

Correlation of increased triglyceride with alteration in hematological and biochemical parameters in apparently healthy individuals

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Abstract

Objective It is suggested that endotoxin and inflammatory cytokines could be resulted from smoking cigarettes. Tobacco smoking cigarettes affect blood parameters and involve in individual's lipid profile. The current study was aimed to evaluate and assess the correlation between adulterations of hematological parameters with high level of triglycerides in healthy smoker individuals.

Methods Ninety volunteers participated in this study constituting smokers (n=70) and non-smokers (n=20). Complete blood count and other tests were performed by using fully automated hematological analyzer devices.

Results The values of white blood cells ($p = 0.005$), red blood cells ($p = 0.01$), hemoglobin content ($p = 0.03$), hematocrit ($p = 0.042$), mean corpuscular hemoglobin and mean corpuscular volume ($p = 0.003$ and 0.0022 , respectively) in smokers showed greater when compared to non-smokers. The values of total cholesterol and triglycerides appeared significantly greater in smokers than in control subjects. All other calculated measure parameters did not show significant differences between the two groups.

Conclusions The current study showed that continuous cigarette smoking among healthy individuals has adverse effects on both biochemical and hematological parameters but not in kidney function activities. There is a strong correlation between high levels of triglycerides with increased levels of blood parameters in smoker group.

Keywords Cigarette smoking, hematological parameters, healthy individuals, kidney function, lipid profile

Introduction

Smoking cigarette is a main public health concern. It is one of the serious causes of death globally.^{1,2} In accord with the World Health Organization (WHO) evaluation data, it was made clear that about 2.5 billion person globally have been using cigarettes in many forms like smoking, chewing, dipping, and snuffing.³ Therefore, some researchers have expected that the number of patients who died because of smoking is about 5 million people around the world.⁴ If these data continue to rise, the number of dead people would be more than double in the near future. It is also known that cigarette tobacco contains some compounds including toxicants, carcinogens, and some amounts of free radicals and oxidants that involve in blood parameters causing hypertension.^{5,6}

The nicotine, which is a cigarette's compound, produce clot formation in the coronary arteries; it leads to weakening of vascular functions and expand the endothelial dysfunction of the arteries. As a result, hypoxia will occur due to increase the amount of carboxy-hemoglobin. The nicotine is also responsible for altering the vascular permeability and lipid accumulations.⁷ In addition, cigarette smoking may increase the arterial stiffness and cause high blood pressure (BP) and this could be a possible mechanism of increased risk of cardiovascular disorders.⁸ It is well-known that hypertension is a silent killer because it can exist in human for a long time without feeling it. Moreover, hypertension is one of the most common blood disorders that affecting mostly the heart, blood vessels, brain, and even kidneys.⁹

Various studies have proved that nicotine is highly associated for alteration of the lipid profile status.^{10,11} However,

there is still unclear about which lipid profile components are mostly altered in case of tobacco smoking, and whether the alterations in lipid profile affect other parts of the blood components directly or indirectly. There are studies showing that some blood parameters are same for smokers and non-smokers,¹² while others revealed that the level of that blood components are different between individuals.¹³ There are some factors influencing the actual data, for example, smoking duration, number of smoking per day, and the age of smokers. Therefore, the current study is aimed to investigate and analyze the adverse effects of cigarette smoking on hematological parameters, lipid profile, and renal functions and to assess the correlation of increased triglyceride with alteration in hematological and biochemical parameters in healthy male smokers in Duhok city.

Materials and methods

Participants

The current study was aimed to discover and analyze the effect of cigarette smoking on hematological and lipid profile parameters and to study the correlation between high triglyceride with alteration of blood components in a group of volunteers who were clinically healthy. Ninety individuals participated in this study constituting 70 smokers and 20 non-smokers (used as control subjects) in the age range of 20–45 years old. The volunteers were recruited from employees of some offices in Duhok city of Iraq. The smokers were consuming 10–20 cigarettes daily as a regular habit for at least 3 years. Each participant was supplied with an informed consent form and study

design protocol to be self-filled and obtained from all the individuals. Subjects in this study include those who are free of evidence from kidney and active liver diseases, gastrointestinal disorders, history of ischemic heart disease, endocrine disorders, any infection, and hormonal therapy.

Sample collection

Blood pressure of each participant was measured with a mercury sphygmomanometer with a standard stethoscope. After that, blood samples were aseptically taken from volunteers' veins after an overnight fast in order to obtain an accurate and reasonable result. This step of the test procedure was done between 7 and 10 am.

Sample processing

Five milliliter of blood was collected by using 5 mL sterile disposable syringe. The sample was divided into two different tubes; 3 mL of the collected blood was put into an EDTA tube for complete blood count (CBC) and 2 mL of the blood put into Gel and Clot Activator Tubes for biochemical tests like lipid profile and kidney functions. The collected blood samples were directly transferred to the Duhok central laboratory for analysis by using fully automatic hematological analyzers like Coulter and COBAS as described by a previous study.¹⁴ The participants underwent the following blood tests: Blood pressure, estimation of lipid profile (total cholesterol and triglyceride), red blood cell (RBC), white blood cell (WBC), hemoglobin (Hb), hematocrit (HCT), platelets (plt), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), differential WBC count, serum urea, and creatinine levels.

Statistical analysis

The GraphPad Prism version 8.2.1 (GraphPad software, California, United States) was used in this experiment for analysis and expresses the results. All results are expressed as mean \pm Stdev. (Standard deviation), comparison between smokers and non-smokers group was carried out by independent sample *t*-test. A result at *p*-value <0.05 was observed as statistically significant for all data analysis.

Results

It can be seen that there was a significant increase in the most important hematological parameters; total leukocyte count (WBC), RBC, HCT, and HB in smoker people when compared to non-smokers. The rest of the blood parameters were not showing as significantly different. Moreover, the red blood cell indices, MCV, and MCH were also showing significantly greater values in smokers when compared to control group. However, a small change was observed in MCHC values between the two groups (Table 1).

It is also clear that the values of total cholesterol and triglyceride in smokers showed statistically higher when compared to control study group, 186.8/dl and 213.8 mg/dl for smokers compared to 152.6/dl and 93.8 mg/dl for non-smoking people with *p*-values of 0.038 and 0.0018, respectively (Table 2).

Table 3 indicates the results of renal functions which including the blood urea and serum creatinine levels in smoker individuals compared to control group. The findings of this

Table 1. Comparison of hematological parameters between both groups (smoker and non-smoker).

Hematological parameters	Smokers (n= 70) Mean \pm SD	Non-smokers (n= 20) Mean \pm SD	<i>p</i> -value
WBC ($\times 10^9/L$)	9.91 \pm 2.1	6.76 \pm 0.72	0.005
Lymphocyte %	31.5 \pm 5.9	27.63 \pm 11	0.39
Monocyte %	5.6 \pm 0.9	6.95 \pm 1.7	1.43
Granulocyte %	63.3 \pm 2.1	64.43 \pm 4.7	0.67
RBC ($\times 10^{12}/L$)	5.49 \pm 0.3	4.9 \pm 0.4	0.01
Hb (g/dl)	15.7 \pm 1	13.05 \pm 2.3	0.03
HCT (%)	48.18 \pm 3.3	41.7 \pm 6.3	0.042
MCV (fL)	88.98 \pm 2.9	79.85 \pm 9.3	0.022
MCH (pg)	29.33 \pm 0.65	27.09 \pm 1.9	0.003
MCHC (g/L)	31.48 \pm 0.9	31.45 \pm 1.9	0.96
RDW (%)	11.83 \pm 0.4	11.10 \pm 2.5	0.44

Table 2. Evaluation of total cholesterol and triglyceride in smoker people compared to non-smokers.

Parameters	Smokers (n=70) Mean \pm SD	Non-smokers (n=20) Mean \pm SD	<i>p</i> -value
Total Cholesterol (mg/ dl)	186.8 \pm 25.9	152.6 \pm 24	0.038
Triglycerides (mg/ dl)	213.8 \pm 35	93.8 \pm 27	0.0018

Table 3. The smokers and non-smokers serum urea and creatinine values.

Parameters	Smokers (n=70) Mean \pm SD	Non-smokers (n=20) Mean \pm SD	<i>p</i> -value
Serum urea (mg/ dl)	34.1 \pm 8.4	25.8 \pm 5	0.06
Serum creatinine (mg/ dl)	0.79 \pm 0.14	0.68 \pm 0.18	0.29

experiment revealed that the urea and creatinine amounts in smoker's blood were slightly higher compared to non-smokers. Therefore, these results show no significant differences between the two groups (*p* > 0.05).

Discussion

While it is clear that cigarette smoking leads to various health problems in individuals, this study also clarified that cigarette smoking has negative impact on certain hematological parameters, lipid profile, and renal functions in healthy subjects.

Regarding to blood parameters, the findings of the current study showed that cigarette smoking has caused significantly increasing total WBC, RBC, hematocrit, and Hb content among smoking population. These results are in agreement

with several previous studies performed by different researchers.¹⁵⁻¹⁸ In the current study, the values of Hb were statistically larger in smokers when compared to control group regardless of the age. However, the value of hematocrit between those two groups shows just marginally significant differences ($p = 0.04$). In addition, the significant increase in Hb contents in smoker group is in correspondence with previous studies.¹⁹ However, a study performed by some researchers has revealed that the value of hemoglobin content was not changed between the two groups of people.²⁰

On the other hand, a previous study has noticed that Hb content and hematocrit measurements were raised in those who smoked 10 cigarettes and more per day.²¹ It is supposed that increasing of hemoglobin concentration could be arbitrated by existence of carbon monoxide. In fact, some researchers have argued that high hemoglobin concentration in blood of smokers could be possibly a compensatory process.⁸ For compensation of low level of oxygen receiving capacity, smokers gain a greater hemoglobin level when compared to non-smokers.²² This could be interpreted that formation of carboxyhemoglobin lead to low level of oxygen in tissue and increasing of secretion of erythropoietin and eventually increased the erythropoietin process. Subsequently, a condition of polycythemia, high level of RBC, would occur and this leads to increase the PCV value.^{23,24} Therefore, the smoker group shows statistically significant larger values of erythrocytes and HCT in relation to non-smokers (Table 1).

MCV, MCH, and MCHC are considered as three main red blood cell indices and they are using in measuring the typical size and hemoglobin content of a typical red blood cell. The current study has proven that the value of MCV and MCH was significantly higher among smokers. The same results were also confirmed by other previous studies.^{25,26} However, the MCHC and RDW values were likely not caused by chance for a given statistical significance.

However, these findings are opposed to those of a previous study that did not show any notable changes in MCV and MCH among those two groups.²⁷ On the other hand, some studies have shown completely different results than ours. For instance, a previous study has found that decreasing in MCH and MCHC while increasing in MCV in people who smokes.²⁸ Moreover, another published research showed that the value of MCH and MCHC were significantly lower in smokers than in control subjects.²⁹

The results of the current study showed that the smokers have statistically greater number of leukocytes when compared to control group. The mechanism of increasing WBC count in smokers is still controversial. Some researchers suggested that tobacco smoking triggered inflammation on respiratory system and could be leading to elevate leukocyte in circulation. There are others believed that inflammatory catalyzing accumulates in bronchial ducts which lead to increase inflammatory biomarkers in the circulation.^{30,31} The presence of high number of leukocytes could be a good indicator of endothelium damages. Therefore, increased number of this kind of cells in smoker's blood contributes in diseases that relates to cigarette smoking, such as ischemic vascular disease. This leads to an increase volume of WBC and deposits to cause microcirculatory occlusion.³² Another study has also confirmed that a high number of leukocytes in blood circulation represent a good biomarker of atherosclerosis and cardiovascular disorders.³³ Therefore, high leukocyte number in

male smokers when compared to non-smokers indicates that they have a greater risk of getting cardiovascular diseases and atherosclerosis.⁸

The present study has revealed that there was a serious higher level of total cholesterol and triglycerides in smokers than in non-smokers. These results were agreed to those findings with previous experiment.³⁴ A previous study has demonstrated that excessive and long duration of smoking will lead to worsening alteration in lipid profile and lead to increase level of lipids in blood causing dyslipidemia.³⁵ Our study has also revealed that there is a strong correlation between alteration in hematological and biochemical parameters with high level of triglyceride. One possible mechanism for dyslipidemia is that nicotine from cigarette stimulates the adrenal cortex to release more adrenalin leading to elevate the concentration of free fatty acids and stimulates the liver to synthesize and secrete more cholesterol and subsequently secretion of lipoproteins, proteins that combine and transport the fats and lipids in blood stream.³⁶ Another possible mechanism of how smoking effects the lipid profile is that cigarettes causing hyperinsulinemia by increasing insulin resistance. It is well-known that triglyceride and lipoprotein levels are raised in hyperinsulinemia.³⁷

The current study has confirmed that cigarette smoking elevated the values of serum creatinine and urea in smokers compared to control group. These results are correspondence with other earlier studies.³⁸ This might be due to the fact that tobacco smoking leads to minimize the filtration rate in glomerular tissue (GFR), plasma blood filtration in kidney, by increasing the resistance of renovascular activity.³⁹ Moreover, urea reabsorption increases as GFR decreases which leads to reduction the rate flow of distal tubule.⁴⁰ There could be another possible mechanism of adverse effect of cigarette smoking on the kidneys as nicotine inhales some chemical elements such as Lead (Pb) and Cadmium (Cd) which causes high level of these elements accumulation and causing nephrotoxicity.⁴¹ Other previous studies have linked smoking to minimize the stimulation of the sympathetic nervous system leading to renal vasoconstriction, smooth muscle cell proliferation and finally could lead to renal damage.^{42,43}

Conclusion

Cigarette smoking leads to increase releasing of endotoxin and inflammatory cytokines. Continuous smoking increases the RBC, WBC, Hb concentration, hematocrit, MCV, and MCH values in healthy populations. These hematological and biochemical alterations have a direct correlation to triglyceride and total cholesterol values. Moreover, these alterations might be accompanied with greater risk of developing some diseases related to heart, for example, atherosclerosis and chronic obstructive pulmonary disease. The nicotine also makes changes in lipid profile values and involves in the kidney functions in healthy subjects. To our knowledge, this is the first data studying the relationship and correlation between smoking cigarettes and hematological and biochemical parameters in healthy subjects in Duhok city. Therefore, more studies are required to confirm our results, especially confirm the correlations and kidney function tests.

Conflict of Interest

All authors declared that there is no conflict of interest

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