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Effect of Long–Term Cigarette Smoking on Certain Hematological Parameters

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Abstract

Background: Smoking is a major global health concern, playing a significant factor in the initiation and progression of various chronic illnesses such as cardiovascular diseases and lung cancer, among others. The American Cancer Society reports that tobacco-related deaths in the United States surpass those caused by alcohol, motor vehicle accidents, HIV, and illicit drugs combined. **Objective of work:** To investigate how heavy cigarette smoking affects different blood parameters, including white blood cell (WBC) and red blood cell (RBC) counts, platelet levels, and specific hematological indices like hemoglobin (HGB), hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC) in male smokers, with comparisons made to non-smokers. **Methods**: The research included 150 healthy male participants from the Hilla city population, categorized into two groups: 100 smokers and 50 non-smokers (serving as the control group). A 5 ml blood sample was collected from each participant under sterile conditions for complete blood analysis. The data obtained were statistically analyzed and compared between the two groups. **Results:** The analysis revealed significant differences in several hematological parameters in smokers compared to non-smokers, focusing on WBC, RBC, and platelet counts being significantly higher in smokers ($P \leq 0.05$). Additionally, levels of HCT, MCV, and HGB were notably elevated in smokers compared to non-smokers. However, the MCH and MCHC values were slightly higher in smokers than in non-smokers, though these differences were not statistically significant.

Keywords: smoking, Hematological changes, Blood indices

Introduction

Smoking can be defined as the process in which tobacco smoke is inhaled through different methods a cigarette, cigar, bili, and pipe. Usually, smokers get a sense of pleasure and relaxation for a certain period of time. Worldwide, there are 1.3 billion regular smokers (1). Numerous studies have highlighted that cigarette smoking is known to negatively impact human health, acting as a major risk factor for the development of several diseases, such as chronic obstructive pulmonary disease (COPD), cancer, and cardiovascular disorders, such as coronary artery disease (2). According to the WHO, there are approximately 5 million deaths that occur annually worldwide from diseases associated with smoking, such as lung cancers (3). Smokers

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face a threefold increased risk of developing most cardiovascular diseases compared to non-smokers. Moreover, smoking contributes to resulting in more deaths compared to the combined fatalities from HIV and traffic accidents (2,3).

Cigarette smoke is composed of hundreds of different chemicals, many of which are classified as carcinogenic agents, mutagenic compounds, free radicals, and radioactive elements (4). Hematological indices are often a significant indicator of an individual's overall health. While the exact mechanisms behind the hematological changes observed in smokers remain unclear, it is believed that these variations may result from changes in blood flow properties, inflammation, infections, oxidative stress, and modifications in the antithrombotic and fibrinolytic systems (3). Some studies suggest that smoking causes structural damage to erythrocytes, leading to their deformation, rupture, and the release of hematoporphyrin into the plasma as metabolites. This process results in noticeable morphological changes in the erythrocytes of smokers, which often take on a shape resembling a "Mexican hat." (5). These significant damages to the erythrocytes may facilitate the absorption of tobacco toxins by hemoglobin, potentially leading to increased hemolysis and a notable reduction in the lifespan of erythrocytes in smokers compared to control subjects (5). Although research is scarce on the effects of smoking on blood components, this study aims to investigate the impact of prolonged cigarette smoking on several hematological parameters in clinically healthy men from the Hilla city population.

Methodology

This study was conducted to explore the potential effects of heavy cigarette smoking on specific hematological parameters in clinically healthy men from the Hilla city population. A total of 150 participants, including both smokers and non-smokers, were involved. The participants were categorized into two groups: smokers (n=100) and non-smokers (n=50), the latter serving as the control group. Participants were identified as heavy smokers if their daily cigarette consumption ranged (30-40) cigarettes for at least 10 years. The health status of all the studied samples was checked by professionals. Information on the smoking status, health, age, and daily Cigarette consumption was obtained by a self-administered questionnaire presented to all subjects to fill out before the study administration, and those with certain diseases were excluded, such as high Blood pressure, diabetes, and others. The objectives and methods of the study were thoroughly communicated to all participants, and written consent was provided.

With the assistance of nurses, a total of 150 blood samples (5 ml each) were drawn intravenously following standard protocols and collected in EDTA vials containing the anticoagulant. The blood samples were then analyzed using a fully automated hematological analyzer (Swe Lab Alta CBC). Leukocyte, erythrocyte, and platelet counts were recorded, along with measurements of hemoglobin, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC). Statistical analysis was conducted using SPSS software.

Results

The present study included one hundred and fifty healthy males selected from Hilla city, Iraq population as volunteers. The subjects were categorized into two groups based on their smoking status and age ranges, as demonstrated in Table 1.

The first group (n=100) included heavy cigarette smokers for at least 10 years. Their mean age was 53.5±10.2 Years (1 range 31-61 Years). The second group (n=50). represented the non-smokers (as control), their mean age was 41-50 years (range 27-60 years). The average daily cigarette consumption was 32.2, with a range of 20-40 cigarettes. The mean

values ± SD for leukocyte (WBC) and erythrocyte (RBC) counts, platelet counts, along with hemoglobin (HGB), hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC), and mean corpuscular hemoglobin (MCH) indices are presented in Table 2. The data were statistically analyzed and compared between smokers and non-smokers, with a significance level of P≤0.05 and mean ± SD.

The present data revealed a statistically significant increase in leukocyte count (P=0.015), erythrocyte count (P=0.042), and platelet count (P=0.035) in the smoker participants compared to non-smoker males. Additionally, several hematological parameters such as hemoglobin (HGB) (P=0.011), hematocrit (HCT) (P=0.003), and mean corpuscular volume (MCV) (P=0.034) were notably higher in smokers compared to non-smokers. A mild increase was observed in mean corpuscular hemoglobin (MCH) (P=0.31) and mean corpuscular hemoglobin concentration (MCHC) (P=0.51), though these differences were not statistically significant.

Table 1: smoking status and age ranges of the participants

	NO	Age mean	Cigarette consumption
smokers	**100**	**53.5±10.2**	**32.2±5.3**
Non smokers	**50**	**38.3±7.3**	

Table 2: Mean values ± SD of various hematological parameters in smokers and non-smokers males (as controls).

NO.	Hematological Parameters	Male smokers (n=100)	Males non-smokers (n=50)	P.
1.	**WBC($\times10^9$/L)**	**9.67±1.5**	**6.22±1.5**	**0.015***
2.	**RBC($\times10^{10}$/L)**	**6.2±0.32**	**4.25±0.35**	**0.042***
3.	**HGB(9/dL)**	**14.8±1.12**	**12.4±0.98**	**0.011***
4.	**HCT (%)**	**46.29±3.05**	**40.46±2.01**	**0.003***
5.	**MCV (FI)**	**88.86±6.55**	**84.63±5.2**	**0.034***
6.	**MCH (pg)**	**30.132±2.5**	**27.75±2.21**	**0.412**
7.	**MCHC (g/L)**	**33.62±1.22**	**32.92±5.5**	**0.512**
8.	**PLT ($\times10^9$/L)**	**282.23±60.05**	**210.21±60.72**	**0.035***

* Significant difference (P≤0.05)

Discussion

Several studies indicate that cigarette smoke contains more than 3500 organic and inorganic chemicals and a large quantity of oxidants. Most of these materials are harmful to human health and cause different human diseases (6,7). The data obtained from the present study showed that cigarette smoke had a clear and adverse impact on certain hematological parameters. The results of this study revealed a notable rise in the counts of white blood cells, red blood cells, and platelets, as well as higher levels of hemoglobin (HGB), hematocrit (HCT), and mean corpuscular volume (MCV) in smokers compared to non-smokers. However, a slight increase in the levels of MCH and MCHC was not statistically significant. Such results were consistent with many previous studies (8,9). It is possible that many toxic chemicals in the nicotine smoke substances, like superoxide anions, hydroxyl radicals, H_2O_2, and HOCl, can cause various types of injury to some human tissues (10). The carbon monoxide, which is the main component in Cigarette smoke, is toxic and can diffuse rapidly across alveolar capillaries, bind firmly to the hemoglobin molecule, forming Hbco which causes tissue hypoxia that can lead to the significant increases in values level of RBC count, HGB, HCT, and MCV (11).

The significant increase of the leukocyte count in the blood of the smoker subjects (P=0.015) compared with that of the nonsmokers was correlated with other studies (12,13). Although the exact mechanisms that lead to the increase in the white blood cells are not clear. It has been suggested that the increase in leukocyte count may result from nicotine-induced stimulation of the release of catecholamines and certain steroid hormones from the adrenal glands (14). Elevated levels of hormones such as epinephrine and cortisol can result in a rise in leukocyte numbers (14,15). The elevated white blood cell count associated with smoking can be attributed to inflammatory and immune responses. "Several compounds in tobacco promote the activation and release of pro-inflammatory cytokines, including tumor necrosis factor-alpha (TNF-α) and interleukin-6 (16-18). The inflammatory response in the respiratory system results in higher levels of circulating inflammatory markers, especially cytokines (3), which affect white blood cell counts. Moreover, the adhesion of leukocytes to the vascular endothelium is linked to inflammation, causing the cells to remain stationary before migrating through the intercellular spaces between other cells. Leukocyte adhesion can also promote the attachment of these cells to the blood vessel walls (3).

According to Acik et al. (19), increased concentrations of free radicals and peroxides in the blood of smokers stimulate the production of prostaglandins and thromboxane, which contribute to the development of chronic inflammatory diseases, carcinogenesis, and atherosclerosis. Nicotine triggers clot formation in the coronary vasculature, leading to endothelial dysfunction (20). Additionally, higher levels of carboxyhemoglobin from smoking lead to hypoxia, increased vascular permeability, and lipid buildup, which ultimately result in endothelial damage.

It can be concluded that certain hematological parameters, such as WBC count, RBC Count, platelet Count, Hemoglobin level, HCT, and MCV, were significantly affected in the smokers' blood compared with the nonsmokers. Clear abnormalities in the level ranges can be considered with great risk, contributing to the onset of severe conditions like chronic obstructive pulmonary disease, heart disease, and atherosclerosis.

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voluntarily participated in the study and to the professional staff in the medical laboratory techniques for their help given to undertaking the study.

Ethical approval

The present research was carried out based on the ethical principles outlined as outlined in the Helsinki Declaration. The authors attained ethical approval from the scientific committee of the Department of Medical Laboratory Techniques. NO.192 Date/3/6/2022. Written informed consent was collected from all voluntary participants before enrollment.

Conflict of interest: NIL

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