

**EFFECTS OF TOBACCO CIGARETTE SMOKING ON SOME
HEMATOLOGICAL PARAMETERS OF MALE CIGARETTE
SMOKERS IN SOUTHERN NIGERIA.**

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31 Abstract

32 In Nigeria smoking is a common habit in both rural and urban areas. Cigarette smoking is
33 associated with alterations in inflammatory markers among smokers and it affects various
34 organs and tissues in the body including blood. Cigarette smoking is associated with
35 development and progression of numerous chronic diseases worldwide. It is a known fact that
36 smoking is one of the most important factors contributing to the evolution of atherosclerosis
37 and chronic obstructive pulmonary disease. This study investigates the effects of smoking on
38 haematological parameters among tobacco cigarette smokers in Southern Nigeria. A total of
39 150 smokers and 110 controls (non-smokers) within the age range of 20-50 years residing in
40 Calabar metropolis of Cross River State, South-South, Nigeria were recruited. The smokers
41 were apparently healthy males who were regular cigarette smokers who have at least smoked
42 100 cigarette sticks in their life time. Full blood count was done using Sysmex, kx-210
43 automated haematology analyser (Sysmex America, Illinois). The erythrocyte sedimentation
44 rate was determined by westergren's method. The relative plasma viscosity was performed
45 using the method of Bach *et al.* 1981. The tobacco cigarette smokers had significantly
46 ($p<0.05$) higher haemoglobin, mean corpuscular haemoglobin, mean corpuscular
47 haemoglobin concentration, total white blood cell count, mixed cells, Erythrocyte
48 sedimentation rate, relative plasma viscosity, mean platelet volume and platelet distribution
49 width and significantly ($p<0.05$) lower neutrophil count as compared to controls. This study
50 showed that smoking has negative effect on the haematopoietic system. The study has also
51 shown that haematological parameters were altered in smokers and thus should be considered
52 during diagnosis, interpretation of result and treatment of patients.

53 Key words: Tobacco, Cigarette, Smoking, Haematological

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67 INTRODUCTION

68 Tobacco cigarette smoking is one of the leading causes of death and essential public health
69 challenge in the world over². It is a major cause of death worldwide, resulting in millions of
70 death annually more than malaria, tuberculosis and HIV/Aids². According to world health
71 organization (WHO) report, there are about 2.4 billion people worldwide that have consumed
72 tobacco in the form of estimated smoking, chewing, snuffing or dipping. WHO also estimated
73 that tobacco related deaths will amount to 8.3 million in 2030 and one billion deaths during
74 the 21st century³. There are more than 4000 chemicals present in cigarette smoke among
75 which includes nicotine, carbon monoxide, free radicals and other gaseous products which
76 are dangerous⁴. Cigarette smoking is a powerful risk factor for atherosclerosis.

77 A variety of studies have shown an association of smoking with coronary heart disease
78 (CHD)⁵, peripheral artery disease,⁶ aortic aneurism,⁷ and stroke⁸.

79 More so, cigarette smoking accelerates pathogenesis in different type of cancers such as lung,
80 pancreas, breast, liver and kidney⁹. Similarly it changes the pH in stomach that results in
81 peptic ulcers and gastric diseases². Tobacco smoking rates have decreased in industrialized
82 countries since 1975, but there has been a corresponding 50% increases in some low-income
83 countries in Asia¹⁰. In respect to this, it becomes pertinent to adjust for these factors in
84 population based surveys when interpreting haematological values. The present study
85 investigates the effects of smoking on haematological parameters among tobacco cigarette
86 smokers.

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90 **MATERIALS AND METHODS**

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

100 Informed consent was obtained from the subjects before the commencement of the study.
101 Information of the subjects was obtained via a predesigned questioner. After taking antiseptic
102 precautions, 9ml venous blood was collected into EDTA vacutainers (Akuret, Eastern Medkit
103 Limited), and 0.5ml 3.8% sodium citrate container. The EDTA blood samples were processed
104 by using Sysmex, kx-210 automated hematology analyser (Sysmex America, Illinois). The
105 erythrocyte sedimentation rate was determined by Westergren's method of ESR
106 determination.¹¹The relative plasma viscosity was performed using the disposable syringe
107 method as described by Bach *et al.*¹². The barrel of a 20ml syringe with a hypodermic needle
108 (21.6 x 0.40) was filled by drawing up undiluted plasma through the needle starting with the
109 plunger of the 1ml mark taken in this fashion, the serum level was just over the 2ml mark at
110 the moment the plunger is withdrawn completely from the barrel of the syringe. With the
111 syringe hand clamped in a vertical position, the run-through time was started when the
112 bottom of the meniscus passes the 2ml mark of the barrel and the timing was stopped when
113 the meniscus reaches the zero mark of the barrel. The same procedure was performed for
114 distilled water. The relative plasma viscosity (RPV) was derived by dividing the run-through
115 time for the plasma against that of distilled water.

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).

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/m² whereas the control group had mean value of 24.10 ± 2.10 Kg/m². 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.

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.

140 This observation is in consonance with previous finding.¹³ This elevated Hb value is likely a
141 compensatory reaction to exposure to carbon monoxide. The inhaled carbon monoxide (CO)
142 has a high affinity for haemoglobin relative to oxygen. Hence, CO displaces oxygen from
143 haemoglobin in red blood cells to produce carboxyhaemoglobin which reduce the release of
144 oxygen to tissues creating a chronic hypoxia¹⁴. An elevated total white cell count was
145 observed in this study. This observation is consistent with previous studies,^{15,16}. The exact
146 mechanism responsible for this smoking associated leucocytosis is unclear. However, it has
147 been hypothesized to be due to nicotine induced release of catecholamines as increase in
148 certain endogenous hormone levels such as epinephrine and cortisol have been reported to
149 increase leucocyte count¹⁷. More so, the resultant inflammatory response induced by
150 particulates of cigarette smoke may have been another mechanism for smoking induced
151 leucocytosis^{18, 19}. A significant elevation and reduction were observed in the mixed cell and
152 neutrophil counts, respectively. The result of the neutrophil count is consistent with report by
153 Tulger *et al.*, (2016)²⁰ with a contrasting result in the mixed cell counts. The mechanism
154 behind the differences in the mixed cell count and neutrophil count is unclear. An elevated
155 ESR was observed in the smokers when compared with the control. This finding is in
156 agreement with earlier report⁹. Cigarette smoke induces endothelial damage by producing
157 free radicals such as nitric oxide and hydrogen peroxide. This oxidative stress promotes
158 systemic acute phase reaction, hence, increasing inflammatory cytokines and eventual rise in
159 ESR value²¹. The association between inflammation and cardiovascular heart diseases has
160 gained considerable interest²². Several systemic markers of inflammation including ESR have
161 been found to be predictor of coronary heart disease²³ and heart failure²⁴. The observed
162 elevated relative plasma viscosity in the smokers was consistent with earlier finding²⁵.
163 Plasma viscosity has been indicated as a predictive risk factor for coronary heart disease²⁶. In
164 other study, high plasma viscosity was shown to lead to an increased risk of acute myocardial

infarction in patients with unstable angina pectoris²⁷. The observed elevated mean platelet volume is consistent with earlier report by Anandhalakshmi *et al.*, (2015)²⁸. However, it is in contrast with previous finding by Butkiewicz *et al.*, (2006)²⁹. Mean platelet volume is an indicator of platelet activation. Increased mean platelet volume has been reported as an independent risk factor for cardiovascular events³⁰.

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.

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.

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312 **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)	Smokers (n=150)	P value	Confidence Interval
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	mean ± S.D	means ± S.D		(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

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