

Effect of smoking on Red Blood Cells Count, Hemoglobin Concentration and Red Cell indices

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ABSTRACT

Background. Cigarette smoking contributes to the development or progression of numerous chronic and age-related disease processes. One major risk factor for morbidity and mortality among smokers is cardiovascular disease and lung cancer. Hematological abnormalities have been associated with coronary heart disease and other oxidative damage at the tissue levels increasing in age is significantly associated with higher hemoglobin concentrations.

Aim: To see the effects of smoke on RBCs count, HB concentration and RBCs Indices and to compare them with other countries to create awareness in public and plan launching anti-smoking campaigns.

Methods: A descriptive cross sectional study was done to investigate the relationship between cigarette smoking and hemoglobin concentrations, red blood cell counts, white blood cell counts, in comparison with age 20-60 years. The study included 100 male (50) smokers and (50) nonsmokers. They were selected among the staff and students of colleges of Tehsil Liaquatpur who had been smoking for the last five and more years.

Results: In this study the values of Hb, RBCs count, HCT (PCV) and Red Cell indices in age matched smokers were compared with non-smokers. The results regarding values of Hemoglobin, RBC Count, PCV, and MCH show significant increase of various degrees ($p < 0.5$, 0.01 or 0.001) in the different groups of smokers as compared to non-smokers of same age groups while the increase in values of MCV and MCHC is found less marked and non-significant ($p > 0.05$).

Conclusion: It has been concluded that smoking causes persistent state of hypoxia in the body due to smoke contents which cause increase in erythrocyte count, Hb and Red cell Indices

Keywords: Smoking, Red blood cell count, hemoglobin

INTRODUCTION

Smoking is a process in which tobacco is burnt and smoke is inhaled by different ways i.e. cigarette, cigar, biri and pipe. It gives sense of pleasure and satisfaction to the smoker. It is complex external and internal stimulus consisting of visual, tactile, mechanical (mouth movement), gustatory, olfactory and irritating factor¹.

The average per capita cigarette consumption in hungry is among the highest in the world (WHO)². Cigarette smoking is one of the 10 leading health indicators that reflect the major health concerns in the USA³. Although the percentage of the population that smokes has declined in the USA and other industrialized countries. It is increasing in developing countries⁴. According to the WHO smoking diseases are set to become a greater problem in these countries than communicable diseases and malnutrition⁵.

Tobacco use is one of the chief preventable causes of death in the world⁶. Nearly 50,000 deaths annually are attributed to tobacco and in Islamic Republic of Iran it is estimated that the figure will reach about 200,000 annual deaths due to smoking in 20 years time⁷. Numerous throughout the world have examined the risk factors for cigarette smoking. Some of these include: genetic and demographic factors, social norms, peer influences and parental attitudes and behavior⁸. Cigarette smoking is considered a "gateway" drug in as its use often precedes use of alcohol, marijuana or other illicit drugs⁹.

During the last 20 years the amount of tar and Nicotine content delivered by cigarette made by United States has decreased more than 50%¹⁰. WHO estimates that by the decade 2020-2030 tobacco will be responsible for 10 million deaths per year, with 70% occurring in developing countries¹¹. In Thailand Prevalence of current smoker has been reported to be greater than 9 million or 19.5% of 49.4 million, in 2005¹². It generates many toxic and carcinogenic compounds harmful to health, such as nicotine, NO, CO, hydrogen Cyanide and free radicals.(13) About

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1.3 billion people are regular smokers worldwide and every day between 8,200 and 9,900 young people start to smoke, risking rapid addiction to nicotine¹⁴ tobacco smoking in pregnancy exerts a negative effect on the environment in which the foetus develops, and consequently, on the health of newborn babies¹⁵.

The aim of this study was to examine age-related change and cigarette smoking in the strength of the association of RBCs count, hemoglobin concentrations, Red Cell Indices to create awareness in public and plan launching anti-smoking campaigns.

MATERIALS AND METHODS

A total of 100 healthy volunteer male subjects (smokers(50) and nonsmokers(50); The smokers with the history of smoking for at least five years having age's between 20-60 years from the students and staff members of colleges of Tehsil Liaqatpur were selected for this study. A careful history was taken. The subjects practicing vigorous exercise and those working in such industries or in atmosphere where the chance of dust and fumes present were excluded from the study. Similarly subjects with history of any respiratory acute or chronic illness during previous three months were also excluded. To avoid the acute effect of smoking subject were requested not to smoke for at least few hours before taking the sample of blood for study. A detailed history was taken after selection. All the selected subjects fulfilled the criteria of no respiratory tract infection during previous 3 months and were quite healthy at the time of test. They were questioned about the number of cigarettes smoking per day and duration. In this study the

control subjects, apparently healthy were selected who never smoked in their lifetime. They were also questioned about any illness and checked clinically to find any illness. These control subjects were also aware about passive smoking and they did give history of possibly avoidance of such smoking. The study population was divided into different groups according to their.

Non Smokers Groups

- A. 20-30 years
- B. 31-40 years
- C. 41-50 years
- D. 51-60 years

Smokers Groups

- AS. 20-30 years
- BS.31-40 years
- CS.41-50 years
- DS.51-60 years

RESULTS

In this study the values of Hemoglobin, RBCs count, Hematocrit (PCV) and Red Cell indices in age matched smokers have been compared with non-smokers. The results regarding values of Hemoglobin, RBC Count, PCV, and MCH show significant increase of various degrees (p<0.5, 0.01 Or 0.001) in the different groups of smokers as compared to non-smokers of same age groups while the increase in values of MCV and MCHC is found less marked and non-significant (p>0.05). The mean values of various hematological parameters in; Non-smoker control subject Groups (A-D) and Smokers Groups AS-DS) was studied and given in Table 1

Table.1. Mean values of various hematological parameters in Non-smoker control subject Groups (A-D) and Smokers Groups AS-DS)

Para-meters	Group A 20-30 yrs	Group B 31-40yrs	Group C 41-50 yrs	Group D 51-60 yrs	Group AS 20-30 yrs	Group BS 31-40 yrs	Group CS 31-40 yrs	Group DS 31-40 yrs
Age	26 ±0.61	37±0.60	43.90± 0.82	53.20± 0.51	25.07±0.49	34.31± 0.60	44.60 ±0.67	53 ± 0.65
HB (g/dl)	14.57 ±0.21	15.07±0.18	15.13± 0.40	15.05± 0.26	16.11± 0.19	16.04±0.23®	16.39± 0.2 *	16.37±0.19•
HCT	44.28±0.45	44.75±0.48	45.00±0.85	45.60 ± 0.60	48 ±0.60	47.87± 0.49•	47.80±0.66*	48.30±0.81*
RBC Count	5.09 ±.093	4.98±.093	4.98±12	5.10 ±.07	5.40®±.04	5.27 ±.21®	5.36 ®±.04	5.32±.06 *
MCV(fl)	87.18±0.85	88.42±1.9	88.71±2.4	89.83±0.68	88.93±0.86	91.03±1.00	89.10 ± 0.97	90.77±1.1
MCH (pg)	28.87±0.414	30.41±0.46	30.42± 0.37	29.69 ± 0.32	30±0.31 *	30.41±0.39	30.36 ± 0.25	30.76±0.24*
MCHC%	33.83 ±3.8	33.82±2.1	33.84±4.83	33.50±4.23	33.57±2.97	33.45±3.13	33.82 ±2.64	33.63 ±3.20

*P<.05 (AS vs A, BS vs B, CS vs C & DS vs D) ® p<.01 (AS vs A, BS vs B, CS vs C & DS vs D)

• p<.001 (AS vs A, BS vs B, CS vs C & DS vs D)

DISCUSSION

Many toxic substances especially reactive oxygen species (ROS) such as superoxide anions, hydroxyl radicals, H2O2 and HOCL present in smoke can damage cellular constituents leading to inflammation and injury¹⁶. Cigarette has numerous adverse health

effects and is reportedly the second leading cause of death worldwide¹⁷.

Cigarette smoke has 4000substances among which CO and tars are the main toxic substances. CO can diffuse rapidly across alveolar capillaries, bind firmly to Hb (with binding ability of 200-250 times greater than that of O2) forming HbCO and is a leading

cause of tissue hypoxia leading to increased values of RBCs, Hb and PCV¹⁸.

In healthy persons smoking causes an increase in Hb levels probably mediated by exposure to carbon monoxide (CO) which binds to Hb to form carboxyhaemoglobin (HbCO). Mean Hb levels and HbCO levels increase progressively with the number of cigarettes consumed per day. In addition to the number of cigarettes smoked per day, the duration of chronic exposure to HbCO also correlates with the development of polycythemia¹⁹.

Our study shows a significant increase in the RBCs count, Hb, PCV and MCH in the smokers as compared to non-smokers of the same age groups and a non-significant increase in the values of MCV and MCHC. Many studies done at different times and at different places are consistent with our study with slight variations of change in all parameters. On the other hand in few studies one or more of the parameters show different values from those of our study. In 1993 Kondo H along with his coworkers observed significantly increased values of Hb, PCV and MCH in the smokers similar to our study but the observations regarding MCV and MCHC the change was less marked in our study ($P > 0,05$) as compared to the study mentioned above²⁰.

In other study the erythrocytes count in smokers was significantly high ($p < 0.0005$) as compared with the non-smokers but the values of Hb were found opposite to those found in our study. The level of Hb was found significantly less in the smokers as compared to non-smokers while our study shows significantly higher values in the smokers ($p > 0.01$)²¹.

The higher values of Haematocrit as observed by our study are favored by other studies also Two recent studies in 2012 and 2013 in Saudi Arabia and India respectively also found the similar rise in hematocrit in the smokers^{22,23}. The similar study in Nigeria in 2013 also shows similar trend as seen in our study, the higher values Hb and PCV. (42.9 ± 2.7 and 14.1 ± 2.7 , versus 41.6 ± 2.7 and 12.1 ± 1.2 , respectively $p = 0.001$, 0.03 , respectively²⁴ hemoglobin concentration (Hb), mean corpuscular volume of red blood cells (MCV) were positively correlated with numbers of cigarettes consumed²⁵. The studies of Chien with his companions and Milman along with co-workers also favour our study regarding Hb and polycythemia but doesn't for MCV^{26,27}.

Salamzada in his cross sectional study done in Iran also favors our study as he found higher values of RBC and Hb. He also favors us by observing no difference in MCV in two groups of smokers and non-smokers. On the other hand he observed lower values of MCH and MCHC while our study shows higher value of MCH ($P < 0.05$) and non-significant

rise of MCHC ($p > 0.05$ in the smokers. In this case the values are consistent with our study in case of RBCs Count, HB and MCV but different regarding PCV, MCH and MCHC. The differences detected between peripheral blood leukocytes and erythrocytes composition of smokers and non-smokers may be reflections of the gaseous and solid phases of cigarette smoke toxic product effects on the bone marrow as well as the adaptive, defensive and immunologic reactions of the body to long-term active smoking²⁸.

In older studies it was found that Smoking increased hemoglobin level and hematocrit significantly in comparison to nonsmokers, but had no effect on the number of erythrocytes. It was concluded that adaptation to carbon monoxide inhaled with cigarette smoke is reflected by an increased red cell mass and hemoglobin²⁹. In one of the study the smokers had significantly higher levels of red blood cell ($p < 0.011$), hemoglobin ($p < 0.001$) and hematocrit ($p < 0.006$), whereas mean corpuscular hemoglobin concentration ($p < 0.009$) and platelet crit ($p < 0.017$) were significantly lower³⁰.

Biochemical data in plasma from 3053 Japanese in Tokyo were investigated who underwent an annual health check-up from 2003 to 2007 with amount and duration of cigarette smoking. Dose-dependent effects of cigarette smoking as indicated by Brinkman index (daily number of cigarettes \times years) were observed on increased circulating white blood cell counts in men and women, red blood cell in women, and plasma triglycerides concentrations in men. Higher levels of hemoglobin and hematocrit in females were seen with ≤ 400 of Brinkman index, but these increases were observed in the male group with ≤ 800 of index. Decreased high-density lipoprotein cholesterol levels in blood were seen in men (> 800 of index)³¹. In one of the study no significant change has been observed in all the parameters as mentioned in our study³².

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