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Effects of Tobacco Cigarette Smoking on Some Hematological Parameters of Male Cigarette Smokers in Southern Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author IMO designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author HUO managed the analyses of the study and the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

In Nigeria smoking is a common habit in both rural and urban areas. Cigarette smoking is associated with alterations in inflammatory markers among smokers and it affects various organs and tissues in the body including blood. Cigarette smoking is associated with development and progression of numerous chronic diseases worldwide. It is a known fact that smoking is one of the most important factors contributing to the evolution of atherosclerosis and chronic obstructive pulmonary disease. This study investigates the effects of smoking on haematological parameters among tobacco cigarette smokers in Southern Nigeria. A total of 150 smokers and 110 controls (non-smokers) within the age range of 20-50 years residing in Calabar metropolis of Cross River State, South-South, Nigeria were recruited. The smokers were apparently healthy males who were regular cigarette smokers who have at least smoked 100 cigarette sticks in their life time. Full blood count was done using Sysmex, kx-210 automated haematology analyser (Sysmex America, Illinois). The erythrocyte sedimentation rate was determined by westergren's method. The relative plasma viscosity was performed using the method of Bach et al. 1981. The tobacco cigarette

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smokers had significantly ($p<0.05$) higher haemoglobin, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration, total white blood cell count, mixed cells, Erythrocyte sedimentation rate, relative plasma viscosity, mean platelet volume and platelet distribution width and significantly ($p<0.05$) lower neutrophil count as compared to controls. This study showed that smoking has negative effect on the haematopoietic system. The study has also shown that haematological parameters were altered in smokers and thus should be considered during diagnosis, interpretation of result and treatment of patients.

Keywords: Tobacco; cigarette; smoking; haematological.

1. INTRODUCTION

Tobacco cigarette smoking is one of the leading causes of death and essential public health challenge in the world over [1,2]. It is a major cause of death worldwide, resulting in millions of death annually more than malaria, tuberculosis and HIV/Aids [2]. According to world health organization (WHO) report, there are about 2.4 billion people worldwide that have consumed tobacco in the form of estimated smoking, chewing, snuffing or dipping. WHO also estimated that tobacco related deaths will amount to 8.3 million in 2030 and one billion deaths during the 21st century [3]. There are more than 4000 chemicals present in cigarette smoke among which includes nicotine, carbon monoxide, free radicals and other gaseous products which are dangerous [4]. Cigarette smoking is a powerful risk factor for atherosclerosis.

A variety of studies have shown an association of smoking with coronary heart disease (CHD) [5], peripheral artery disease, [6] aortic aneurism, [7] and stroke [8].

More so, cigarette smoking accelerates pathogenesis in different type of cancers such as lung, pancreas, breast, liver and kidney [9]. Similarly it changes the pH in stomach that results in peptic ulcers and gastric diseases [2]. Tobacco smoking rates have decreased in industrialized countries since 1975, but there has been a corresponding 50% increases in some low-income countries in Asia [10]. In respect to this, it becomes pertinent to adjust for these factors in population based surveys when interpreting haematological values. The present study investigates the effects of smoking on haematological parameters among tobacco cigarette smokers.

2. MATERIALS AND METHODS

This study was a case controlled study. A total of 150 smokers and 110 controls (non-smokers) within the age range of 20-50 years residing in Calabar metropolis of Cross River State, South-South, Nigeria from October 2015 to November 2015 were recruited using simple random sampling method. The smokers were apparently healthy males who are regular cigarette smokers who have at least smoked 100 cigarette sticks in their life time. Ex-smokers and those who also smoke marijuana or on drugs were excluded. The control group were apparently healthy males who are not currently undergoing any clinical investigation. The study was approved by Cross River State ministry of Health Research Ethics Committee, Calabar, Nigeria.

Informed consent was obtained from the subjects before the commencement of the study. Information of the subjects was obtained via a predesigned questioner. After taking antiseptic precautions, 9 ml venous blood was collected into EDTA vacutainers (Akuret, Eatern Medkit Limited), and 0.5ml 3.8% sodium citrate container. The EDTA blood samples were processed by using Sysmex, kx-210 automated hematology analyser (sysmeic America, Illinois). The erythrocyte sedimentation rate was determined by Westergren's method of ESR determination [11]. The relative plasma viscosity was performed using the disposable syringe method as described by Bach et al. [12]. The barrel of a 20 ml syringe with a hypodermic needle (21.6 x 0.40) was filled by drawing up undiluted plasma through the needle starting with the plunger of the 1ml mark taken in this fashion, the serum level was just over the 2ml mark at the moment the plunger is withdrawn completely from the barrel of the syringe. With the syringe hand clamped in a vertical position, the run-through time was started when the bottom of the meniscus passes the 2 ml mark of the barrel and the timing was stopped when the meniscus reaches the zero mark of the barrel. The same procedure was performed for distilled water. The relative plasma viscosity (RPV) was derived by dividing the run-through time for the plasma against that of distilled water.

2.1 Statistical Analysis

Mean and Standard deviation were used to access mean values while two sample t test was used to ascertain significant differences among the different hematological parameters. The alpha level of the study was set at 0.05. All statistical analysis were performed using SPSS version 20.0 (SPSS Inc., Chicago, USA).

3. RESULTS

Table 1 shows the demographic data of the smokers and control subjects consisting of the age, height, weight, body mass index, systolic and diastolic blood pressures. The mean age of the test and control subjects were 35.90±8.20 years and 34.70±7.60 years, respectively. The mean height of the smokers and the control subjects were 1.60±0.04 meters and 1.63±0.02 meters, respectively. The smokers had a mean body mass index of 24.20±1.30 Kg/m^2 whereas the control group had mean value of 24.10±2.10 Kg/m^2. A comparatively higher mean systolic blood pressure (121±7.90 mmHg) was recorded for the smokers than the control subjects (106±5.1 mmHg). Similarly, a comparatively higher diastolic blood pressure (91±6.0 mmHg) was recorded for the smokers than the control subjects (79±3.1 mmHg). The haematological parameters of both smokers and control subjects are given in Table 2. The cigarette smokers had significantly ($p<0.05$) higher mean values of haemoglobin, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration, total white blood cell count, mixed cells, erythrocyte sedimentation rate, relative plasma viscosity, mean platelet volume and platelet distribution width and significantly ($p<0.05$) lower mean neutrophil count as compared to the controls.

Table 1. Demographic parameters of smoking and control subjects

Parameter	Smokers (N=150)	Control (110)
Age (Years)	35.90±8.20	34.70±7.60
Height (Meters)	1.60±0.04	1.63±0.02
Weight (Kg)	57.40±3.20	59.1±4.3
Body Mass Index (BMI) (Kg/m^2)	24.20±1.30	24.10±2.10
Systolic blood pressure (mmHg)	121±7.90	106±5.10
Diastolic blood pressure (mmHg)	91±6.0	79±3.1

Note: Data are represented as Mean±SD

Table 2. Haematological parameters of smoking and control subjects

Variables	Control (n=110) mean ± S.D	Smokers (n=150) means ± S.D	P value	Confidence interval (95%)
RBC × 10^6/µL	4.99 ± 0.84	5.20 ± 0.51	0.116	-0.056, 0.498
Hb (g/dL)	13.88 ± 2.10	15.30 ± 1.31*	0.000	0.707, 2.133
HCT (%)	44.55 ± 2.87	44.53 ± 4.27	0.908	-1.360, 1.528
MCV (fL)	88.53 ± 10.23	86.06 ± 9.67	0.216	-6.429, 1.473
MCH (Pg)	28.16 ± 2.67	29.52 ± 2.81*	0.015	0.275, 2.453
MCHC (g/dL)	31.83 ± 1.64	33.91 ± 2.78*	0.000	1.169, 2.990
RDW SD (fL)	43.98 ± 2.91	44.85 ±3.67	0.191	-0.442, 2.191
RDW CV (%)	14.58 ± 1.21	14.81 ± 1.06	0.308	-0.219, 0.687
WBC (×10^3/µL)	4.56 ± 1.00	5.56 ± 1.24*	0.000	0.559, 1.456
LYMPHOCYTE (%)	45.93 ± 10.74	48.25 ± 11.18	0.292	-2.029, 6.672
MIXED CELLS (%)	11.17 ± 4.09	13.20 ± 5.39*	0.037	0.127, 3.928
NEUTROPHIL (%)	42.80 ± 12.19	37.72 ± 9.21*	0.021	-9.362, -0.786
ESR (mm/hr)	17.0 ± 4.52	24. 0 ± 6.32*	0.001	4.412, 8.621
RPV (mPa.s)	1.74 ± 0.12	1.84 ±0.16	0.026	2.61, 9.025
PLATELET (×10^3/µL)	209.64 ± 30.71	229.55 ± 23. 43	0.319	-28.33, 9.35
MPV (FL)	8.56 ± 1.11	9.80 ± 0.78*	0.000	0.78, 1.70
PDW (FL)	10.95 ± 1.63	13.08 ± 2.12*	0.000	1.23, 3.03

- *= P<0.05 compared to control; Hb = Hemoglobin*
- *HCT = Haematocrit, MCV = Mean corpuscular volume, MCH = Mean corpuslar Haemoglobin, MCHC = Mean corpuscular Haemoglobin concentration, RDW = Red Cell Distribution width, WBC = White Blood cells, ESR = Erythrocyte sedimentation rate, MPR = Mean platelet volume, PDW = Platelet Distribution width*

4. DISCUSSION

This study investigated the effect of smoking on the haematopoietic system via complete blood count parameters, erythrocyte sedimentation rate and relative plasma viscosity. A higher haemoglobin concentration was observed in the smokers than the control subjects. This observation is in consonance with previous finding [13]. This elevated Hb value is likely a compensatory reaction to exposure to carbon monoxide. The inhaled carbon monoxide (CO) has a high affinity for haemoglobin relative to oxygen. Hence, CO displaces oxygen from haemoglobin in red blood cells to produce carboxyhaemoglobin which reduce the release of oxygen to tissues creating a chronic hypoxia [14]. An elevated total white cell count was observed in this study. This observation is consistent with previous studies, [15,16]. The exact mechanism responsible for this smoking associated leucocytosis is unclear. However, it has been hypothesized to be due to nicotine induced release of catecholamines as increase in certain endogenous hormone levels such as epinephrine and cortisol have been reported to increase leucocyte count [17]. More so, the resultant inflammatory response induced by particulates of cigarette smoke may have been another mechanism for smoking induced leucocytosis [18,19]. A significant elevation and reduction were observed in the mixed cell and neutrophil counts, respectively. The result of the neutrophil count is consistent with report by Tulger et al. [20] with a contrasting result in the mixed cell counts. The mechanism behind the differences in the mixed cell count and neutrophil count is unclear. An elevated ESR was observed in the smokers when compared with the control. This finding is in agreement with earlier report [9]. Cigarette smoke induces endothelial damage by producing free radicals such as nitric oxide and hydrogen peroxide. This oxidative stress promotes systemic acute phase reaction, hence, increasing inflammatory cytokines and eventual rise in ESR value [21]. The association between inflammation and cardiovascular heart diseases has gained considerable interest [22]. Several systemic markers of inflammation including ESR have been found to be predictor of coronary heart disease [23] and heart failure [24]. The observed elevated relative plasma viscosity in the smokers was consistent with earlier finding [25]. Plasma viscosity has been indicated as a predictive risk factor for coronary heart disease [26]. In other study, high plasma viscosity was shown to lead to an increased risk of acute myocardial infarction in patients with unstable angina pectoris [27]. The observed elevated mean platelet volume is consistent with earlier report by Anandhalakshmi et al. [28]. However, it is in contrast with previous finding by Butkiewicz et al. [29]. Mean platelet volume is an indicator of platelet activation. Increased mean platelet volume has been reported as an independent risk factor for cardiovascular events [30].

However, efforts towards recruiting female smokers were futile owing to the societal stereotype on female smokers in the study area, hence, the all male subjects.

5. CONCLUSION

The findings of this study showed that smoking has negative effect on the haematopoietic system. These events have been reported to lead to vascular mortality and cardiovascular events, hence, death. More so, this study has shown that haematological parameters were altered in smokers and thus should be considered during diagnosis, interpretation of result and treatment of patients.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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