



A COMPARATIVE STUDY OF HEMOGLOBIN LEVEL, RED BLOOD CELL COUNT AND SERUM FERRITIN LEVEL AMONG ADULT MALE SMOKERS AND NON SMOKERS OF GUWAHATI CITY

Physiology

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ABSTRACT

Background & Objectives: Smoking has various effects on hematological parameters. The aim of the present study was to compare the Hemoglobin levels, RBC count and Serum ferritin level among the male smokers and non-smokers and also to find whether there is any correlation between the intensity of smoking and levels of these parameters

Methods: Total 290 healthy male individuals between 20-40 years participated in the study, 145 were smokers, 145 non-smokers. Hemoglobin level, RBC counts and Serum ferritin were estimated by standard methods.

Results: All three parameters were found to be significantly higher in smokers as compared to non-smokers ($p < 0.05$). These parameters were also higher in smokers when they were compared in three different age groups ($p < 0.05$).

Conclusion: The study showed that cigarette smoking has got significant effect in different hematological parameters. Cigarette smoking history should be taken properly before arriving into any diagnosis.

KEYWORDS

Male Smokers, Hemoglobin, RBC, Ferritin

INTRODUCTION

One of the most widely used caution- "Smoking is injurious to health", is seen written almost everywhere in the World to generate awareness about the ill effects of smoking. But in spite of it and being aware about the adverse effects of smoking, people are seen acquiring this habit. Now a days, the most common method of smoking is through cigarettes.¹ Global Adult Tobacco Survey (2010) has reported that the number of cigarette smokers in Assam is 26%.² Cigarette smoking causes inadequate oxygenation which leads to tissue hypoxia that results in erythropoiesis and consequent increase in erythropoietin production.³ Increased level of erythropoietin enhances erythropoiesis and leads to increase in the red cell mass above normal level. Increased turnover of red blood cells ultimately leads to increase in the destruction of these cells which subsequently causes hepatocellular damage by increasing iron overload in the body.⁴

Hemoglobin has got affinity for the oxygen due to which oxygen gets attached to heme part of the oxygen molecule forming oxyhemoglobin. The concentration of hemoglobin in the body varies with age, sex and stage of pregnancy. It is also affected by ethnicity, smoking pattern and habit. Erythropoietin is a chemical which is responsible for the production of erythrocytes i.e. RBCs. Hypoxia is the most potent stimulator for endogenous erythropoietin production.⁵ Ferritin is the main source of iron storage in the body and is one of the key proteins that regulates body iron homeostasis.⁶ Most of the patients of COPD or having symptoms mimicking respiratory problems are current or former smokers.⁷ The present study was undertaken so as to bring out any significant difference in Hemoglobin level, RBC count and Serum ferritin level between smokers and non-smokers and whether these parameters are affected by number and duration of cigarette smoking.

MATERIALS AND METHODS:

The present study was conducted in the Department of Physiology, Gauhati Medical College and Hospital, Guwahati, Assam.

DURATION OF STUDY:- July 2017 to June 2018 (One year).

TYPE OF STUDY:- Cross sectional study.

STUDY POPULATION:- The study was carried out on adult male smokers and non smokers between 20-40 years of age of Guwahati city, who met the inclusion and exclusion criteria, outlined below and were willing to participate in the study.

SAMPLE SIZE:- Total sample size was 290 comprising of:-

Smokers-145, Non-smokers-145

Inclusion Criteria:

A) For smokers: Male in age group 20-40 years, who were smoking for at least 1 year and no history suggestive of significant acute or chronic illness

B) For non-smokers: Male in age group: 20-40 years who were never-smoker and no history suggestive of any significant acute or chronic illness

Exclusion Criteria:

- 1) All the male smokers and non-smokers of less than 20 years and more than 40 years who were smoking for less than 1 year, Ex smokers, ex occasional smokers.⁸
- 2) All female smokers.
- 3) All smokers and non smokers with history suggestive of any acute or chronic systemic illness and history of any bleeding disorder, drug abuse and no history of blood donation within last 6 months

Ethical clearance was obtained from the Institutional Ethics Committee (Human), Gauhati Medical College and Hospital, Guwahati, Assam.

Collection Of Samples:-

Blood samples were collected from each participant of the study in following vials: **Clot activator vial-** 3 ml for serum ferritin level, **EDTA vial-** 2 ml for hemoglobin level, For RBC counting blood was collected by pricking tip of the left ring finger. All the samples were collected after 12 hours of overnight fasting.

- A) Hemoglobin estimation was done using a DIGITAL PHOTO COLORIMETER.⁹
- B) Estimation of Red blood cell count was done manually by using hemocytometer slide with improved Neubauer's counting chamber.¹⁰
- C) Serum ferritin was measured in MINIVIDAS from Biomerieux using VIDAS® Ferritin (FER) kit as per manufacturer's protocol.¹¹

Proper analysis and computation was done by entering the data into the Microsoft excel software, 2007. The data was presented as mean $\pm$ standard deviation. "p" value of < 0.05 was considered statistically significant. The statistical analysis was done using Chi-square test, unpaired t-test and ANOVA

RESULTS AND OBSERVATIONS:

The results and observations of the study groups have been expressed in the form of Tables complemented by Pie diagrams, Bar diagrams, Scatter diagrams, Graphs etc. as per requirement.

Table 1:- Demographic And Personal Profile Of The Study Subjects.

Variable	Smokers	Non-smokers	p-value
Age in years (Mean $\pm$ SD)	30.95 $\pm$ 5.30	29.80 $\pm$ 5.84	0.08*
Sex			
Male	145 (100)	145 (100)	
Female	0	0	
Religion			0.31**
Hindu	90 (62.1)	80 (55.2)	
Islam	45 (31)	55 (37.9)	
Christian	8 (5.5)	5 (3.45)	
Others	2 (1.4)	5 (3.45)	
Marital status			0.29**
Married	87 (60)	78 (53.8)	
Unmarried	58 (40)	67 (46.2)	
Awareness on effect of smoking			0.28**
Aware	104 (71.7)	112 (77.2)	
Not aware	41 (28.3)	33 (22.8)	

N.B. Numbers in parentheses show percentage; SD: Standard Deviation; $p < 0.05$ is considered as significant.

*Two-tail p-value calculated by unpaired t-test, **p-values were calculated by Chi-square test.

Interpretation:

As shown in the Table 1, baseline characteristics of the smokers and non-smokers regarding age and sex was same. Subjects were mostly Hindu (62.1% in Smokers and 55.2% in non-smokers). Study subjects were mostly married (60% in smokers and 53.8% in non-smokers). Regarding awareness to the adverse health effects of smoking, most of the smokers and non-smokers were found to be aware. No significant difference ($p > 0.05$) in awareness among the smokers and non-smokers.

Most of the smokers were in the age group 27-33 years followed by 34-40 years and 20-26 years respectively; Most of the non smokers were in the age group 20-26 years followed by 34-40 years and 27-33 years respectively. There is no significant difference in the mean age of different age groups among smokers and non-smokers ($p > 0.05$)

Interpretation:

Hemoglobin level was found to be significantly higher in smokers as compared to non-smokers ($p < 0.05$). The mean hemoglobin level in smokers was 13.33 ± 1.54 g/dl while in non-smokers it was found to be 11.27 ± 1.24 g/dl. Similarly RBC count and Serum ferritin were also found to be higher in smokers as compared to non-smokers ($p < 0.05$). Mean RBC count in smokers and non smokers were (4.64 ± 0.82 , 4.28 ± 0.54) millions/ mm^3 and serum ferritin levels in smokers and non smokers were (218.73 ± 62.27 , 74.32 ± 17.33) ng/ml respectively. p-values were calculated by unpaired-t test.

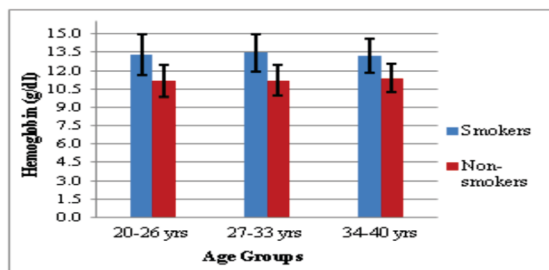


Figure 1:- Differences in mean hemoglobin levels among smokers and non-smokers were found to be significant ($p < 0.05$) in all the three age groups.

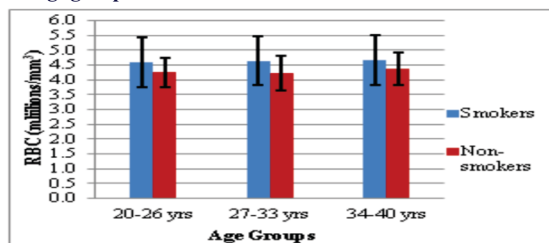


Figure 2: Differences in mean RBC levels among smokers and non-smokers were found to be significant ($p < 0.05$) in all the three age groups.

non-smokers were found to be significant ($p < 0.05$) in all the three age groups.

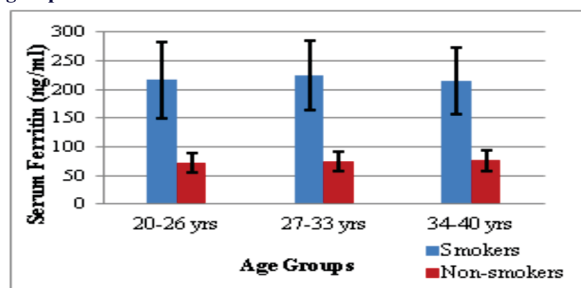


Figure 3: Differences in mean serum ferritin levels among smokers and non-smokers were found to be significant ($p < 0.05$) in all the three age groups.

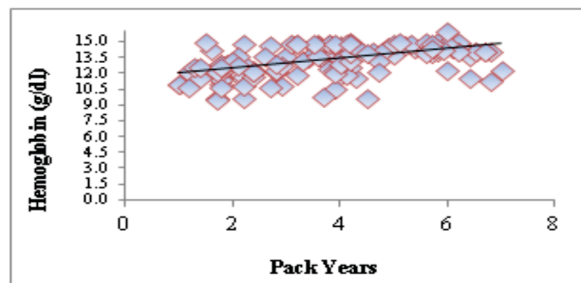


Figure 4: Scatter diagram showing positive correlation ($r = 0.48$) between intensity of smoking (pack years) and hemoglobin level and it was found to be statistically significant ($p < 0.05$).

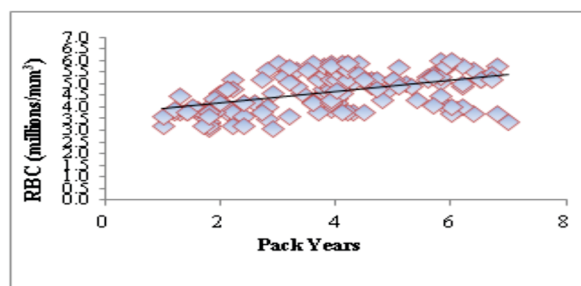


Figure 5: Scatter diagram showing positive correlation ($r = 0.47$) between intensity of smoking (pack years) and RBC count and it was found to be statistically significant ($p < 0.05$).

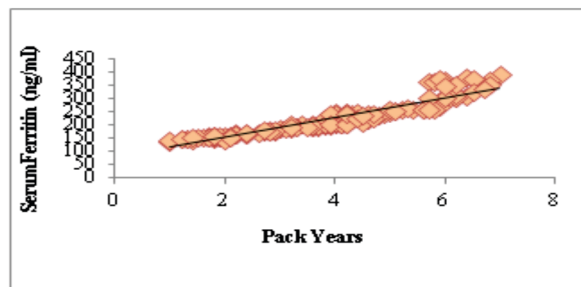


Figure 6: Scatter diagram showing positive correlation ($r = 0.94$) between intensity of smoking (pack years) and serum ferritin level and it was found to be statistically significant ($p < 0.05$).

DISCUSSION AND CONCLUSION:

In the present study when the smokers and non smokers were compared as a whole then it was found that all the three parameters viz hemoglobin level, Red Blood Cell count and serum ferritin levels were higher in smokers than in non smokers. The differences in these parameters among smokers and non-smokers were found to be statistically significant ($p < 0.05$).

When these parameters were compared in three different age groups among smokers and non smokers, they were found to be significantly increased ($p < 0.05$) among the smokers than the non smokers in all the

age groups. Similarly all the parameters have shown that there exists positive correlation with pack years.

One of the gaseous components of cigarette is carbon monoxide (CO).¹² Carbon monoxide has got more affinity towards hemoglobin than oxygen. The affinity of hemoglobin towards CO is around 200-250 times more than oxygen. The increase in the level of hemoglobin in smokers may be due to state of hypoxia, which occurs when high concentrations of carboxy hemoglobin is formed leading to decrease oxygen tension. This may lead to the stimulation of compensatory erythropoiesis to maintain increased hemoglobin levels, RBC count and indices, and polycythemia may develop.¹³ Another study explained that increased CO level due to cigarette smoking reduces the oxygen delivery to the renal oxygen sensors which may responsible for erythropoietin release leading to polycythemia.¹⁴

Agarwal et al in the year 2005 proposed that the smokers might have heightened state of oxidative stress and inflammation. Ferritin level in the serum may be elevated in response to this inflammation and stress.¹⁵ Positive correlation between intensity of smoking, prevalence of metabolic syndrome and increased ferritin level were also confirmed in one of earlier population based studies which was carried out in China.¹⁶

As because of cigarette smoking, the levels of hemoglobin and RBC count may be falsely elevated, so proper history of cigarette smoking like the duration for which smoking is practiced or number of cigarette smoked per day should be taken into consideration while diagnosing anemia on the basis of hemoglobin level and RBC count. Otherwise, an anemic person may be falsely diagnosed as normal one because of elevated hemoglobin levels and RBC counts. It has been already found in various studies that cigarette smoking causes development of COPD and intensity of smoking has a linear relationship with decline of lung function. It has also been found that in COPD patients with increase in cigarette smoking the level of serum ferritin increases. The present study shows that the serum ferritin level may be elevated in smokers who are presently healthy and the level is positively correlated with intensity of smoking. So, this shows the possibility of serum ferritin level being used as a predictor of development of diseases in smokers who are presently healthy. By increasing awareness regarding ill effects of smoking and advising the smokers to stop smoking during the early stage we may be able to stop development of different diseases that might be seen due to the practice of cigarette smoking.

However Our Study Encountered Some Limitations:-

- 1) Confounding factors such as ethnicity, nutritional status, geographical location etc. have to be adjusted for statistical procedures to find out the changes in the variables independent of these factors.
- 2) Follow up of the subjects could not be done to see the effects of the increased hemoglobin levels, RBC count and elevated serum ferritin level in the smokers.

Recommendation And Future Scope :-

Studies demonstrating association of hemoglobin level and RBC count with lipid profile may be performed to detect whether these parameters can be used as predictive tools for development of cardiovascular diseases. If the in-depth knowledge of mechanisms involved in the development of the diseases is known then preventive measures can be taken against those mechanisms

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REFERENCES

- 1) Mudawi SAA, Ahmed SM, Al- Abd BAH. Assessment of the Levels of Serum Iron and Magnesium in Sudanese Cigarette Smokers. IOSR J Pharm 2013 May;3(4):26-30
- 2) Mishra S, Joseph RA, Gupta PC, Pezzaack B, Ram F, Sinha DN, et al. Trends in bidi and cigarette smoking in India from 1998 to 2015, by age, gender and education. BMJ Glob Health [serial online]. 2016 Apr 6 [cited 2017 Mar 25];1(1). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5321300/>
- 3) El-Zayadi AR. Heavy smoking and liver. World J Gastroenterol 2006;12(38):6098-101.
- 4) Bacon BR, Britton RS. The pathology of hepatic iron overload: A free radical-mediated process? Hepatology [serial online]. 1990 Jan [cited 2017 Mar 25];11(1):127-37. Available from: URL:<https://www.ncbi.nlm.nih.gov/pubmed/2153094>
- 5) Adamson JW. Regulation of red blood cell production. Am J Med 1996 Aug;101(2 Supp 1):4S-6S.
- 6) Arosio P, Levi S. Ferritin, iron homeostasis, and oxidative damage. Free Radic Biol Med

- 2002 Aug;33(4):457-63
- 7) Lee CH, Goag EK, Lee SH, Chung KS, Jung JY, Park MS et al. Association of serum ferritin levels with smoking and lung function in the Korean adult population: analysis of the fourth and fifth Korean National health and nutrition examination survey. Int J Chron Obstruct Pulmon Dis 2016;11:3001-6.
- 8) Section7.THL. Available from: URL:<http://www.thl.fi/publications/ehrm/product1/section7.htm>
- 9) Hemocor-D [kit insert]. Tulip Group. Available from: URL: http://www.tulipgroup.com/Coral_New2/html/pack_inserts/Hemocor%620D.pdf
- 10) Pal GK, Pal P. Textbook of practical physiology. 3rd ed. India: Universities Press (India) Pvt Ltd; 2010. p. 42-4
- 11) VIDAS®Ferritin (FER) [kit insert]. France: BIOMERIEUX
- 12) Davis RM, Wakefield M, Amos A and Gupta PC. The hitchhiker's guide to tobacco control: A global assessment of harms, remedies, and controversies. Annu Rev Public Health 2007;28:171-94
- 13) S AL, Lakshmanan A, P GK, A S. Effect of Intensity of Cigarette Smoking on Hematological and Lipid Parameters. J Clin Diagn Res 2014 Jul;8(7):BC11-3
- 14) Moore-Gillon J. Smoking – a major cause of polycythemia. J R Soc Med 1988 Jul;81(7):431
- 15) Agarwal R. Smoking, oxidative stress and inflammation: Impact on resting energy expenditure in diabetic nephropathy. BMC Nephrol 2005 Nov 22;6:13
- 16) Li J, Wang R, Luo D, Li S, Xiao C. Association between serum ferritin levels and risk of the metabolic syndrome in Chinese adults: a population study. PLoS ONE [serial online]. 2013 Sept [cited 2018 Aug 18];8(9). Available from: URL:<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3774625/>.