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Original Article

Changes Caused by Smoking in Hemogram Parameters in Patients Presenting to the Emergency Department

Bahar Işık[1], Sara Salcan[2]

[1]Department of Emergency Medicine, Erzincan Binali Yıldırım University Medical Faculty, Erzincan, Türkiye
[2]Department of Public Health, Erzincan Binali Yıldırım University Medical Faculty, Erzincan, Türkiye

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ORCID IDs for the authors: B.I. 0000-0002-5379-6677, S.S. 0000-0001-5049-1838

ABSTRACT

Objective: The aim of this 3-stage study is to reveal the smoking rate after the exclusion criteria was applied in patients who presented to the emergency department and to assess if smoking has any effect on their hemogram test results. And at last, the opinions of those included in the study are sought regarding whether establishing a smoking cessation center in the emergency department would be beneficial or not.

Methods: After exclusion criteria were applied, a total of 2000 patients presenting to the emergency department were included in the study. The study was carried out in 3 stages. In the first stage, the smoking rate of 2000 patients was investigated. In the second stage, in addition to the exclusion criteria at the beginning of the study, in order to reduce the possible impact on blood parameters, those with any comorbidities (n = 747) were excluded, and hemogram parameters were compared in the remaining patients (n = 1263). Then hemogram levels were compared both in male and female in smokers and non-smokers since the normality limit of some of these values differs for both genders. In the third stage, establishing a smoking cessation center in the emergency department would be beneficial or not was statistically researched.

Results: In total, 50% of the patients were male and 50% were female. The mean age was 51.57 ± 20.29 years. Of the patients, 28.26% (n = 566) were smokers. In total, 38.7% (n = 385) of men and 17.1% (n = 178) of women were smokers. The smoking rate was 30.7% in those without comorbidities, which was higher. The rate we obtained, although not directly comparable to the results of other studies due to differences in inclusion and exclusion criteria, was similar to the rate in the general population. There were significant differences in white blood cell (WBC), erythrocyte (RBC), and hemoglobin counts, as well as mean corpuscular volume (MCV) between the 2 groups. No significant difference was found in platelet count. White blood cell count was 12% higher, erythrocyte count was 3.13% higher, MCV was 1.5% higher, and eosinophil count was 24.1% higher in smokers. Hemoglobin level was 7.8% higher in smokers. When men and women without comorbidities were analyzed separately as smokers and non-smokers, hemoglobin, WBC, and eosinophil counts were higher in male smokers; hemoglobin, WBC, MCV, and eosinophil counts were higher in female smokers. Mean corpuscular volume and RBC count in men, and RBC count in women were higher in the smoker group, although it was not statistically significant. Only 33.7% of patients stated that it would be beneficial to establish a smoking cessation unit in the emergency department.

Conclusion: Cigarette smoking has severe adverse effects on hematological parameters that might be associated with a greater risk of developing chronic diseases. The rate of smoking among the patients in the emergency department is similar to the general population. Making the necessary arrangements for emergency departments to become primary centers for smoking cessation and including this topic as part of residency training could be beneficial.

Keywords: Emergency department, hemogram parameters, smoking

INTRODUCTION

Smoking, one of the leading causes of preventable diseases and deaths, is a widespread public health problem. Primarily affecting the cardiovascular and respiratory systems, smoking significantly increases the frequency of many diseases and certain malignancies.[1] This is because cigarette smoke contains over 7000 chemical compounds, including arsenic, formaldehyde, hydrogen cyanide, lead, carbon monoxide, acrolein, and numerous other toxic

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substances. More than 70 of these chemicals are carcinogenic. Tobacco also contains nicotine, a psychoactive drug that stimulates the central nervous system, which is the addictive substance responsible for dependency.[2]

Smoking is a major public health problem that has been heavily addressed in recent decades, leading to a decrease in smoking in most parts of the world, but it continues to increase in some developing countries.[3] In Türkiye, studies aimed at determining the smoking rate in the population have mostly been conducted regionally, and it has been observed that there is no common definition of smoking across these studies. The results obtained may also vary according to the sociocultural structure of the region under investigation. For these reasons, there is a need for nationally conducted studies based on comparable methods and repeated at certain intervals. In 1997, the rate of smoking was 51% among men and 49% among women in Türkiye.[4] According to the 2016 Adult Tobacco Survey (ATS), 19.2 million people in Türkiye (31.6% of the entire population) were current tobacco product users, including occasional smokers. The prevalence of tobacco use was higher in men (44.1%) compared to women (19.2%). Excluding occasional smokers, 18 million people (29.6%) were using tobacco every day (41.8% of men and 17.5% of women).

Türkiye is among the countries in the European Region with the highest smoking rate among men.[5] Over the past 25 years, there has been a decrease in the rate of smoking among men in most Northern, Southern, and Western European countries. In women, the decrease in smoking is not as pronounced as in men.[6] In fact, there is an increase in smoking rates in women. In another similar study, Özer et al.[7] evaluated 10 epidemiological studies to assess smoking habits in Türkiye. The results showed that when occasional smokers were included, the prevalence of smoking was determined to be 30.5% in the entire group, 15.7% among women, and 46.1% among men. Although the change in raw prevalence values over time was not statistically significant in this study, when the data from the 3 studies that provided prevalence values by age categories were standardized by age, it was stated that between 2003 and 2012, the smoking rate decreased by 6.8% (20.2%) when occasional smokers were included. Excluding occasional smokers, it decreased by 8.4% (26.3%). Over the past 40 years, the general decrease in smoking rates is thought to be linked to various factors including advertising restrictions, cigarette taxation, and smoking prohibition laws.[8] According to the 2019 data from the Turkish Statistical Institute (TÜİK), 28% of Türkiye's population uses tobacco products daily. Contrary to developed countries, according to the Turkish Statistical Institute (TÜİK) data, smoking rates in Türkiye fluctuated between 25.4% and 28% from 2010 to 2019, showing an inconsistent trend with both increases and decreases, which might not indicate a clear

MAIN POINTS

- Smoking is a widespread public health problem that is one of the leading causes of preventable deaths.
- Cigarettes contain numerous substances that lead to alterations in blood parameters due to their direct and indirect effects.
- Previous studies have shown that the rate of smoking is higher in patients presenting to the emergency department compared to the general population.
- Efforts are being made to transform emergency departments, which face a high influx of patients, into primary centers for smoking cessation, aiming for public health benefits.
- The topic of establishing smoking cessation centers in the emergency department is controversial, the effects of smoking on hemogram parameters are significant.

Table 1. Values in Smokers and Non-smokers Among the 2000 Patients

	n/Mean ± SD	%/Median (Minimum–Maximum)
Gender		
Male	1000	(50,00)
Female	1000	(50,00)
Age	51.57 ± 20,29	52 (18-100)
Presence of comorbidity		
Yes	747	(37,35)
No	1253	(62,65)
Smoking		
Yes	566	(28,26)
No	1434	(71,74)

Table 2. Values in Smokers and Non-smokers Among the 1253 Patients Without Comorbidities

	n/Mean ± SD	%/Median (Minimum–Maximum)
Gender		
Male	582	(46,45)
Female	671	(53,55)
Age	43.67 ± 18.75	41 (1-97)
Smoking		
Yes	384	(30,72)
No	869	(69,28)

Table 3. Mean Hemogram Values in Smokers and Non-smokers Among the 1253 Patients Without Comorbidities

	Smoking				
	Yes		No		
Group without Comorbidities	Mean ± SD	Median (Minimum–Maximum)	Mean ± SD	Median (Minimum–Maximum)	*P*
WBC	8664.56 ± 5499.65	8300 (4000-110 000)	7721 ± 3316.18	7550 (3400-9000)	**<.001**
RBC	5003197.92 ± 664071.5	5045 000 (5080 000-6800 000)	4851017.32 ± 529643.79	4820 000 (4930 000-6970 000)	**<.001**
MCV	86.43 ± 4.19	86.3 (73.7-101)	86.35 ± 25.08	85.3 (70.8-814)	**.002**
PLT	257231.77 ± 63896.95	248 000 (122 000-445 000)	260234.41 ± 61476.92	257 500 (117 000-529 000)	.539
Eosinophil count	155.16 ± 126.96	120 (0-810)	126.31 ± 113.87	100 (0-1000)	**<.001**
Hemoglobin	15.15 ± 3.88	15.1 (10.4-85)	13.98 ± 1.42	13.9 (10-18.7)	**<.001**

Mann–Whitney *U*-test.
HGB, hemoglobin; MCV, mean corpuscular volume; PLT, platelets; RBC, red blood cells; WBC, white blood cells.

declining trend, contrary to some studies. However, especially following the COVID-19 pandemic, a decrease in smoking has been observed worldwide. In a recent study examining 188 donor candidates for organ transplantation in 2023, it was observed that 61 individuals (32.4%) were smokers.[9]

Studies conducted in America, Australia, and New Zealand have shown that smoking rates among emergency department patients are even higher than those in the general population.[10-12] Research suggests that the prevalence of tobacco use and tobacco-related diseases among emergency department patients is likely to be a multifactorial result influenced by government policies, socioeconomic conditions, and healthcare system structures. The high prevalence of smoking among emergency department patients observed in these types of studies may suggest that implementing a suitable, targeted intervention program within the emergency department setting for smoking cessation could potentially achieve higher success rates in quitting smoking. Establishing a unit within the emergency department to provide smoking cessation counseling and training the staff to guide smokers toward community support units for follow-up could serve as an initial step. Traditionally, smoking cessation counseling falls within the scope of practice of primary healthcare providers. This type of service is not provided in emergency departments. The American literature suggests that smokers among emergency department patients are less likely to seek primary healthcare services compared to non-smokers, indicating they might not seek cessation support elsewhere.[13] This has led to

Table 4. Mean Hemogram Values in Smokers and Non-smokers Among the 582 Male Patients Without Comorbidities

	Smoking				
	Yes		No		
Male without Comorbidities	Mean ± SD	Median (Minimum–Maximum)	Mean ± SD	Median (Minimum–Maximum)	*P*
Hemoglobin	15.62 ± 1.16	15.8 (10.9-19)	15.12 ± 1.25	15.2 (10-18.7)	**<.001**
WBC	8882.84 ± 6574.34	8400 (4200-110 000	8062.95 ± 4922.9	7700 (3400-9000)	**<.001**
RBC	5171198.44 ± 688232.49	5230 000 (5080 000-6450 000)	5173916.92 ± 564118.57	523 000 (4930 000-6970 000)	.440
MCV	86.13 ± 4.09	85.9 (73.7-95.9)	85.48 ± 3.82	85.1 (76.2-97.4)	.052
PLT	249447.47 ± 59415.3	240 000 (133 000-445 000)	246633.85 ± 60976.45	236 000 (129 000-512 000)	.598
Eosinophil count	156.29 ± 122.45	120 (0-600)	140.13 ± 132.5	100 (0-1000)	**.020**

Mann–Whitney *U*-test.
HGB, hemoglobin; MCV, mean corpuscular volume; PLT, platelets; RBC, red blood cells; SD, standard deviation; WBC, white blood cells.

Table 5. Mean Hemogram Values in Smokers and Non-smokers Among the 671 Female Patients Without Comorbidities

Female without Comorbidities	Smoking				
	Evet		Hayır		
	Mean ± SD	Median (Minimum–Maximum)	Mean ± SD	Median (Minimum–Maximum)	*P*
Hemoglobin	14.2 ± 6.46	13.6 (10.4-85)	13.3 ± 1.01	13.2 (10-16.3)	**.004**
WBC	8222.83 ± 1956.78	8100 (4000-12 400)	7515.58 ± 1721.04	7400 (4000-11 900)	**<.001**
RBC	4663228.35 ± 451710.83	4630 000 (3200 000-6800 000)	4657038.82 ± 397452.86	4660 000 (3200 000-6120 000)	.753
MCV	87.04 ± 4.32	87 (76.6-101)	86.87 ± 31.59	85.4 (70.8-814)	**<.001**
PLT	272984.25 ± 69744.88	261 000 (122 000-439 000)	268404.81 ± 60373.63	268 000 (117 000-529 000)	.648
Eosinophil count	152.87 ± 136.12	110 (0-810)	118.01 ± 100.25	90 (0-840)	**.012**

Mann–Whitney *U*-test.
HGB, hemoglobin; MCV, mean corpuscular volume; PLT, platelets; RBC, red blood cells; WBC, white blood cell.
atelet

the recognition of the need for emergency department-specific cessation interventions in the United States and other countries.

MATERIAL AND METHODS

A total of 2000 individuals were included in the study after excluding those with any inflammatory disease (having had a contagious disease within the past 4 weeks, reported fever, bronchitis, or urinary tract infection up to 2 weeks before the registration date), any malignancy, hematologic disorder, steroid usage, trauma, or those presenting to the emergency department with complaints related to these conditions. Eligible patients were identified with the help of resident physicians and registered nurses to ensure they met the inclusion criteria. Occasional smokers were also excluded. The condition for being a smoker was set as smoking at least half a pack (10 cigarettes) per day.

Those included in the study were informed in writing. Written informed consent was obtained from all participants. The questionnaires were administered to the participants by the researchers. All responses were recorded electronically in a confidential manner. The data were collected throughout the day for 3 months in all 3 emergency department units based on triage levels. Data collection were stopped upon reaching 2000 participants. Before conducting the study, ethical approval was obtained from the Research Ethics Committee of Erzincan Binali Yıldırım University (approval no. E-21142744-804.99-77857 date: 04.05.2021). Responses to the questions were self-reported by the participants.

In the second stage of the study, during the phase of comparing blood parameters, individuals identifying any comorbidity were also excluded from the study (n = 747). Blood samples were collected without considering conditions such as fasting or refraining from smoking. Measurements were made on fresh venous blood samples collected on the day of emergency department admission. The differential counts included leukocytes, platelets, and erythrocytes reported as the total cell count per microliter (μL). Hemoglobin levels were measured in grams per deciliter (g/dL), while mean corpuscular volume (MCV) was evaluated in femtoliters (fL).

In the third stage of the study, 2000 people were asked whether they found it helpful to establish a smoking cessation center in the emergency department.

Statistical Analysis

International Business Machiness (IBM) Statistical Package for the Social Sciences (SPSS) version 25.0 (IBM SPSS Corp.; Armonk, NY, USA) program was used to analyze the data. The suitability of the variables to normal distribution was examined by using histogram graphics and the Kolmogorov–Smirnov test. Mean, standard deviation, median, and minimum–maximum values were used when presenting descriptive analyses. Mann–Whitney *U*-test was used when evaluating non-parametric variables between groups. Cases where the *P*-value was below .05 were considered statistically significant results.

RESULTS

Of the patients included in the study, 50% were male and 50% were female. The mean age was 51.57 ± 20.29 years. In total, 28.2% of the patients (n = 566) were smokers. In total, 38.7% (n = 385) of male patients and 17.1% (n = 178) of female patients were smokers. There were 1253

patients without any comorbidity (62.6%). Three hundred eighty-four of the patients without any comorbidity were smokers, while 869 were non-smokers. The smoking rate was 30.7 in those without comorbidities. When comparing these 2 groups statistically, there were significant differences in mean WBC, RBC, and HGB values between smokers and non-smokers. However, there was no significant difference in platelet levels. White blood cell count was 12% higher, erythrocyte count was 3.13% higher, MCV was 1.5% higher, and eosinophil count was 24.1% higher in smokers. Hemoglobin level was 7.8% higher in smokers. In the last stage, when men and women without comorbidities were analyzed separately as smokers and non-smokers, MCV and RBC count in men, and RBC count in women were higher in the smoker group, although it was not statistically significant. When asked whether it would be beneficial to establish a smoking cessation center in the emergency department, 673 people answered yes (33.7%), while 1327 people answered no (66.4%).

DISCUSSION

When compared with the existing studies conducted in Türkiye and those mentioned above, it was observed that the smoking rates in this study, conducted with emergency department patients, were similar to the results of other studies. However, unlike our study, these studies did not require smoking at least half a pack of cigarettes daily. To the best of our knowledge, there is no study or population survey with the same criteria used in our present study. However, if the smoking criteria used in the present study are taken into consideration and it is acknowledged that smoking is decreasing in the society, it might be presumed that there is a slightly higher prevalence of smoking among emergency department patients. According to studies conducted worldwide, smoking rates tend to decrease among men and increase among women. In the present study, the smoking rate was 38.7% in men and 17.1% in women, which was consistent with the literature. There was no significant decrease in male smokers. In some studies conducted in Türkiye, it has been observed that with the increase in taxes, individuals resort to purchasing loose tobacco for rolling cigarettes or obtaining cigarettes through illicit means as these alternatives have become more cost-effective.[14] This could potentially contribute to our inability to accurately determine smoking rates. One of the reasons for smoking cessation efforts is the negative impact of smoking on the hematopoietic system. Mechanistically, the increase in white blood cells due to smoking can be explained by a systemic inflammatory response. Gaseous cigarette smoke contains >10^{14} organic radicals per puff, leading to the activation and release of various proinflammatory cytokines such as tumor necrosis factor. Carbon monoxide contributes to the formation of carboxyhemoglobin in red blood cells, reducing their capacity to transport oxygen. Therefore, smoking-induced hypoxic peripheral stimulation may lead to increased hematocrit and hemoglobin as a compensatory mechanism to maintain oxygen transport, theoretically leading to increased erythrocyte counts.[15] Within a complex network involving various growth factors, induced inflammation may promote the production and release of white blood cells.[16] The ongoing systemic inflammation due to smoking induces a continuous myeloid series with the release of mediators like C-reactive protein, interleukin-6, and tumor necrosis factor alpha (TNF-α). This results in the formation of a malignant clone or dysplastic series, leading to the development of bone marrow and hematological neoplasms.[17] Consistent with this view, we observed an overall increase in hematologic parameters among smokers. In this study, no significant difference was found between smokers and non-smokers in terms of mean cell volume and platelet count. The results of a similar study's findings showed that cigarette smoking has severe adverse effects on hematological parameters as in our study.[8] According to this study, the smokers had significantly higher levels of WBC, hemoglobin, MCV, and mean corpuscular hemoglobin concentration. All other measured parameters did not differ significantly, and smokers and non-smokers had almost equal values of the total erythrocyte count. This study established a significantly larger number of leukocytes in smokers of both sexes, in relation to non-smokers. Also, the values of leukocyte count were statistically significantly larger in male smokers. Similar to ours, the study conducted by Ahmed et al.[19] showed there were significant differences between the subgroups for all hematological parameters except for PLTs and lymphocyte count between smokers and non-smokers. According to a study, blood eosinophil count was higher in smokers with and without chronic obstructive pulmonary disease because the blood eosinophil count may reflect eosinophilic inflammation in small airways.[20] Pederson et al.[21] included 104 607 white Danes in a Copenhagen General Population study. White blood cell counts were increased by 14%-19% in current smokers. Compared with never-smokers, thrombocytes were increased by 5% in current smokers. For red blood cell indices, compared with never-smokers, hematocrit, hemoglobin, and mean corpuscular volume were only slightly increased with 1.6%- 2.3% in current smokers, whereas erythrocytes and mean corpuscular hemoglobin concentration did not seem to differ. The increases in blood parameters observed in the present study were consistent with the results of previous studies. In a similar study involving a total of 70 healthy male doctors and engineers, a statistically significant increase in the total leukocyte count ($P < .01$ and $Z > 2$) and lymphocyte count ($P < .01$ and $Z > 2$)

was detected in smokers as a result of comparing hemoglobin, hematocrit, and RBC counts. The change in the rest of the parameters was statistically insignificant.[22] In a study of 750 people who applied for check-up in 2020, smokers were particularly affected by hemoglobin levels (15.6 g/dL vs. 13.5 g/dL, respectively; $P < .001$) and WBC count (9 × 103/μL vs. 6.95 × 103/μL, respectively; $P < .001$) a significant difference was observed. Mean corpuscular volume, eosinophil count, and lymphocyte count were also higher in smokers.[23]

Recent research on smoking cessation indicates that approximately 5%-10% of patients quit smoking for at least 6 months upon the recommendation of their primary care physicians. The primary care physician can serve as a catalyst to help smokers, especially those seriously considering quitting, to break this habit.[24] Quitting smoking is very challenging; nicotine absorbed through the cheek reaches the brain within 10 seconds of inhalation, leading to nicotine addiction in a very short period. Nicotine is both psychologically and physically addictive.[25] More than 74.7% of smokers attempt to quit smoking without any assistance or try quitting using home remedies.[26] Former smokers typically attempt to quit smoking between an estimated 6-30 times before successfully doing so.[27] It is estimated that only 4%-7% of people can quit smoking without any intervention or aid.[28] In a growing number of countries, there are now more people who have quit smoking than there are smokers.[29] Smoking cessation clinics have been established in many countries. Among the services provided are individual interventions such as behavioral counseling, medication therapy, and nicotine replacement therapy. Smoking cessation clinics lead to a significant increase in smoking cessation rates with the aid of medication and motivational counseling support. Additionally, services such as consultation with a physician or psychologist, lung imaging, respiratory function testing, CO measurement, treatment planning (nicotine replacement therapy, bupropion, or varenicline), telephone counseling support, setting a quit date, and establishing support can be provided in some smoking cessation centers, managed solely under the supervision of chest specialists. When asked whether emergency applicants would want to benefit from a smoking cessation unit if such a unit was established in the emergency department and provided services in the form of distribution of brochures, suggestions, psychological support and referral to the necessary units, accompanied by healthcare personnel trained on this subject, approximately 33.7% of the participants in the present study expressed a positive opinion. Most patients stated that they would not prefer to visit such a center while having existing complaints. However, they expressed that if this service were provided as a separate unit independent from the emergency department within the hospital, their likelihood of applying would be higher. Similar to the present study, in a survey conducted in a previous study, when patients were offered options on how to quit smoking, it was observed that 33% of the patients considered quitting smoking through counseling during an emergency department visit.[30] There are also studies showing that smokers are interested in receiving smoking cessation interventions during emergency department visits and that smoking cessation interventions by emergency department doctors increase patient satisfaction.[31] Motivational interviewing has been used as a basis for alcohol and drug interventions in the emergency department.[32] The current lack of knowledge and need for brief emergency department-based interventions for tobacco use is clearly recognized in the field of emergency medicine.[33]Although the emergency department is often considered for preventive health practices, this is difficult to realize. There are many barriers, including time constraints, lack of knowledge about appropriate and effective interventions, concerns about disturbing and alienating patients, lack of clinician skills to impact patient health through smoking interventions, and lack of knowledge of attitudes about appropriate interventions.[34]

Limitations

The smoking rate was obtained from the answers of the people included in the study. Exclusion criteria such as previous infections and the presence of comorbidities were investigated by confirming both the answers of those included in the study and their existing medical records. Therefore, the study results may have been affected by the objectivity of the study participants. Additionally, being a passive smoker may also affect the results of our study.

Smoking, which affects all systems and changes hematological results due to the substances it contains, increases the risk of many diseases, and promotes the development of malignancies by continuously stimulating myeloid cells, is more common in some center's emergency department patients than in the general population. Smoking should be promptly discontinued. The number of smoking cessation centers in Türkiye should be increased. For this purpose, emergency departments, which face a high influx of patients in Türkiye, can be included in this system by modifying their working conditions. However, as shown by the results obtained in the present study, it is questionable whether they would be beneficial due to the sociocultural characteristics of the country and the preferences of the patients. Although smoking changes hemogram parameters, it does not lead to significantly different

results. For this purpose, further studies can be conducted to assess whether additional emphasis should be placed on smoking cessation counseling and motivational interviewing techniques in emergency medicine residency training.

Ethics Committee Approval: Ethics Committee of Erzincan Binali Yıldırım University (approval no. E-21142744-804.99-77857 date: 04.05.2021).

Informed Consent: Written informed consent was obtained from patients who agreed to take part in the study.

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