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A Cross-Sectional Study to Assess the Effects of Tobacco Consumption on Hematological Parameters

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Abstract:

Introduction: Tobacco consumption is mainly done in two forms, smoked tobacco and smokeless tobacco.

Aim of the study: This study was carried out to determine the negative effects of cigarette smoking, bidi smoking, and tobacco chewing on hematological parameters and to establish a link between them.

Subjects and Methods: A matched comparative cross-sectional study was carried out in the Upgraded Department of Physiology in partnership with the Department of Medicine at SMS Medical College, Jaipur. The study included 210 healthy people (70 cigarette smokers, 70 bidi smokers, 70 tobacco chewers, and 70 non-tobacco users). Blood samples (venous) were collected for the estimation of hematological parameters.

Results: Non-significant changes were observed in the complete blood profile in cigarette smoking, bidi smoking and tobacco chewers when compared to nonusers except TWBC and RDW-CV. Hb, Monocyte, Eosinophil Counts, Platelet Counts, PCT and MPV were higher in tobacco users than in the control group. The lymphocyte and basophil count were found to be lower in tobacco users compared to the control group. The mean and standard deviation of HCT increased in bidi and cigarette smokers but decreased in tobacco chewers compared to the control group. RDW-CV and TWBC significantly increase in the tobacco users' groups than the control group.

Conclusion: The current study may be beneficial in raising knowledge of the adverse effects on the population using tobacco.

Keywords: Tobacco, Smoked, Smokeless, RDW-CV, SLT.

1. Introduction

Worldwide, tobacco usage has been a habit and addiction for ages. One of the world's major public health risks, the tobacco pandemic kills about eight million people a year, including 1.2 million from second-hand smoke [1,2]. Various methods

are used to consume tobacco. Smoked and smokeless tobacco are consumed most. The use of tobacco without burning is called smokeless tobacco (SLT). SLT use has grown worldwide, especially among adolescent boys and young men who see it as a safer alternative to smoking. Smoking is the most common way to consume tobacco. Approximately 1/3 of the world's population consumes tobacco. World's second leading cause of death is smoking [3].

Young men are switching from cigarettes to cheaper bidis and dipping tobacco, which is causing problems. Nicotine, a highly addictive chemical, is the primary element in tobacco. The fact that people are prepared to switch to cheaper brands but will not quit demonstrates that nicotine addiction drives tobacco use [4]. Tobacco-specific nitrosamines (TSNAs) are the most carcinogenic compounds. They form while tobacco grows, cures, ferments, and ages [5]. A 30-minute chew contains the same amount of nicotine as three cigarettes, and a two-can/week snuff dipper contains the same amount of nicotine as smoking one and a half packs of cigarettes each day [6].

Young men are switching from cigarettes to cheaper bidis and dipping tobacco, which is causing problems. SLT products robustly modulate the metabolic pattern and escalate the risk of systemic inflammation such as RBC morphology modulation, polycythemia Vera, and cardiovascular diseases. All tobacco products are toxic, and there is no safe level of exposure. Considering the aforementioned, we must educate children, teenagers, and adults about the dangers of tobacco. We need recent, scientific data on the health risks of smoked and smokeless tobacco in the local community. The present study aimed to determine how tobacco use affects hematological markers.

2. Subjects & Methods

2.1.Subjects

The study was undertaken in the Upgraded Department of Physiology in partnership with the Department of Medicine, SMS Medical College, Jaipur. A sample of male individuals aged 20-40 years, who were attending the Medicine OPD in SMS Medical College, Jaipur, and were using either cigarettes, bidis, or

chewing tobacco (any one of these), were selected. Comparable controls were also included in the study. The length spanned 18 months, commencing in March 2022 and concluding in September 2023. The ultimate sample size for the present study was 280 people, with 70 subjects in each of the four groups.

Study groups

- **Group A:** consists of individuals who have been exclusively smoking cigarettes for a duration of one to five years.
- **Group B:** consists of individuals who have exclusively smoked bidis for a duration ranging from one to five years.
- **Group C:** consists of individuals who have been exclusively chewing tobacco for a duration of one to five years.

- **Group D:** Controls consist of individuals who have never consumed tobacco in any way.

Inclusion criteria for cases

- Age range: 20 to 40 years.
- Exclusively male individuals who consume tobacco.
- Participants who have given informed written consent for the study.

Inclusion criteria for controls

- Age must be within the range of 20 to 40 years.
- Males who do not use tobacco.
- Participants who have given informed written consent for the study.

Exclusion criteria

- Non-co-operative subjects.
- Mix users of cigarette and tobacco chewers
- Alcohol users

2.2.Methods

Healthy patients from the outpatient department of the Medicine Department at S.M.S. Hospital in Jaipur were approached and completely persuaded. Those who met the inclusion and exclusion criteria were recruited and assigned to groups A, B, C, and D after providing informed written consent.

A pre-designed study form was used to collect data on participant demographics and other essential information. Tobacco consumption occurs through the act of smoking cigarettes or bidis. The measurement will be given as pack years.7

A normal pack contains 20 cigarettes. This can be converted into pack years. Pack years are computed by multiplying the number of packs smoked each day by the number of years a person has been smoking.

For instance, if someone smokes 10 cigarettes per day for 10 years, it would be equivalent to smoking half a pack of cigarettes per day. This would result in a total of 5 pack years, calculated by multiplying half a pack per day by 10 years (1/2 x 10 = 5).

Furthermore, the consumption of tobacco through chewing was measured in terms of pouch years.7 The calculation for pouch years is determined by multiplying the number of pouches consumed per day by the number of years of chewing. For 10 years, consuming 1 pouch of tobacco per day would amount to 10 pouch years. Each normal pouch contains 12 grams of tobacco.

Subjects were categorized into three groups based on the number of years they had pouches.

- Group I refer to individuals who have smoked less than 5 pouch/pack years.
- Group II consists of individuals who have a history of smoking between 5 and 10 pouch/pack years.
- Group III consists of individuals who have smoked more than 10 pouches/packyears.

Assessment of hematological parameters

The central laboratory of SMS Medical College and connected group of hospitals utilized the Sysmax model no. XN-1000 Automated Chemical Analyser for the determination of Hematological parameters.

2.3.Data compilation and statistical analysis

The obtained data was recorded on a pre-designed study proforma and then entered into a Microsoft Excel sheet to create a master chart. The mean and standard deviations were used to describe linear data, whereas proportions (%) were used to portray nominal/categorical variables. The analysis of linear variables involved the utilization of different parametric tests such as the One-Way ANOVA test and post-hoc test. Non-parametric tests such as the A significance level of < 0.05 were used to determine statistical significance. The statistical calculations were performed using the program SPSS 22.0 version.

3. Results

Table 1 shows the inclusion of 70 subjects in each group in the study. The difference in the mean age of participants was non-significant for cigarette smokers (Group A), Bidi smokers (Group B) tobacco chewers (Group C), and controls (Group D) ($p > 0.05$) which shows that the groups were comparable.

Table 1: Distribution of study subjects according to Age.

Parameter	Group	N	Mean	SD	'p' value*
Age (In Years)	**Group A** (Cigarette smokers)	70	29.49	6.07	0.738
	Group B (Bidi smokers)	70	29.04	5.11	
	Group C (Tobacco chewers)	70	28.60	6.61	
	Group D (Control)	70	28.50	5.42	

** ANOVA - Analysis of Variance.*

When the severity of tobacco use was compared using packs per year among groups A, B and C, it was observed that there was not any significant difference in using of tobacco in terms of packs per year ($p > 0.05$) (**Table 2**).

Table 2: Comparison of pack per year of tobacco abuse among study groups

Parameter	Group	N	Mean	SD	'p' value*
Tobacco Abuse (Pack/Year)	**Group A** (Cigarette smokers)	70	6.67	2.92	0.923
	Group B (Bidi smokers)	70	6.46	4.10	
	Group C (Tobacco chewers)	70	6.42	4.65	

** ANOVA - Analysis of Variance.*

Tables 3, 4, and **5** show that Hb, Monocyte, Eosinophil count, Platelet count, PCT and MPV were non-significantly higher in cigarette, bidi and tobacco chewers

than in the control group. The lymphocyte and basophil count were found to be lower in tobacco users compared to the control group. The mean and standard deviation of HCT increased in smokers but decreased in tobacco chewers compared to the control group, although the difference was not statistically significant (p >0.05). In cigarette smokers, RBC counts increased but decreased in tobacco chewers. Neutrophil counts do not significantly increase in tobacco chewers, but they decrease in smokers. RDW-CV and TWBC significantly increased in both the tobacco user group and the control group (p <0.05).

Table 3: Comparison of hematological parameters.

Parameter	Group	N	Mean	SD	'p' value*	Significant difference from#
HB (in g/dl)	Group A	70	15.13	1.58	0.158	-
	Group B	70	14.64	2.35		-
	Group C	70	14.88	1.63		-
	Group D	70	14.51	1.24		-
TRBC (Million/ mm^3)	Group A	70	5.06	0.69	0.811	-
	Group B	70	4.99	0.73		-
	Group C	70	4.95	0.63		-
	Group D	70	5.01	0.49		-
RDW-CV	Group A	70	14.80	2.48	0.019	B, D
	Group B	70	13.99	1.68		A
	Group C	70	14.39	1.39		-
	Group D	70	13.99	1.26		A
HCT (%)	Group A	70	45.35	5.05	0.311	-
	Group B	70	46.41	7.44		-
	Group C	70	44.72	4.05		-
	Group D	70	45.11	4.99		-

** ANOVA - Analysis of Variance; #Post hoc Tukey HSD test.*

Table 4: Comparison of differential leucocyte count.

Parameter	Group	N	Mean	SD	'p' value*	Significant difference from#
Total WBC (x1000/µl)	Group A	70	8.32	3.07	<0.001	-
	Group B	70	9.03	3.90		C, D
	Group C	70	7.36	2.10		B
	Group D	70	7.16	2.60		B
Neutrophils	Group A	70	61.12	14.26	0.260	-
	Group B	70	58.64	13.07		-
	Group C	70	62.90	11.16		-
	Group D	70	61.16	11.95		-
Lymphocytes	Group A	70	26.04	10.31	0.151	-
	Group B	70	32.73	38.27		-
	Group C	70	25.34	9.49		-
	Group D	70	27.61	9.62		-
Monocytes	Group A	70	7.69	6.86	0.395	-
	Group B	70	6.98	2.77		-
	Group C	70	6.94	2.87		-
	Group D	70	6.48	2.80		-
Eosinophils	Group A	70	4.63	4.84	0.824	-
	Group B	70	4.94	3.85		-
	Group C	70	4.37	4.62		-
	Group D	70	4.32	3.96		-
Basophils	Group A	70	0.55	0.57	0.912	-
	Group B	70	0.59	1.06		-
	Group C	70	0.53	0.49		-
	Group D	70	0.60	0.32		-

** ANOVA - Analysis of Variance; #Post hoc Tukey HSD test.*

Table 5: Comparison of platelet parameters.

Parameter	Group	N	Mean	SD	'p' value*
Platelet Count (x1000/µl)	Group A	70	256.67	91.35	0.336
	Group B	70	260.44	130.65	
	Group C	70	240.67	72.15	
	Group D	70	231.80	119.42	
MPV	Group A	70	10.25	4.02	0.445
	Group B	70	9.64	4.69	
	Group C	70	10.80	5.24	
	Group D	70	10.59	3.96	
PCT	Group A	70	0.39	0.65	0.365
	Group B	70	0.77	4.24	
	Group C	70	1.26	5.86	
	Group D	70	0.27	0.14	

4. Discussion

The study found higher Hemoglobin (Hb), Monocyte, Eosinophil count, Platelet count, PCT and MPV levels among tobacco users including cigarette smokers, bidi smokers and tobacco chewers compared to non-users. However, despite these observed differences in mean levels, statistical analysis did not find any significant differences between the groups. This finding is consistent with previous research by Irmark et al. (2019), They also found a positive link between tobacco use and hemoglobin levels and monocytes, showing that Hb and monocyte levels rise in tobacco users [8]. Similarly, Malenica et al. (2017) discovered a statistically significant difference in hemoglobin levels (147.00 g/dl for smokers vs 139.00 g/dl for non-smokers, p = 0.042), with smokers having higher Hb levels than controls, however, the difference was not statistically significant [9]. Kumar et al. (2017) discovered non-significant increases in eosinophil count, platelet count, PCT, and MPV levels [10].

It is hypothesized that the increase in hemoglobin concentration is induced by the presence of carbon monoxide, and some researchers have suggested that the increase in hemoglobin levels in smokers' blood may be a compensatory mechanism. Carbon monoxide binds to Hb, forming carboxyhemoglobin, a non-functional kind of hemoglobin that cannot transport oxygen. Carboxyhemoglobin induces a leftward shift in the Hb dissociation curve, which reduces Hb's ability to deliver oxygen to tissues. To compensate for their diminished ability to deliver oxygen, smokers maintain a higher level of hemoglobin than nonsmokers [11].

Acute smoking can cause endothelial damage that leads to an increase in platelets. Moreover, platelet production is controlled by hormonal metabolisms and may be potentially impaired via smoking causing the production of platelets and increased platelet count. Higher circulating thrombopoietin levels have been shown in cigarette smokers, which is a humoral growth factor that is responsible for increasing platelet production than non-smoking controls [12].

In the present study, the lymphocyte and basophil count were found to be lower in tobacco users compared to the control group. Similar results were found by Goel et al. (2020) [13]. Lymphocyte count was marginally decreased in smokers (0.3664) compared to non-smokers (0.3717). Also,

similar results were found by Kumar et al. (2017) found that Basophils decreased in both age groups of smokeless tobacco users. Basophil (%) levels in non-users (0.41% ±0.31) versus tobacco chewers (0.39% ±0.29) showed no statistically significant difference (p =0.780) [10]. Other studies found basophil counts were lower in tobacco chewers than non-tobacco users [14-16]. Mukherjee et al. (2013) suggested that the negative effect of gutkha on blood hematology is no less adverse than smoking which was similar in our study [17].

The mean Total Red Blood Cell Count (TRBC) was higher in Cigarette smokers (5.06 ±0.69) and lower in tobacco chewers (4.95 ±0.49) than control Group (5.01 ±0.49) but the difference was not significant. This result was consistent with previous research by Malenica et al. (2017) who found no significant difference in red blood cell counts (4.88 x1012/L for smokers and non-smokers 4.88 x1012/L (4.53-5.22 x1012/L) [9]. Metin et al. (2004) also reported an increase in red blood cell (RBC) count among smokers compared to controls, although the difference was not statistically significant [18].

Shukla et al. (2019) discovered that tobacco chewers had a lower mean serum TRBC count (4.88 mill/cu.mm) compared to nonusers (5.59 mill/cu.mm) [19]. Similarly, Rajasekhar et al. (2007)16 also observed that tobacco chewers had a lower mean serum TRBC count (4.88 mill/cu.mm) compared to nonusers (5.59 mill/cu.mm).

The elevated count of red blood cells and hematocrit levels in male smokers can be attributed to tissue hypoxia resulting from the increased production of carboxyhemoglobin. This, in turn, triggers a higher release of erythropoietin, leading to an increase in erythropoiesis. The carbon monoxide present in tobacco smoke causes capillaries to become more permeable, resulting in a decrease in plasma volume. This mimics the condition of polycythemia, where there is an increased proportion of red blood cells in the blood volume. This is also reflected in higher hematocrit values [20,21]. Increased hematocrit levels can lead to polycythemia vera (PV), a condition characterized by excessive production of red blood cells by the bone marrow. This condition is associated with a higher risk of developing atherosclerosis and cardiovascular disease [22].

Tobacco users have exhibited changes in the structure of RBCs. Scanning electron microscopy detected alterations in

the membranes of red blood cells, resulting in the loss of their discoid shape and the appearance of small "bubble-like" protrusions. The components of tobacco disrupt the cellular metabolism of individuals, resulting in changes in shape and size that have significant implications for sustaining good health [23]. In discussing these findings, it's important to note that while there may be differences in TRBC levels among various tobacco user groups, these differences do not reach statistical significance in the current study or previous research. This suggests that factors other than tobacco use may influence TRBC levels.

RDW-CV (coefficient variation of red cell distribution width) significantly increases in all tobacco user groups cigarette, bidi and tobacco chewers than control group. In a similar type of work, RDW-CV was increased in tobacco smokers than in the control group [15, 24]. Tobacco chewers, exhibited the highest mean value of neutrophil at 62.90, while bidi smokers, displayed the lowest mean at 58.64. but the difference was not statistically significant.

Malenica et al. (2017) discovered similar findings, demonstrating a substantial reduction in neutrophils among smokers compared to the non-smoking control group [9]. Kastelein et al. (2015) found that there was no significant difference in neutrophil levels between middle-aged smokers and non-smokers [25]. The present study also showed similar results, with a drop-in neutrophil observed in the smoker group, although the difference was not statistically significant.

Previous studies reported findings of an elevated neutrophil percentage in individuals who chew tobacco [10, 14, 17]. Neutrophils are known to make cytotoxic substances that impair the functions of the lungs [26]. So, the higher number of neutrophils found in smokers in this study might indicate that their lungs are malfunctioning as well. In this study, smokers and gutka users had a higher number of neutrophils. This may be linked to ongoing inflammation of tissues. The net effect of cigarette smoke on neutrophils is an elevation of the neutrophils count and a reduction of their functionality. The systemic inflammatory response triggered by exposure to cigarette smoke is characterized by the stimulation of the hematopoietic system, specifically the bone marrow, which results in the release of leukocytes and platelets into the circulation [27].

Nicotine has been found to prevent the generation of free oxygen radicals in PMN. As a result, nicotine is likely capable of suppressing a variety of neutrophil-mediated inflammatory activities. PMN from smokers' peripheral blood had lower migration and chemotaxis than PMN from nonsmokers [28].

5. Conclusion

Tobacco smokers hurt hematological markers. The current study could be used as an early diagnostic tool for any systemic disorders, as well as to raise awareness about the harmful effects of tobacco use in the general population. Given these and other health hazards linked with tobacco use, all current users should be advised to quit. To achieve a smoke-free future, tobacco control efforts should raise awareness and knowledge about the systemic and oral health consequences of tobacco use.

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