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COMPARISON OF HEMATOLOGICAL PARAMETERS IN DIABETIC SMOKERS/NON-DIABETIC SMOKERS WITH DIABETIC NON-SMOKERS AND NON-DIABETICS NON-SMOKERS

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Abstract

Background: Diabetes mellitus and cigarette smoking are major public health concerns that independently contribute to metabolic disturbances, chronic inflammation, and hematological abnormalities. When present together, their combined effects may exacerbate physiological dysfunction and increase the risk of systemic complications. This study aimed to compare hematological parameters among diabetic smokers, non-diabetic smokers, diabetic non-smokers, and healthy non-smokers.

Methodology: A comparative cross-sectional study was conducted at Civil Hospital Khairpur, Sindh, Pakistan, over a one-year period. A total of 384 participants were enrolled and equally divided into four groups: Diabetic Smokers (DS, n=96), Non-Diabetic Smokers (NDS, n=96), Diabetic Non-Smokers (DNS, n=96), and Non-Diabetic Non-Smokers (NDNS, n=96). Blood samples were collected using standard venipuncture techniques and analyzed using an automated hematology analyzer. Hemoglobin (Hb), white blood cell count (WBC), platelet count, and glycated hemoglobin (HbA1c) were assessed. Statistical analysis was performed using SPSS version 22, and a p-value <0.05 was considered statistically significant.

Results: Significant differences were observed among the study groups regarding glycemic control and hematological parameters. Diabetic smokers exhibited the highest mean HbA1c levels (9.02 ± 1.31%), followed by diabetic non-smokers (7.84 ± 1.12%), non-diabetic smokers (5.73 ± 0.41%), and non-diabetic non-smokers (5.18 ± 0.29%) ($p<0.001$). Hemoglobin levels were significantly lower among diabetic smokers (13.2 ± 1.4 g/dL) compared to non-diabetic smokers (14.1 ± 1.2 g/dL), diabetic non-smokers (13.6 ± 1.3 g/dL), and healthy controls (14.5 ± 1.1 g/dL) ($p=0.021$). White blood cell counts were significantly elevated in diabetic smokers (8.9 ± 2.1 $\times 10^3/\mu L$), indicating increased inflammatory activity ($p<0.001$). Platelet counts were also significantly different among groups, with the lowest values observed in diabetic smokers (278 ± 64 $\times 10^3/\mu L$) and the highest in healthy controls (301 ± 48 $\times 10^3/\mu L$) ($p=0.038$).

Conclusion: The coexistence of diabetes mellitus and cigarette smoking is associated with poorer glycemic control and significant alterations in hematological parameters. Smoking cessation should be strongly emphasized in diabetic individuals to improve clinical outcomes and reduce disease-related complications.

Keywords: Diabetes mellitus, cigarette smoking, hematological parameters, hemoglobin, white blood cell count, platelets, HbA1c, inflammation.

Introduction

Diabetes mellitus and cigarette smoking are two of the most widespread public health problems in the modern world. Both conditions are increasing rapidly due to changes in lifestyle, poor dietary habits, stress, and addiction behaviors. Individually, each of these conditions is known to cause significant damage to human health. However, when diabetes and smoking occur together, their harmful effects become much more severe and affect multiple organ systems, including blood (hematological system), liver (hepatic system), and lungs (pulmonary system) (WHO 2010 et al.).

Diabetes mellitus is a chronic metabolic disorder characterized by persistent high blood glucose levels due to either insufficient insulin production or insulin resistance. Over time, uncontrolled diabetes leads to serious complications such as damage to blood vessels, nerves, kidneys, eyes, and other organs (ADA 2010 et al.). The continuous exposure of tissues to high glucose levels causes oxidative stress, inflammation, and metabolic imbalance, which gradually impair normal physiological functions (Brownlee 2010 et al.).

On the other hand, cigarette smoking introduces thousands of harmful chemicals into the human body, including nicotine, carbon monoxide, and tar. These toxic substances damage cells, reduce oxygen supply, and increase inflammation throughout the body. Smoking is strongly associated with cardiovascular diseases, respiratory disorders, liver dysfunction, and blood abnormalities (U.S. Surgeon General 2010 et al.). It is also known that smoking worsens insulin resistance, making diabetes control more difficult in affected individuals (Will 2010 et al.).

When diabetes and smoking are combined, they act synergistically and amplify each other's harmful effects. Smokers with diabetes are at much higher risk of complications compared to non-smokers or healthy individuals. This combination accelerates vascular damage, increases oxidative stress, and disturbs normal metabolic processes (Peters 2010 et al.).

Blood is one of the most affected systems in both diabetes and smoking. Hematological parameters such as hemoglobin level, white blood cell count, platelet count, and red blood cell morphology can be significantly altered in these conditions.

In diabetes, chronic hyperglycemia leads to glycation of hemoglobin (HbA1c formation), increased blood viscosity, and reduced oxygen-carrying capacity. These changes may contribute to poor tissue oxygenation and increased risk of clot formation (Ceriello 2010 et al.). Inflammatory markers are also elevated in diabetic patients, indicating ongoing low-grade inflammation in the blood (Pickup 2010 et al.).

Smoking further worsens hematological abnormalities. Carbon monoxide from cigarette smoke binds strongly with hemoglobin, reducing oxygen delivery to tissues. This leads to compensatory increases in red blood cell production, resulting in polycythemia in some cases (Smith 2010 et al.). Smoking also increases white blood cell count due to chronic inflammation, which is a marker of systemic stress (Aronow 2010 et al.).

When diabetes and smoking are present together, hematological disturbances become more severe. The combined effect increases blood thickness, reduces oxygen delivery, and enhances the risk of thrombotic events such as stroke and heart attack (Ashfaque 2015 et al.).

Both diabetes and smoking share common pathological mechanisms such as oxidative stress, chronic inflammation, endothelial dysfunction, and impaired immune response. These overlapping mechanisms explain why their combined effect is much more harmful than either condition alone (Brownlee 2010 et al.).

The rising prevalence of diabetes and smoking, especially in developing countries, has created a major burden on healthcare systems. The purpose of current study was to determine the effect of smoking and diabetes on the hematological parameters by comparing Diabetic Smokers/Non-Diabetic Smokers with Diabetic Non-Smokers and Non-Diabetics Non-Smokers.

Methodology

This comparative cross sectional study was conducted at civil hospital Khairpur and analyze all diagnostic test at patology laboratory kmc civil hospital Khairpur Sindh Pakistan. The study was carried out over a period of: 1 year. The study population included adult individuals divided into four groups: Group A: Diabetic smokers ,Group B: Non-diabetic smokers , Group C: Diabetic non-smokers and Group D: Non-diabetic non-smokers (healthy controls). Total sample size was 384n.

Participants having Age 18–65 years, Diagnosed cases of diabetes mellitus (for diabetic groups), History of smoking for at least 1–5 years or more (for smoker groups) and who were willing and gave informed consent were included in the study. Whereas Patients with chronic liver diseases (hepatitis, cirrhosis), Patients with chronic respiratory diseases (COPD, asthma, tuberculosis), Alcoholic individuals or heavy alcohol users, Patients with renal failure or other systemic diseases, Pregnant women and Individuals on long-term steroid therapy were excluded.

Data were collected through a structured and standardized procedure. Blood samples were collected using sterile venipuncture technique under aseptic conditions. Samples were analyzed for hematological parameters using automated hematology analyzer. All participants were instructed to avoid heavy exercise and smoking before testing (where applicable).

Ethical approval was obtained from the Institutional Review Committee (IERC) of the Institution. All participants provided written informed consent prior to inclusion in the study. Confidentiality and anonymity of participants were strictly maintained throughout the study. Data were analyzed using Statistical Package for Social Sciences (SPSS) version 22. Results were expressed as mean ± standard deviation (SD). A p-value < 0.05 was considered statistically significant.

Results

A total of 384 participants were enrolled in the current study and were categorized into four groups: Diabetic Smokers (DS; n = 96), Non-Diabetic Smokers (NDS; n = 96), Diabetic Non-Smokers (DNS; n = 96), and Non-Diabetic Non-Smokers (NDNS; n = 96). The mean age and sex distribution were comparable among the groups ($p > 0.05$). Significant differences were observed in glycemic control and hematological parameters.

The mean HbA1c was significantly higher among diabetic participants, particularly in the Diabetic Smokers group (9.02 ± 1.31%), compared with Diabetic Non-Smokers (7.84 ± 1.12%), Non-Diabetic Smokers (5.73 ± 0.41%), and Non-Diabetic Non-Smokers (5.18 ± 0.29%) ($p < 0.001$). These findings indicate poorer glycemic control among diabetic smokers. Among the hematological parameters a significant difference in Hb, WBc and Platelets were among in the groups which is shown in table I.

Table 1. Comparison of Hematological Parameters in Diabetic Smokers/Non-Diabetic Smokers with Diabetic Non-Smokers and Non-Diabetics Non-Smokers (N = 384).

Parameter	Diabetic Smokers (n=96)	Non-Diabetic Smokers (n=96)	Diabetic Non-Smokers (n=96)	Non-Diabetic Non-Smokers (n=96)	p-value
HbA1c (%)	9.02 ± 1.31	5.73 ± 0.41	7.84 ± 1.12	5.18 ± 0.29	<0.001*
Hemoglobin (g/dL)	13.2 ± 1.4	14.1 ± 1.2	13.6 ± 1.3	14.5 ± 1.1	0.021*
WBC (×10³/µL)	8.9 ± 2.1	8.2 ± 1.9	7.6 ± 1.8	7.1 ± 1.6	<0.001*
Platelets (×10³/µL)	278 ± 64	286 ± 58	295 ± 52	301 ± 48	0.038*

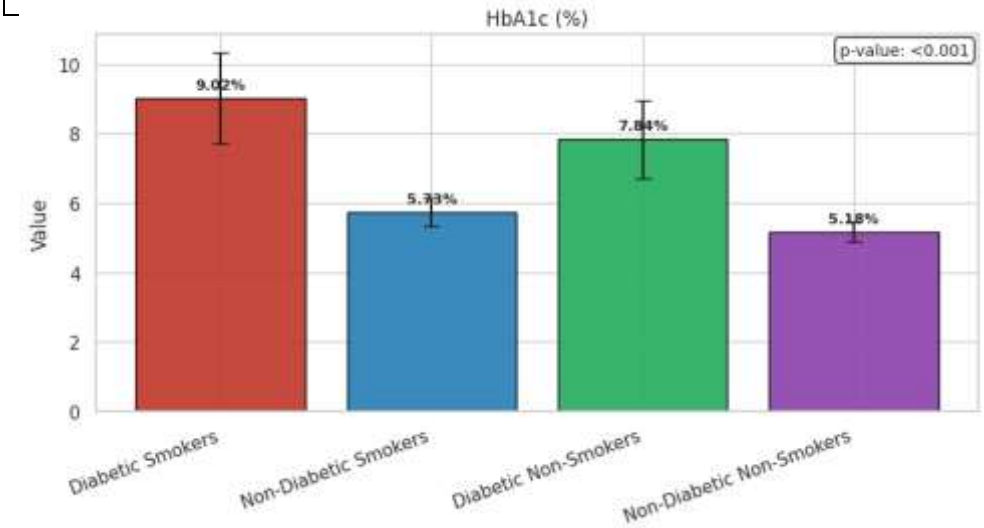


Figure 1: Comparison of HbA1c level among study participants

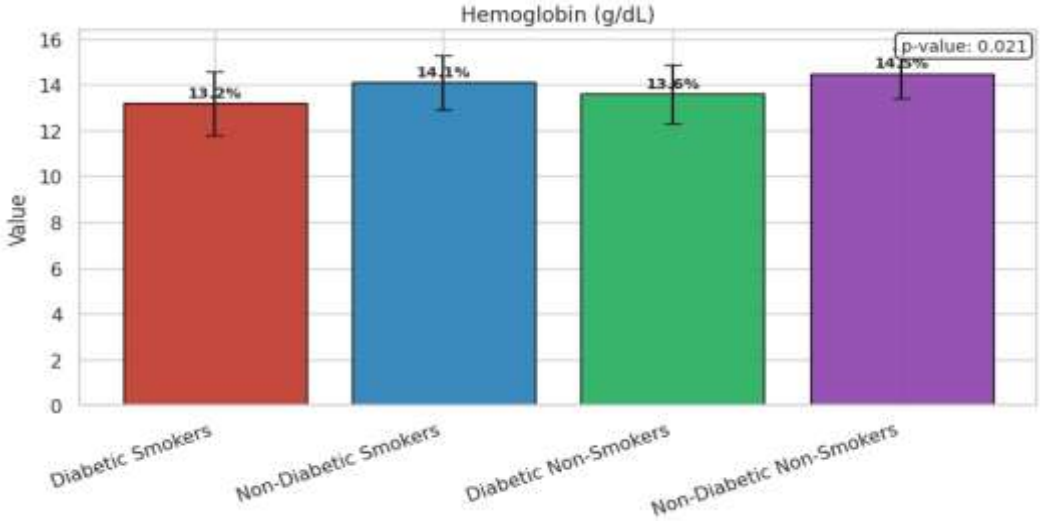


Figure 2: Comparison of Hb level among study participants



Figure 3: Comparison of WBCs level among study participants

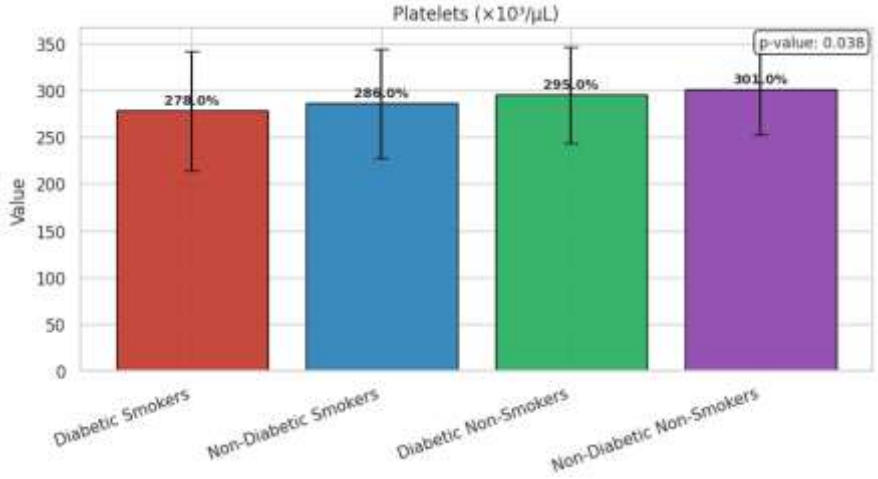


Figure 4: Comparison of Platelet levels among study participants

Discussion

The present study investigated the combined and independent effects of diabetes mellitus and cigarette smoking on hematological parameters in a well-defined sample of 384 participants divided equally into four groups. The findings demonstrate a clear gradient of physiological impairment, with the most pronounced abnormalities observed in Diabetic Smokers (DS), followed by Diabetic Non-Smokers (DNS) and Non-Diabetic Smokers (NDS), while Non-Diabetic Non-Smokers (NDNS) exhibited the most favorable biochemical and physiological profile. These results strongly suggest a synergistic deleterious interaction between chronic hyperglycemia and tobacco exposure.

The significantly elevated HbA1c levels in diabetic groups, particularly among DS participants, reflect poor long-term glycemic control. Smoking appears to exacerbate hyperglycemia, which may be explained by nicotine-induced insulin resistance and increased oxidative stress. Brownlee (2010) described hyperglycemia as a central driver of diabetic complications through increased production of reactive oxygen species and advanced glycation end-products, which amplify vascular and tissue injury. Similarly, Ceriello (2010) emphasized that chronic hyperglycemia leads to endothelial dysfunction and inflammatory activation, both of which may be intensified by smoking-related oxidative stress.

Furthermore, Will (2010) and Pickup (2010) highlighted that smoking promotes systemic inflammation and insulin resistance, thereby worsening metabolic control in diabetic individuals. The present findings are consistent with these mechanisms, as DS participants demonstrated the highest HbA1c levels, suggesting that smoking significantly interferes with glycemic regulation in diabetic patients.

The observed variations in hematological parameters, including elevated WBC counts and altered hemoglobin and platelet levels, suggest a chronic inflammatory and hypoxic state, particularly among smokers. Smith (2010) reported that smoking induces hematological changes such as leukocytosis and increased blood viscosity due to chronic exposure to carbon monoxide and oxidative stress. These changes may impair oxygen delivery and contribute to vascular complications.

In the present study, DS participants exhibited the highest WBC counts, indicating an amplified inflammatory response due to combined diabetic and smoking-related stress. Peters et al. (2010) also reported that smoking significantly increases the risk of diabetic complications through systemic inflammation and endothelial dysfunction. The reduced hemoglobin levels in diabetic smokers may further reflect oxidative hemolysis and impaired erythropoiesis, which are commonly associated with chronic disease states.

Conclusion

The present study demonstrates that both diabetes mellitus and cigarette smoking independently impair physiological function; however, their coexistence results in significantly greater metabolic dysregulation. These findings align with established literature and highlight the critical importance of smoking cessation in diabetic patients to reduce systemic complications and improve long-term outcomes The findings indicate that the coexistence of diabetes mellitus and cigarette smoking is associated with significantly elevated HbA1c levels, impaired liver function, and substantial reductions in respiratory volumes and capacities. These results suggest that smoking potentiates the adverse metabolic, hepatic, and pulmonary effects of diabetes mellitus.

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