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Original Article

The Effect of Cigarette Smoking on Leukocytes and Platelet Parameters among Student and Academic Staff at the Faculty of Medical Technology, University of Zawia

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ABSTRACT

Purpose: Cigarette smoking is a preventable lifestyle factor that has a great impact on the health and quality of human lives. Smoke from cigarettes can influence nearly all organs in the body by encouraging cell damage, including blood cells. The main objective of this study is to observe and compare the variations in leukocytes and platelets count of smokers and non-smokers.

Methods: The population of the study was from different cities in western Libya. All the volunteers are students and staff at the Faculty of Medical Technology, Zawia University.

Results: There were 45 smokers and 50 non-smokers of varying ages. After taking their consent, the samples were obtained using 2 ml of anticoagulated blood tubes from the subjects, and with all the aseptic precautions. The total leukocyte count in smokers was found to be higher than that of non-smokers, accompanied by an increase in lymphocytes. Leukocytes also increased correspondingly with the smoking duration in adult men. Besides, the platelet count was found to be higher in smokers, compared to that of non-smokers, though there was no major significant difference.

Conclusions: It can be concluded that cigarette smoking has negative effects on leukocytes in smokers in terms of certain anthropometric parameters. Additionally, having ill effects on health is closely associated with cardiac diseases.

Keywords: Cigarette smoking, leukocyte count, platelets, Libya.

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INTRODUCTION

Over the world, tobacco smoking is considered one of the causes that lead to millions of premature deaths each year.[1] It appears that the harmful effect of smoking is not only local but also systemic. Smoking is associated with many diseases in the body including chronic obstructive pulmonary disease (COPD), lung cancer, cardiovascular disease, diabetes mellitus, and bladder cancer.[2] In addition, smoking has acute and chronic effects on hematologic parameters. This is because cigarette smoke has more than 4000 chemicals such as nicotine, free radicals, carbon monoxide, and other gaseous products which could damage the smoker's body.[3] peroxides and Free radicals from tobacco smoke are connected with physiological phenomena including the synthesis of prostaglandins and thromboxane that in their role contribute to the process of inflammatory formation.[4] Moreover, there was a strong correlation exists between cigarette smoking and cardiovascular disease and atherosclerosis.[5] Injury in endothelial cells is considered as an initial stage in the pathogenesis of cardiovascular disorder.[6] Some studies have shown that smoking impacts the level of von Willebrand factor protein (vWF). This protein is synthesized and conserved inside megakaryocyte and endothelial cells and is considered as helpful marker for identifying endothelia injury.[7] vWF performs as a stabilizer and carrier for factor VIII and enhances hemostasis of platelet adhesion to the sub endothelium of an injured vessel wall.[8]

Smoking traditional cigarettes increases white blood cell (WBC) counts in peripheral blood. Molecules and gases presented in smoke cause activation of innate immune response leading to an increase in monocytes and neutrophils, and also they induce adaptive immune response represented in B and T lymphocytes.[9] Worldwide, several studies have verified the effect of cigarette smoking on different human body systems, including the immune system, though very few have been implemented in Arab countries, particularly in Libya. Hence, this current study aims to assess the influence of smoking on the immune system, focusing on white blood cells and platelet counts. The reason why the main focus of this study was WBCs is that the elevation of WBC counts is a useful and conventional signal to confine inflammatory responses.

MATERIALS AND METHODS

Design and Setting

Ninety-five males, aged 18 ï 53 years with a smoking habit, participated in this study. All volunteers were either students or staff at the Faculty of Medical Technology, University of Zawia. Contributors were informed about the aims and benefits of this study and signed a consent form before contributing. Also, volunteers filled out a questionnaire, where they answered questions about their age, blood groups, the cigarettesô brand name, number smoked per day, length of smoking period, time since the last cigarette smoked before blood was sampled, and some lifestyle and socioeconomic information. Age-matched non-smoker donors were invited to compose the control group. Students and staff suffering from chronic diseases, such as asthma, etc. were excluded, as well as those on long-term medications and drugs, like hormones, etc. Subjects with chronic diseases, dengue, typhoid, or those taking regular medicines for the last 2 years were excluded, too.

Sample Procedure

Blood samples were collected under certain conditions between 9.30 and 11.30 am. The samples were then analyzed with an automated analyzer known as Mindray Auto-haematology Electronic Counter which counts differential count of leukocytes and platelet. Then a questionnaire was prepared and given to the study participants. It included demographic information such as age, besides questions regarding smoking habits, lifestyle, etc. The survey contained both close- and open-ended questions with simple words easily interpreted and answered by both students and staff.

Data Analysis

In this study, analysis of changes in WBC count, lymph cell count, and platelets count, SPSS software version 21 was used through (ANCOVA). The comparisons between the parameters of the control group and the experimental group were statistically analyzed via unpaired Student T-Test and ANOVA for the F test. All tests were two-sided, and P values < 0.05 were considered to indicate statistical significance. Data were expressed as mean ± standard deviation (SD).

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RESULTS

Analysis of different types of WBCs helps to investigate the effect of smoking on blood parameters. Total and differential counts of white blood cells were performed among the 50 non-smokers and 45 smokers along with the percentage. Table 1 shows that the WBC count in smokers 9004 cells/mm3 was higher than non-smokers 6820 cells/mm3. Similarly, lymphocyte levels in smokers were significantly higher than in non-smokers where the P-value was <0.05. while the neutrophils, eosinophils, basophiles, and monocytes were non significantly different.

Moreover, The leukocytes were seen to increase significantly with the intensity of smoking that enters the lung. Table 2 shows that the total leukocytes (WBC) in heavy smokers were 9455 cells/mm3, whereas in mild and moderate smokers were 8163 cells/mm3 and 9037 cells/mm3, respectively. In the case of lymphocytes, moderate smokers have the highest value of 33.32 %, in comparison to heavy 32.80 % and mild smokers 30.53 %. Based on six different age groups of study subjects, the WBCs were calculated and it was determined that smokers have significantly higher leukocytes than non-smokers where P value was up to 0.05 of the same age group (Table 3). Smokers have 2000 cells/mm3 more leukocytes than non-smokers in almost every age group.

Table 1. Different types of leucocytes (WBCs) in smokers and non-smokers.

Parameter	Non-Smokers (Mean ± SD)	Smokers (Mean ± SD)
WBC (cells/mm3)	6820 ± 1075.9	9004 ± 1146.91 *
Neutrophils (%)	63.09 ± 5.42	61.59 ± 5.46
Eosinophils (%)	2.85 ± 0.98	2.23 ± 0.84
Lymphocyte (%)	30.27 ± 4.41	33.43 ± 4.75 *
Monocyte (%)	5.50 ± 1.46	5.77 ± 1.70
Basophils (%)	0.77 ± 0.50	0.22 ± 0.41

* Statistically significant differences between smokers and non-smokers (t test for independent groups, P < 0.05).

Table 2. Different levels of WBCs in (mild, modest, and heavy) smokers.

Parameter	Mild-Smokers (Mean ± SD) (1-10 cigarettes per day)	Moderate-Smokers (Mean ± SD) (11-19 cigarettes per day)	heavy-Smokers (Mean ± SD) (more than 20 cigarettes per day)
WBC (cells/mm3)	8163 ± 1226.65	9037 ± 955.23*	9455 ± 1078.73*
Neutrophils (%)	62.05 ± 4.80	60.95 ± 7.11	59.9 ± 4.40
Eosinophils (%)	2.33 ± 0.89	2.30 ± 0.89	2.50 ± 0.83
Lymphocyte (%)	30.53 ± 4.55	33.32 ± 5.87*	32.8 ± 4.62*
Monocyte (%)	5.77 ± 1.66	5.23 ± 1.44	5.70 ± 1.84
Basophils (%)	0.45 ± 0.51	0.14±0.44	0.12 ± 0.31

Table 3. WBC of the population in the different age groups.

Age groups per years	Non-Smokers (Mean ± SD)	Smokers (Mean ± SD)
18-23	6570.08 ± 971.65	8851.77 ± 1022.27*
24-29	6044.75 ± 603.15	8812.71 ± 960.02*
30-34	7520.18 ± 926.82	8910 ± 1585.69*
35-40	7816 ± 480.99	8843.33 ± 1418.21*
41-46	8264.29 ± 438.26	8870 ± 937.10*
47-52	8555.28 ± 494.23	8881± 892.13

In addition, longitudinal variation of lymphocytes, neutrophils and monocyte counts was measured in smokers depends on years of cigarette smoking (Figure1). Neutrophil and monocyte count were slightly higher in smokers who have smoked for two years (0-2) compared to individuals who had smoked over three years (B&C). On other hand, lymphocytes count was remarkably higher in smokers who smoke more than three years in compare to currently smokers (A).

The platelet was significantly diverted between smokers and non-smokers in the population study 287.34± 40.81 x 109 /L, and 220.1±39.52 x 109 /L (mean ± SD) respectively (Figure 2A). The platelet count in the group of smokers in mediated period (year 3-4) was statistically significantly higher ($p<0.05$) (Figure 2B). In addition, the platelet count was significantly increased according to the number of cigarettes per day, particularly for individuals who takes more than 30 cigarette per day (Figure 2C).

DISCUSSION

Cigarette smoking is one of the leading causes of numerous diseases and deaths across the world. For this reason, smoking is a crucial public health concern.[10] This current study observes the effect of smoking on hematological parameters, mainly the white blood cells and platelets. While smoking causes numerous health defects, the influence of smoking was taken for statistical analysis on men's health compared to non-smoker subjects. Although leukocytes are very important component of the immune system, their surplus can lead to harmful consequences to human health by causing diverse diseases.[10,11,12] This study showed elevated white blood cell count in smokers compared to non-smokers at different ages and different smoking levels. It demonstrated that the mean difference between the white blood cells of smokers and non-smokers was about 2000 cells/ mm3. It agreed with previous research conducted on 6902 male and 8405 female smokers and showed that most of the participants had high leukocyte counts.[12] Another cohort, which studied the relationship between WBC level and mortality showed that smokers who have WBC over 6000 cells/mm3 had higher mortality than those between 3.500 to 6000 cells/ mm3.[13] Supporting research in 2005 showed that cessation of smoking decreases the level of WBCs and neutrophils.[14] In addition, the number of white blood cells is increasing in heavy smokers compared

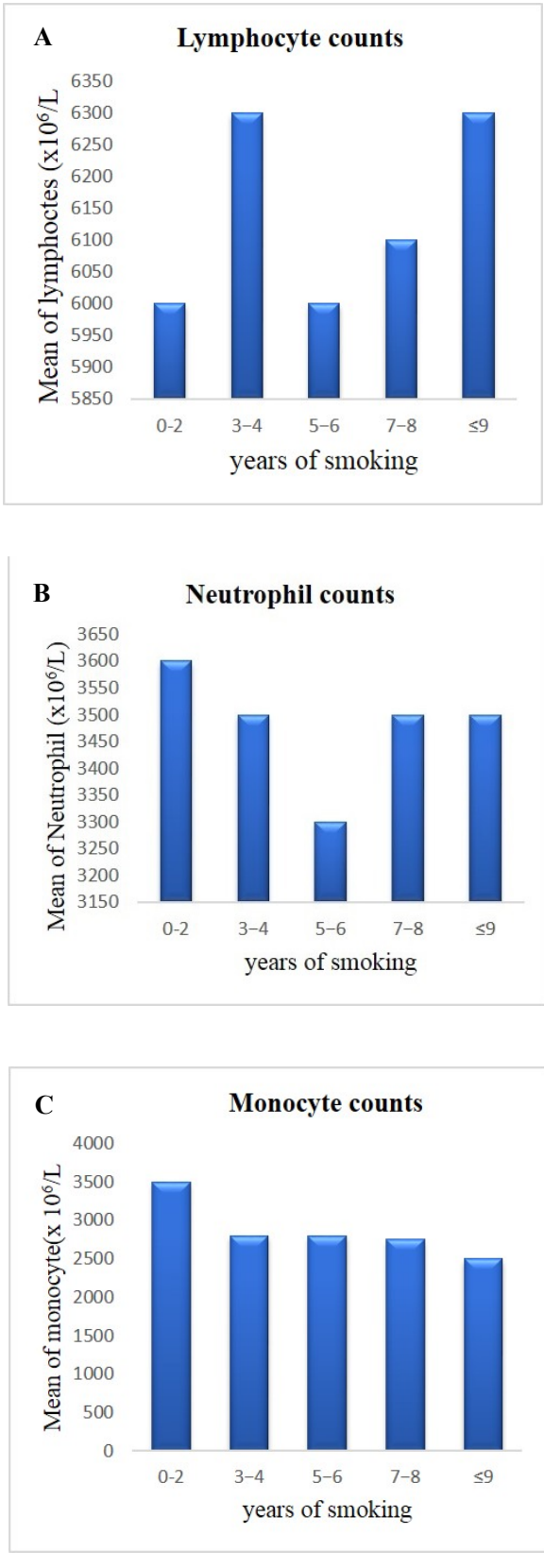

Figure 1. Shows the number of lymphocytes neutrophils and monocytes in smokers who participate according to years of smoking (A, B, and C). also, shows the total white blood cell count in smokers according to the number of cigarettes per day.

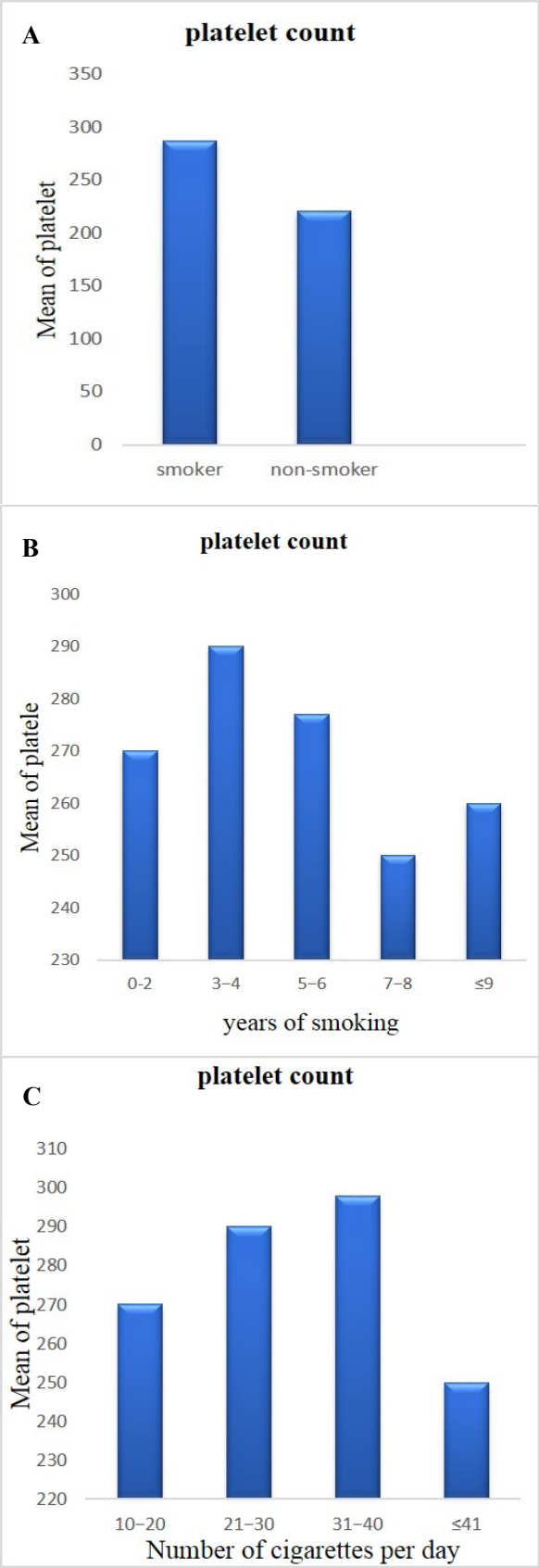

Figure 2. It shows the platelets count in smokers in population study (A), and its level according to years of smoking (B). and number of cigarettes per day in same group(C).

with mild smokers. This study showed that total leukocytes in heavy smokers were (9455 cells/ mm3) higher than moderate (9037 cells/mm3) and mild smokers (8163 cells/mm3). It is in agreement with the study conducted in 2014 that showed Heavy smokers had significant dyslipidemia with an increase in red blood cell count, total leukocyte count, and neutrophil count.[12] Therefore, The increase in WBCs might be a result of the effect of nicotine on releasing of catecholamine, which in turn leads to an increase in the level of leukocytes in smokers. Also, irritation by cigarette smoke could be a contributory factor that causes inflammation of the respiratory tract and leads to high WBC.[15,16] Moreover, smoking may induce the formation of free radicals, that can damage cellular structures such as cell membranes, or macromolecules (proteins, lipids, and nucleic acids) and express inflammatory markers in blood circulation such as C-reactive protein.[17] Burning or irritating of a bronchial tract by smoking could lead to activate proinflammatory cytokines and chemokines including IL-8, IL-16, and tumor necrosis factor α (TNF-α) which in turn helps the migration of leukocytes from lymphoid organs to bronchi and cause inflammation.[18]

Again, a parallel pattern is observed when it comes to the differential counts of leukocytes, monocytes, and lymphocytes, all of which have a key role in the immune system and its reactions besides human health in general. This study confirms that a higher number of lymphocytes is associated with the intensity of smoke that enter the lung and the period of smoking. The number of lymphocytes in moderate smokers showed the highest value of 33.32 % than mild 30.53% and heavy smokers at 32.80 %, while the neutrophils in current smokers were higher than in those who smoked for more than three years. This study was agreed with Shipa et al study in 2017 showed a similar increase in the neutrophil count and lymphocytes.[16] On the other hand, a previous study described that smokers had a significantly increased undertaking in all types of WBC, neutrophils, lymphocytes, and monocytes.[18,19] The current study highlights that a possible explanation for the significant increase in the lymphocyte count in smokers might be due to the stimulating effect of nicotine onlymphocytes. However, the specific mechanism

by which nicotine affects lymphocytes has not yet been determined.[11,15] The findings are consistent with those reported by other studies,[14] that investigated the effect of smoking on T cell subsets and showed that recent smokers had a significantly higher lymphocyte count than non-smokers. The amount of CD4 T lymphocytes was also increased significantly in smokers. Similarly, they found that the percentage of CD4 cells continues to rise with increasing the number of cigarettes smoked per day. The increase in lymphocyte counts gained in the present study may be directed to the stimulating influence of nicotine on lymphocytes. Furthermore, disruptions in the function of the adrenal gland due to the effects of the blood pressure-like factor, smoking, might play an important role in revealing the lymphocyte count. The irritation influence of smoking on the respiratory system that results in chronic inflammation might be another cause for the increased production of lymphocytes from the lymphoid organs. It is important to mention that this study did not investigate the CD4 count.[14,17,18,19,20] Perhaps the most interesting finding was that based on the six different age groups of the study subjects, WBC counts concluded that smokers displayed higher leukocytes than non-smokers ($P < 0.05$) of the same age group (Table 3). Smokers had 2000 cells/mm3 more leukocytes than non-smokers in almost every age group. From this observation, it was determined that smoking affects leukocyte count according to age.

The finding is in agreement with an extensive report regarding the effect of smoking.[14,15,18,21] Preceding investigations have confirmed that platelets can act as part of the innate response against infections. Therefore, the second aim of this study was to assess the effect of cigarette smoking on the platelet count, the results determined that platelet count was significantly higher in smoker males than in non-smokers. Additionally, smokers had remarkably increased platelets as compared to non-smokers. The increase in platelet count in the study subjects is difficult to explain.[22,23,24,25] Higher platelet turnover indicates the presence of younger and activated platelets in the circulation compared to mature platelets. These have a larger concentration and show a higher appearance of surface receptors.[13,14,26] Findings further support the results of the current study, which have been confirmed by higher P-selectin concentrations in male smokers than non-smokers.[22,25,27] Similarly, another study proved the increase of P-selectin expression in smokers, which was demonstrated by platelet activation.[19,24,28] Hence, these results imply that the effects of smoking can be interpreted and applied as inflammatory markers.

CONCLUSIONS

This study determined that continuous cigarette smoking has many adverse influences on white blood cell count in the human body. The number of WBCs is increased significantly in smokers compared to non-smokers. Higher numbers of white blood cells in general, as well as platelets, can make the smokers' blood more viscous. Therefore, the blood does not move efficiently, which can contribute to the risk of developing clotting problems, stroke, and deep vein thrombosis. Moreover, this study also suggests that the number of WBCs and platelets might be a good biomarker for progressing atherosclerosis and cardiovascular diseases in smokers. Additionally, this study revealed a strong association between smoking and altered physiological and haematological parameters. Likewise, research is very important to investigate what level of smoking should be decreased for the promotion of health. This is crucial for individuals who are resilient to quitting.

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