention. Researches have suggested that the influence of smoking on hematological parameters may take around 2 or more years to reverse once the subject quits smoking. However, there appear gender variations in the phenomenon.^[16] Thus, the influence of smoking on hematological parameters appears to be long term and reverse slowly even if subject quits smoking. Thus, timely, identification of anemia in smokers is important if complications are to be avoided.

Aims and Objectives

There appear very few studies which have evaluated male smokers for the presence or absence of anemia on the basis of the severity of smoking. Thus, keeping in view the public health importance of anemia and smoking and their consequent adverse effects on health, the present study was undertaken to study the hematological parameters in male smokers and find the presence of anemia in them and also find a correlation between severity of smoking and hematological parameters (namely, Hb, red blood cell [RBC], and white blood cell [WBC]).

MATERIALS AND METHODS

The present study was an observational study conducted in the department of physiology between January and June 2018.

The study was approved by the Institutional Research and Ethics Committees of Integral Institute of Medical Science and Research (IIMSR), Integral University, Lucknow.

Inclusion and Exclusion Criteria

A study consisted of 100 male subjects (willing to participate and current smokers) visiting various outpatient departments of IIMSR Hospital, Lucknow. Subjects not giving consent, suffering from chronic diseases, and those taking medications for anemia were excluded from the study.

Severity of smoking was categorized on the basis of pack-years^[17] and 5 ml of blood sample was drawn under aseptic conditions and hematological parameters were measured with the help of automated analyzer (Beckman Coulter) in the central laboratory of the hospital.

Statistical Analysis

Data were represented as mean \pm standard deviation and were analyzed using the Statistical Package for the Social Sciences 21.0. Data were analyzed using statistical tests such as unpaired *t*-test, Chi-square, ANOVA, and Pearson's correlation. $P < 0.05$ was taken as statistically significant.

RESULTS

The present study included 100 current male smokers who were further categorized into two groups, i.e., anemic (34%) and non-anemic (66%) on the basis of hematological profile. There were significant differences ($P < 0.05$) in the mean age, mean corpuscular volume (MCV), mean corpuscular Hb concentration (MCHC), and WBC between the two groups [Table 1]. Further subjects were divided into three categories on the basis of severity of smoking, i.e., mild ($n = 56$), moderate ($n = 24$), and heavy ($n = 20$). The results indicated that with increase in severity of smoking, the levels of Hb, RBC, MCV and MCHC, and WBC were increased and the difference between them was significant [Table 2]. In smokers with anemia, the highest percentage was found in mild smoker category (19/34, i.e., 55.88%) and with increase in smoking severity, the number of anemic subjects decreased. Similarly, in smokers without anemia, the highest percentage was found in mild smoker category (37/66, i.e., 56.06%). The difference in anemic and non-anemic smokers on the basis of the severity of smoking was found to be insignificant ($P > 0.05$) [Table 3]. The correlation of pack-years with Hb and RBC was found to be significantly ($P < 0.05$) positive [Table 4]. In smokers with anemia with increase in smoking severity, the values of RBC, Hb, WBC, MCV, and MCHC increased and the difference was significant when compared with those without anemia in the same smoking category [Table 5].

Table 1: Differences between anemic and non-anemic smokers

Parameter	Smokers		P-value
	Anemic (n=34)	Non-anemic (n=66)	
Age (years)*	37.91±7.03	41.39±8.59	0.04
Red blood cell (million/mm ³)	4.18±0.23	5.34±0.28	0.114
Mean corpuscular volume (fL)*	85.24±5.29	83.99±2.79	<0.001
Mean corpuscular hemoglobin concentration (g/dl)*	32.24±2.00	31.57±1.24	<0.001
White blood cell (cells/mm ³)*	6356.82±1904	6679.59±1465.87	0.008

*Significant difference between anemic and non-anemic smokers. About 34% (34/100) of the overall smokers were found to be anemic

Table 2: Comparison on the basis of the severity of smoking

Parameter	Mild (n=56)	Moderate (n=24)	Heavy (n=20)	P-value
	(10–14 pack-years)	(15–19 pack-years)	(>20 pack-years)	
Age	39.62±8.53	41.29±8.27	40.55±7.53	0.698
Hemoglobin (g/dl)	13.60±1.17	14.56±1.69	15.17±1.64	<0.001
Red blood cell (million/mm ³)	4.87±0.62	4.84±0.56	5.27±0.55	0.028
Mean corpuscular volume (fL)	82.74±3.29	85.56±3.26	87.77±3.38	<0.001
Mean corpuscular hemoglobin concentration (g/dl)	31.19±1.29	31.93±1.28	33.35±1.53	<0.001
White blood cell (cell/mm ³)	6170.94±1605.45	7039.45±1699.69	7123.25±1320.69	0.017

Table 3: Number and percentage of anemic and non-anemic subjects as per the smoking severity

Smoking severity	Anemic		Non-anemic		P-value
	n	%	n	%	
Mild	19	55.88	37	56.06	Chi-square=0.274 df=2 P=0.872
Moderate	9	26.47	15	22.73	
Heavy	6	17.65	14	21.21	
Total smokers with and without anemia	34	34	66	66	

Table 4: Correlation of pack-years with Hb, RBC, and WBC

Parameter	Pearson's correlation	P-value
Hb	0.418	<0.001*
RBC	0.215	0.03*
WBC	0.260	0.009*

*Significant positive correlation of pack-years with Hb, RBC, and WBC in smokers. Hb: Hemoglobin, RBC: Red blood cell, WBC: White blood cell

DISCUSSION

The results of our study showed that out of 100 male smokers, anemia was present in 34% and their mean age was 37.91 ± 7.03 years. Hb, RBC, MCV and MCHC, and WBC were increased significantly in smokers with anemia when compared to those without anemia. In smokers with anemia, the highest percentage was found in mild smoker category (19/34, i.e., 55.88%) and with increase in smoking severity, the number of anemic subjects decreased. In smokers without anemia, the highest percentage was found in mild smoker category (37/66, i.e., 56.06%). The difference in anemic and

non-anemic smokers on the basis of the severity of smoking was found to be insignificant ($P > 0.05$). Significant positive correlation ($P < 0.05$) was found between pack-years and Hb, RBC, and WBC.

The results are similar to those found in the study done by Kandasamy *et al.*, wherein 32% of the total anemic subjects were smokers and in the age group of 31–50 years, 32% of males were anemic.^[11] In our study, overall 34% of the study subjects were anemic. Increase in severity of smoking resulted in decline in the percentage of anemic, which is probably due to increase in the Hb with increase in smoking severity. It has been found that with increase in the severity of smoking, the levels of carboxy-Hb and mean Hb increase.^[18] However, the decrease in the number and percentage of non-anemic subjects with increase in severity of smoking in our study could possibly be explained on the basis of literature which suggests that in smokers, there is often undermining of anemia detection. Another interesting observation as per literature is that smokers having associated pathology of lung could have chronically elevated levels of Hb.^[19] In non-anemic smoker group, the increase in Hb and RBC counts could possibly

Table 5: Differences between hematological parameters as per the smoking severity and presence and absence of anemia in each group

Parameter	Smoking severity						P-value
	Mild		Moderate		Severe		
	Anemic (n=19)	Non-anemic (n=37)	Anemic (n=09)	Non-anemic (n=15)	Anemic (n=06)	Non-anemic (n=14)	
Red blood cell	4.07±0.15	5.28±0.27	4.15±0.10	5.25±0.18	4.54±0.23	5.56±0.28	<0.001
Hemoglobin	12.26±0.34	14.28±0.79	12.51±0.50	15.79±0.48	12.88±0.11	16.10±0.45	<0.001
Mean corpuscular volume	82.03±4.18	83.10±2.72	87.79±3.04	84.12±2.59	91.55±2.92	86.15±1.99	<0.001
Mean corpuscular hemoglobin concentration	31.25±1.87	31.15±0.88	32.88±1.17	31.36±0.99	34.43±1.23	32.89±1.44	<0.001
White blood cell	5210.63±1238.44	6664.08±1560.23	7416.00±1870.28	6813.53±1612.90	8397.67±898.64	6577.07±1080.96	<0.001

be due to interplay of more than one factor. Antiapoptotic influence of hypoxia-induced increase in erythropoietin results in increase in RBC life span and at the same time, there is an inhibition of hepcidin which, in turn, increases the release of iron from liver, thus resulting in increase in Hb.^[4] The results of our study also showed that with increase in severity of smoking, the values of MCV and MCHC increased in all cases and, similarly, the values were found to be elevated in anemic subjects with increase in the smoking severity. The possible explanation could be that smoking appears a risk factor for macrocytosis due to alterations in levels of Vitamin B12 and folic acid.^[20] However, at the same time, the serum levels of ferritin are found to be low due to smoking-induced hypoxia.^[21] Studies have reported reduction in the levels of Vitamin C and E in smokers as compared to non-smokers.^[22] Thus, both macrocytosis and microcytic effect can result due to smoking and requires further study. Authors of the present paper suggest that the patients having vitamin deficiencies should be advised and counseled for cessation of smoking. In our study, the levels of Hb increased significantly with increase in the severity of smoking. Similarly, significant differences were found in levels of RBC, MCV, MCHC, and WBC with levels increasing with increase in the smoking severity. The results are in line with earlier reported studies showing the influence of smoking of hematological parameters. WBC, RBC, and Hb levels were higher in smokers in a study conducted by Sandhya *et al.*^[23] Statistically significant increase in leukocyte count in smokers has been reported in earlier studies.^[24] Sherke *et al.*, in their study, showed that with increase in smoking, the WBC count increased significantly in smokers, thus putting them at higher risk of future cardiovascular complications and diseases. Similar results were obtained in a study done by Fadiel and Hasan.^[25,26] Levels of WBC, RBC, Hb, and MCV were significantly more and the levels of MCHC were significantly low in smokers as compared to age-matched non-smokers in a study done by Al-Temimi.^[27] Similarly, non-significant higher values of MCV and MCHC were reported in a study done by Khan *et al.* in smokers as compared to non-smokers.^[28] The interplay of various factors associated with smoking such as polycythemia, inflammatory cytokines, oxidative stress, and sympathetically stimulated increase in the levels of glucocorticoids results in elevated RBC and WBC counts.^[13,29,30] The increase in the levels of MCV, MCHC, Hb, and RBC in smokers could possibly be attributed to the levels of carbon monoxide which is expected to be more in smokers.^[31] However, contradictory results have also been reported earlier. The mean values of Hb in smokers were found to be statistically less as compared to those found in non-smokers in a study done by Lakshmi.^[32] The contradictory results could possibly be attributed to less sample size and also the fact that the duration of smoking was not specified in the study. Similarly, age, gender, and severity of the smoking also appear responsible for the varying results.^[33,34] In our study, significant and positive correlation of pack-years with HB, RBC, and WBC were

observed. Ahmed in a study found higher levels of WBC in smokers as compared to non-smokers. The levels were further significantly higher in subjects having higher pack-years. Similar results were reported by Shenwai and Aundhakar.^[35,36]

Limitations and Improvements

Effect of factors such as dietary habits, environmental pollutants, and intoxicants such as alcohol having influence on the hematological parameters was not included in the present study. Thus, the study may not be completely free from confounding factors. Another limitation and suggested improvement are a comparative study between males and females and reassessment of results taking into consideration cutoff values of anemia adjusted for smokers. The study of impact of quitting the smoking or tobacco products on hematological parameters analyzed in the present study is also suggested.

CONCLUSION

In our study, the levels of RBC, Hb, MCV, and MCHC were statistically higher in anemic smokers as compared to non-anemic smokers and with increase in the smoking severity, the percentage of anemic subjects declined. The results assume significance in the light of the previous studies which have emphasized that the estimation of anemia in smokers could possibly lead to erroneous results possibly due to compensatory adjustments in the Hb and RBC levels associated with smoking. Studies have further emphasized the need to adjust the cutoff values for anemia estimation in smokers.^[34,37] On the other hand, according to reports, there appears a variation in the smoking category definition and Hb levels depending on ethnicity, gender, and age.^[38]

ACKNOWLEDGMENT

The authors are thankful to participants in the study and supporting staff. Special thanks to Dr. Ausaf Ahmad, Assistant Professor cum statistician in the Department of Community Medicine, Integral University, Lucknow.

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How to cite this article: Waseem SMA, Alvi AB. Correlation between anemia and smoking: Study of patients visiting different outpatient departments of Integral Institute of Medical Science and Research, Lucknow. *Natl J Physiol Pharm Pharmacol* 2020;10(02):149-154.

Source of Support: Nil, **Conflicts of Interest:** None declared.