Evaluation of Blood Elements and Red Blood Cell Indices among Sudanese Cannabis and Cigarette Smokers in Khartoum State

Dr. Amged Hussein Abdelrahman

Received: 6 September 2021 Accepted: 2 October 2021 Published: 15 October 2021

Abstract

Background: Cannabis, also known as (marihuana), is a psychoactive drug from the cannabis plant used for medical or recreational purposes. It is one of the most commonly used psychoactive drug worldwide, and it is the most popular illegal drugs. Long-term use of cannabis has acute effects on hemostasis of the body and hematological parameters of addicted individuals. Cigarette smoking is one of the major leading causes of death throughout the world: smoking has both acute and chronic effects on hematological parameters; many studies proved its harmful effects on many organ systems, mainly respiratory, reticuloendothelial system, and cardiovascular systems. Tobacco cigarette smoking is one of the main leading causes of death worldwide. Continuous cigarette smoking has severe adverse effects on hematological parameters (e.g., hemoglobin, white blood cells count, mean corpuscular volume, mean corpuscular hemoglobin concentration, red blood cells count, hematocrit).

Index terms— cannaibs; cigarette cannaibs smokers, hematological parameters.

1 Introduction

arijuana also known as (Cannabis) or Cannabis Sativa, is a psychoactive drug from the cannabis plant used for medical and recreational purposes (1). It is one of the most commonly used psychoactive drugs worldwide, and it is one of the most popular illegal drugs (2). Main psychoactive part of cannabis is tetrahydrocannabinol, which has a scientific name called "Cannabinoids and Cannabidiol. Cannabinoids are usually classify as endocannabinoids, phytocannabinoids, and synthetic cannabinoids. Synthetic cannabinoids are in the gathering of drugs called new psychoactive substances and these technically synthetic cannabinoid receptor agonists are designer drugs that mimic the psychoactive effects of cannabis (3). There is a long tradition of cannabis use for culinary, medicinal and ,ceremonial purposes in many developing countries. Various intake routes of tetrahydrocannabinol THC (intravenous, smoke, inhalation and, oral) so can be used by smoking, vaporizing, in food, or an extract. The plasma levels are related to onset, degree and duration of clinical effects. The degree of response and plasma cannabinoid levels attain edvary in a dose-related manner depending upon the potency of smoked marihuana (4). Over the last decades, there have been considerable researches involving cannabinoids and their importance in regulating a variety of physiological M and psychological processes such as pain, feeding behavior, lipid metabolism, pleasure sensation, and immune system (4). The physical harm caused by cannabis is less well-known. In adults, chronic bronchitis, lung cancer, myocardial infarction, hepatotoxicity, decreased sperm count and motility, gynecomastia in males, suppression of ovulation among females, low birth weight and delayed visual system, and development among the newborns of cannabis using females (3). Plant-derived cannabinoids include delta-9-tetrahydrocannabinol (THC), the primary psychoactive component of cannabis. Cannabinoids mediate their effects through binding specific receptors, which are members of the G protein-coupled receptor superfamily. Two cannabinoid receptors was identified: Cannabinoid-1 receptor (CB1) and cannabinoid-2 receptor (CB2). CB1 is expressed primarily in the central nervous system (CNS) and is responsible for the psychoactive effects of cannabinoids by modulating neurotransmitter release). In contrast, CB2 is localized primarily in immune cells such as lymphocytes, macrophages, and neutrophils and is responsible for the immunomodulatory effects of cannabinoids (5). Smoking is the most important health problem in the world. Many studies proved its harmful

effects on many organ systems like respiratory, reticuloendothelial system, and cardiovascular systems. (**??**) Tobacco cigarette smoking is one of the main leading causes of death worldwide. Continuous cigarette smoking has severe adverse effects on hematological parameters (e.g., hemoglobin, white blood cells count, mean corpuscular volume, mean corpuscular hemoglobin concentration, red blood cells count, hematocrit). These represented a predisposing factor for the development of various pathological conditions, and diseases such as atherosclerosis, polycythemia vera, chronic obstructive pulmonary disease and cardiovascular diseases. (7) Smoking effects on hematological indices observed on routine complete blood count testing (CBC). Smoking-induced increased in red blood cell count (RBC) was described. Current smoking has been reported as an associative factor with leukocytosis (TLC), thrombocytosis (PLTS) in some reports. Nicotineinduced JAK-STAT &NF-Kb signaling pathways are thought to mediate the increase in RBC. (8) II.

2 Materials and Methods

Study population: Sudanese voluntary cannabis abusers and Cigarette smokers in Khartoum state, Sudan.

Inclusion criteria: This study included Sudanese voluntary cannabis abusers and Cigarette smokers in Khartoum state, Sudan.

Exclusion Criteria: The Participant with any disease or smoking any other type of smoking was excluded.

Data collection: Collected using self administrated per coded questionnaire, which was specifically designed to obtain information to this study.

Blood sampling: Venous blood was collected using sterile disposable plastic syringes after cleaning the venous puncture area with 70% ethanol, the blood 2.5 ml was added to the anticoagulant container EDTA.

3 Methods:

The result was calculated by CBC analyzer. Whole blood is passed between two electrodes through apertures so narrow that only one cell can pass through at a time.

Statistical Analysis: Statistical assessment was carried out with statistical package for social sciences (SPSS) version 17.0 for windows statistical software.

Ethical Considerations: All participants were voluntarily submitted written informed consent before the commencement of the study. Neither the participant name nor situation or any other information was used in this study.

4 III.

5 Results

A total of 100 Sudanese participants were enrolled in our research, divided into 50 Sudanese individuals smoking cannabis plants as a case group and 50 healthy Sudanese individuals as a control group. (Fig. **??**). All study participants were males with ages ranged from (17) to (35) years old in both groups. (Fig. 2). Concerning some other Cannabis smoking characteristics, the majority of cases group 38 (76%) reported smoking duration more than three years and almost nearly all of them, 49 98%, reported smoking frequencies of more than five times per week as detailed in figure (3), and Table (1). In regards to the effect of cannabis smoking on the results of complete blood count test results, our study showed that measures of cases group were significantly higher among cases group compared to the control group in white blood cells count ($p = 0.0121$), HCT ($p = 0.0055$), neutrophil count ($p = 0.0428$) and in RDW -SD ($p = 0.004$). The study showed that measures of the cases group were significantly lower among case group compared to control group in platelets count ($p = 0.0477$), and in the Lymphocytes count ($p = 0.0238$) as detailed in the table (2). Lastly, the study did not find a significant difference in the complete blood count measures according to the duration of cannabis smoking among the case group except in hematocrit ($p = 0.041$) as detailed in Table (3) the study was not able to assess the effect of cannabis smoking frequency/week of the measures of complete blood count because of the lack of variation in the relevant data; because all most all 49 (98%) of the case group had a similar frequency of weekly cannabis smokers. Among the cigarette smokers this study showed that the majority, 36 72% of the cases group (smokers) were within the age group 20 -25, as detailed in Table (4). Concerning some other smoking characteristics, more than half of cases group 27 (54%) reported smoking cigarette duration less than five years, and almost the majority of them, 40 80% reported smoking frequencies less than ten times per day as detailed in Tables **??** and 6. In regards to the effect of cigarette smoking on the results of complete blood count measures, our study showed that results of cases group were significantly higher among cases group compared to control group in mean cell volume ($p = 0.0362$), in PWD ($p = 0.0259$) as detailed in Table (7) Moreover, the study did not find a significant difference in complete blood count measures according to the duration of smoking among case group except in white blood cells count ($p = 0.0419$) as detailed in Table **??**. This study did not find a significant difference in complete blood count measures according to the frequency of smoking among case group except in white blood cell count ($p = 0.0473$) as detailed in Table (9).

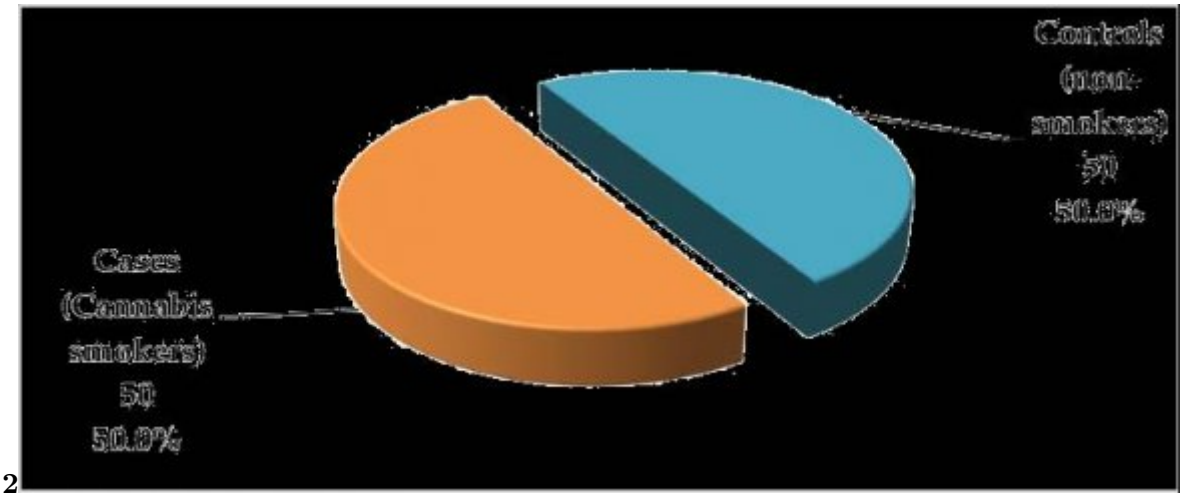
6 Discussion

The effect of Cannabis "marihuana" on hematological parameters has been discussed by many authors as it is the most popular illegal drug used worldwide. This study had demonstrated the effects of cannabis abusing and Cigarette smoking on some hematological parameters, including 100 Sudanese participants, divided into 50 Sudanese individuals smoking cannabis plants as the case group and 50 healthy Sudanese individuals as the control group. Our study revealed a significant higher increase in the WBCs, HCT, absolute neutrophil count and RDW-SD, with P.values equal= (0.012), (0.005), (0.04) and (0.0004) respectively. The WBCs count was higher in case group (mean=6.26) cell/?l compared with control group (mean=5.20) cell/?l. This result was agreed with Deryas study (8) and disagreed with Amaechi and his colleagues study (6). Also, HCT showed a statistically significant higher difference between the case group and the control groups, in which the mean in case group was (46.6) % and (43.2) % in control group. Our result disagreed with the study carried in Nigeria by Amaechi and his colleague which showed lower HCT (6). The mean of Neutrophils absolute count in the case group was (2.5) cell/?l compare with (1.88) cell/?l in the control group. Our result was agreed with stud carried by Derya (8) and disagreed with the studies carried by Amaechi (6) and Salma studies (7). While the brilliant highly significant difference in the mean of RDW-SD in case group, which equal (44.7) fl was higher compare with control group (42.4) fl. This result was agreed with findings of the Derya study that their study showed a significantly increase in RDW-SD (8). On the other hand, our study revealed a significant lower difference in platelete count and lymphocyte percentage count with Values equal (0.04) and (0.02), respectively. Which agreed with the studies carried out by Amaechi (6) and salma (7). While the insignificant differences of RBCs (P.Value=0.35) were agreed with Salma, Amna and, Bashiri studies (7,9,10). Also, Hb concentration revealed no significant difference between both groups with P. Value (0.42) which agreed with Amna, Bashiri and, Derya studies (10). All studies agreed with our findings revealed no significant difference on RBCs indices; MCV, MCH, MCHC, MPV, PDW and P-LCR. Differences in our findings from previous studies may be attributed to the racial, genetic, geographic, nutritional status, duration of cannabis abusing and differences in sample size included. (8,9). Among Sudanese cigarette smokers, our result showed that measures of CBC were significantly higher among the cases group compared to the control group in mean cell volume ($p = 0.0362$), and in PDW ($p = 0.0259$) and the duration of smoking and its frequency significantly increase white blood cells count ($p = 0.0419$), ($p = 0.0473$) respectively. Our result revealed that there was a significant increase in MCV and this finding disagree with Naser M Ergiah,et al, Rawia O. A Mustafa and Muhammad Asif,et al finding that showed there was no significant difference in MCV.(**??**4) (15) (17) Similarly, we found that there was a significant increase in PDW in among smokers compared to non-smokers and these findings disagree with Muhammad Asif, et al. Findings which show that did not show any significant difference in PDW. (**??**7) Furthermore, our result stated that there was no significant difference in MCH, RDW, PLT, MPV and this result agree with Muhammad Asif, et al findings which show that it did not show any significant difference in MCH, RDW, PLT, MPV. (17). On the other hand, our result showed no significant difference in WBCs, RBCs, Hb and ,MCHC and this disagree with Naser M Ergiah,et al findings that stated there was a significant increase in these parameters.(**??**4) Also, our result reported that there was no statistically significant difference in total WBCs and, platelets count and this result disagrees with Dinesh et al which their results show there was a slight increase in white blood cells (WBCs) and platelets observed in smokers compared with non-smokers. (13). We found that there was no statistically significant difference in MCH and PLT and this findings agreed with Naser M Ergiah, et al result. (14) . Similarly, we found that there was no statistically significant difference in RBCs, HB, HCT, MCH, RDW-SD, RDW-CV, Neutrophils, Monocytes and, Eosinophils. And this result disagrees with Rawia O. A Mustafa finding that stated a significantly increase in these parameters and Muhammad I. Khan, et al result which reported that Hemoglobin, RBC Count, HCT and MCH were significantly increased. (15) (16). Furthermore, we found that there was no significant difference in PLT count and these finding disagrees with Rawia O. A Mustafa finding that showed there was a significant decrease observed in PLT count. (15). Finally, we found no significant difference in WBC, RBC, Hb, HCT, MCHC and PCT and, this result disagrees with Muhammad Asif, et al findings which show that WBC, RBC, Hb, and HCT were significant high, at the same time MCHC and PCT were significantly low. (17) V.

7 Conclusion

Our study concluded that some hematological parameters in cannabis smokers differ significantly from non-smoker ones. The most likely consequences are an increase in TWBCs count, HCT, Neutrophils absolute count and, RDW. Also, the study revealed that cannabis abusing results in a low level of platelet count and lymphocyte percentage count., there was no change in RBCs count, Hb concentration, MCV, MCH, MCHC, MPV, PDW and ,P-LCR. Among Sudanese cigarette smokers, the study concluded that smoking might result an increase of MCV and PDW and, long smoking duration and high frequency per day may lead to high [1]

Figure 1: Figure



2

Figure 2: Figure. (2

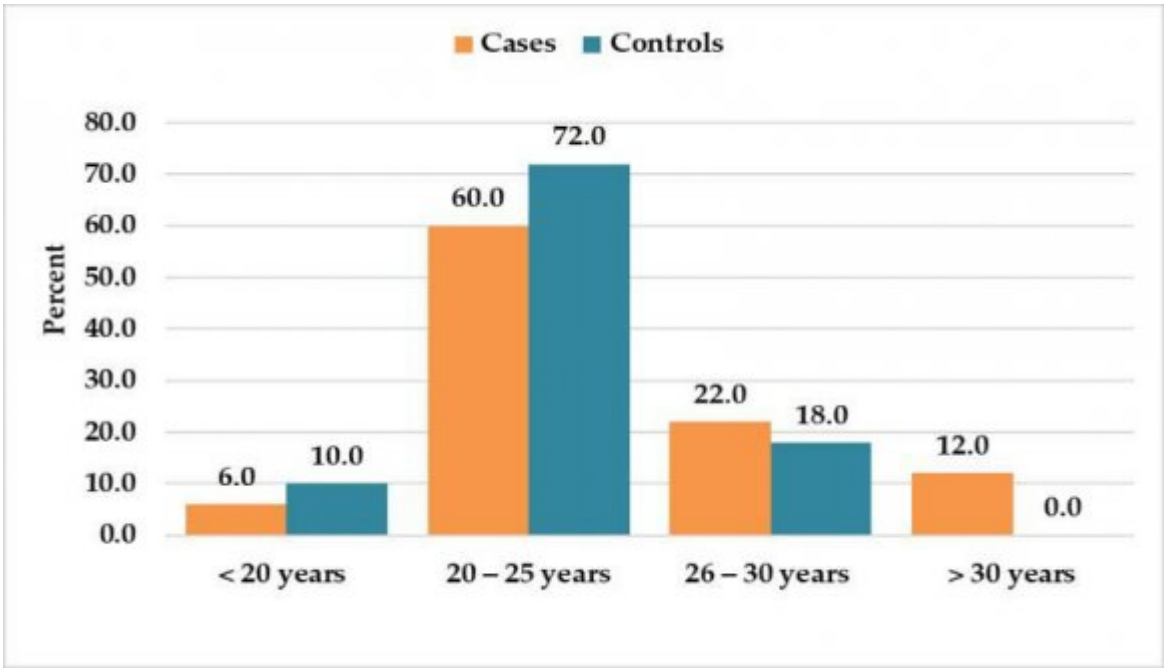

Cases
Controls
Percent
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
6.0
10.0
60.0
72.0
22.0
18.0
12.0
0.0
< 20 years
20 – 25 years
26 – 30 years
> 30 years

Figure 3:

.

	RDW-SD (%)	44.73	42.41
	Cannabis smoking frequency -week RDW-CV (%) 13.58		Frequenc
			14.11
	< 5 times / week		1
	PDW (%)	16.85	15.80
	> 5 times / week		49
	MPV (fL)	11.20	10.95
	Total		50
Year 2021 18	P-LCR (fL) PCT 27.14 Table (2): The difference in complete blood count results between		
	(ng/ml)		
Volume XXI Issue III Version I D D D D) (	Complete blood count WBC (× 10 3) RBC (× 10 3) HGB (g/dL) HCT (%)	Mean in Case 6.26 5.45 14.36 46.62	Mean i Control 5.20 5.2 14.04 43.29
	MCV (fL)	84.48	82.15
Medical Research Global Journal of	MCH MCHC (g/L)	27.78	26.95
	PLT (× 10 3)	35.19	32.68
		237.06	269.44
	LYM (× 10 3)	2.22	2.15 1.8
	NEUT(× 10 3) MIX	2.50	1.13
	(× 10 3)	1.16	
	LYM (%)	35.88	42.08
	NEUT (%)	39.18	36.35
	MIXD (%)	18.91	20.20

[Note: I]

Figure 4: Table . (

(

	MIXD (%)	20.18	18.31	19.07
	RDW-SD (%)	45.10	44.77	44.15
	RDW-CV (%)	14.26	13.19	13.88
	PDW (%)	16.31	16.85	17.51
	MPV (fL)	12.83	10.55	11.08
Year	P-LCR (fL) PCT	25.95 0.28	27.39	27.86
2021	(ng/ml)		0.23	0.28
20				
Volume	Complete Blood Count	Duration of Cannabis smoking (years) < 3 3 -5 > 5 6.36 6.20 6.33 5.35 5		
XXI	WBC (× 10 3) (CBC)			
Issue	RBC (× 10 3) HGB			
III	(g/dL)			
Ver-				
sion				
I				
D D				
D D)				
I				
(	HCT (%)	50.41	45.61	44.91
Medical	MCV (fL) MCH MCHC	81.68 27.67	84.24	88.51
Re-	(g/L)	46.02	27.64	28.32
search			31.72	31.91
Global	PLT (× 10 3) LYM (×	243.17 2.32	228.04	255.00
Jour-	10 3) NEUT(× 10 3)	2.04	2.02	2.65
nal			2.59	2.82
of				
	MIX (× 10 3)	1.14	1.14	1.25
	LYM (%)	36.23	33.11	43.21
	NEUT (%)	35.08	40.25	41.12

[Note: ITable(4): The distribution of the study participants according to their age -years (n = 50 cases)]

Figure 5: Table (3

(

		Duration of smoking (years)			
	Complete blood count	Study group			
	Complete blood count				
		< 5	5-10		
		Case	Control		
	WBC (× 10 3) WBC (× 10 3)	5.38 4.11	5.22	5.10	
	RBC (× 10 3) RBC (× 10 3)	5.24 5.29	5.17	5.22	
	HGB (g/dL) HCT (%)	14.06	13.91 42.48	14.13 42.83	
	HGB (g/dL) HCT (%)	43.08			
		14.10			
		43.46			
	MCV (fL) MCV (fL)	82.61	77.20 83.14		
		82.67			
Volume XXI Issue III Version I D D D D)	MCHC (g/L) PLT (× 10 3) LYM (× 10 3)	27.04	26.84 32.67 278.52 2.10 0.75 2.25 41.68 27.43 32.99 262.37 2.41 0		
		32.69			
	NEUT (× 10 3) MIX (× 10 3) LYM (%)	263.86			
		2.20 0.73			
	MCH (pg) MCH (pg)	2.49 6 41.			
	MCHC (g/L) PLT (× 10 3) LYM (× 10 3)	4 26.96			
		32.54			
	MIX (× 10 3) NEUT (× 10 3)	266.74			
		2.12 0.67			
		2.59			
Medical Research (	MIXD (%) NEUT (%) RDW-CV (%) RDW-SD (%) PDW (%) MPV (fL) P-LCR (fL) PCT (ng/ml) MPV (fL) RDW-CV (%) RDW-SD (%) PDW (%) LYM (%) MIXD (%) NEUT (%)	13.71	15.11 42.37 16.26 42.34 15.59 12.71 26.81 0.29 11.01 14.02 42.69		
		44.43			
		14.08			
		42.78			
		16.78			
		11.23			
		28.30			
		0.29 11.41			
		14.11			
		43.06			
		16.84			
		40.08			
		12.57			
		46.61			
	P-LCR (fL)	29.04	27.38		
	PCT (ng/ml)	0.30	0.29		
	© 2021 Global Journals				

[Note: I I© 2021 Global Journals]

Figure 6: Table (7

(

	Complete blood count	Frequency of smoking (daily)		Overall mean	P value
		< 10	? 10		
	WBC (× 10 3)	4.27	6.01	5.38	0.0473
	RBC (× 10 3)	5.27	5.13	5.24	0.3669
	HGB (g/dL)	14.12	13.80	14.06	0.3188
	HCT (%)	43.31	42.18	43.08	0.2127
	MCV (fL)	82.65	82.45	82.61	0.9104
Volume	MCH (pg) MCHC (g/L)	27.06 32.69	26.99	27.04 32.69	0.9342 0.9085
XXI	PLT (× 10 3) LYM (×	268.55 2.23	32.73	263.86 2.20	0.4955 0.2790
Issue	10 3) MIX (× 10 3)	0.71	245.10	0.73	0.3690
III			2.07 0.82		
Ver-					
sion					
I					
D D	NEUT(× 10 3)	2.54	2.28	2.49	0.5985
D D)					
I					
(					
Medical	MIXD (%) NEUT (%)	13.11 44.52	16.11	13.71 44.43	0.1775 0.9267
Re-	LYM (%)	42.10	44.08	41.64	0.5710
search			39.82		
	RDW-CV (%)	14.12	13.91	14.08	0.0932
	RDW-SD (%)	42.98	41.99	42.78	0.1453
	PDW (%)	16.74	16.94	16.78	0.7147
	MPV (fL)	11.23	11.21	11.23	0.9414
	P-LCR (fL)	28.34	28.13	28.30	0.8401
	PCT (ng/ml)	0.30	0.27	0.29	0.1809

Figure 7: Table (9

.1 Availability of data and materials

The datasets generated during and / or analyzed in this study are not publicly available due to ethical policy in order to protect participant confidentiality.

.2 Competing interest

The authors declare that they have no competing interests.

.3 Funding

.4 No funding was obtained for this study

.5 Authors contributions

AA, AI, AS and, AH contributed in literature search and manuscript writing. AI and AS had the main idea of the study and contributed to manuscript writing, AA contributed to clinic work, AH contributed to statistical analysis. AA supervised the study and, critically reviewed the manuscript. All authors read and approved the final draft of the manuscript.

[Naser Mohammed Ergiah, Zaed Mohammed Jaber, Jamal Mahmoud Al-Ayadi ()] , *EFFECT OF CIGARETTE SMOKING ON SOME HAMATOLGICAL BARAMETERS MESALLATA CITY* Naser Mohammed Ergiah, Zaed Mohammed Jaber, Jamal Mahmoud Al-Ayadi (ed.) 2017. 1.

[Niknamia et al. ()] *A smoking initation among Iranian adolescents a qualitive study. La Revue de sante de Ia mediterranee orientale*, S H Niknamia , F Ahmedi , G Babaee-Rouchi , Heidarnia . 2008. 14 p. .

[Hioki et al. (2001)] 'Acute effects of cigarette smoking on platelet-dependent thrombin generation'. H Hioki , N Aoki , K Kawano , M Homori , Y Hasumura , T Yasumura , A Maki , H Yoshino , A Yanagisawa , K Ishikawa . *European Heart Journal* 2001 Jan 1. 22 (1) p. .

[Guzel et al. ()] 'Alterations of the hematologic cells in synthetic cannabinoid users'. Derya Guzel , Ahmet Bulent Yazici , Esra Yazici , Atila Erol . *J Clin Lab Anal* 2016. 31 p. e22131.

[Amaechi et al. ()] *Assessment of Counts of Cannabis sativa Smokers in Ekpoma, Edo State, Nigeria. Archives of Current Research International*, R Amaechi , I O Babatope , . O Abulele , B N Obodo . 2020. p. .

[Russo ()] *Cannabis and cannabinoids: pharmacology, toxicology, and therapeutic potential*, E B Russo . 2013. London: Routledge.

[Osman and Mustafa ()] *Complete Blood Cells Count in Sudanese Cigarette Smokers in Khartoum North*, Rawia Osman , Ali Mustafa . 2011.

[Higuchi et al. (2016)] *Current cigarette smoking is a reversible cause of elevated white blood cell count: Cross-sectional and longitudinal studies. Preventive medicine reports*, T Higuchi , F Omata , K Tsuchihashi , K Higashioka , R Koyamada , S Okada . 2016 Dec 1. 4 p. .

[Amna et al. ()] 'Effect of cannabis sativa on Haematological Indices in Rats and Men'. H Amna , Nebiela M Mukhtar , Elbagir . *Pakistan Journal of Nutrition* 2011. 10 (4) p. .

[Salma et al. ()] 'Effect of Cannabis Smoke (Bango) on Complete Blood Cell Count among Sudanese Addicts'. Najla Salma , Homri , E Selma , Abdalla , M M Omnia , Siddig . *Interntional Journal of Innovative Science and Research Technology* 2019. 4 (12) p. .

[Asif et al. (2013)] 'Effect of cigarette smoking based on hematological parameters: comparison between male smokers and non-smokers'. M Asif , S Karim , Z Umar , A Malik , T Ismail , A Chaudhary , M Hussain Alqahtani , M Rasool . *Turkish Journal of Biochemistry/ Turk Biyokimya Dergisi* 2013 Jan 1. 38 (1) .

[Malenica et al. (2017)] 'Effect of cigarette smoking on hematological parameters in healthy population'. A Malenica , M Prnjavorac , B Bego , T Dujic , T Semiz , S Skrbo , S Gusic , A Hadzic , A Causevic , A . *Medical Archives* 2017 Apr. 71 (2) p. 132.

[Shola et al. ()] 'Effect of Marijuana Smoking on Some Haematological Parameters of Smokers'. Bashiru Shola , Oluwaranti Fausat Victor Adegboye Togun , Taiwo . *Word Journal of Medical Science* 2006. 1 (2) p. .

[Sherke et al. ()] 'Effect of number of cigarettes smoked per day on red blood cell, lecocyte and platelet count in adult Indian male smokers-A case control study'. B A Sherke , K Vadapalli , D V Bhargava , A R Sherke , M M Gopireddy . *International Journal of Medical Research & Health Sciences* 2016. 5 (2) p. .

[Brar S ()] 'Effect of smoking on red blood cells count, hemoglobin concentration and red cell indices'. Brar S . *Group* 2014. 31 p. 40.

[Dinesh et al. ()] 'Effect of smoking on total WBC count and platelet count. 48'. J Dinesh , N Ravindra , W Balai , C Himanshu , D Mukesh , J Sangeeta . *Int J Int Med Res* 2015. 2 p. .

[Lymperaki et al. (2015)] 'Effects of acute cigarette smoking on total blood count and markers of oxidative stress in active and passive smokers'. E Lymperaki , K Makedou , S Iliadis , E Vagdatli . *Hippokratia* 2015 Oct. 19 (4) p. 293.

[Nadia et al. (2015)] 'Effects of Cigarette and Shisha Smoking on Hematological Parameters: An analytic case-control study'. M M Nadia , H A Shamseldein , A S Sara . *IMJH* 2015 Dec. 10 p. .

[Huesis ()] 'Human Cannabinoid Pharmacokinetics'. Marilyn A Huesis . *Chemistry & Biodiversity* 2007. 4 (8) p. .

[Daloee et al. (2017)] *Impact of cigarette smoking on serum pro-and antiinflammatory cytokines and growth factors. American journal of men's health*, M H Daloee , A Avan , S R Mirhafez , E Kavousi , M Hasanian-Mehr , S Darroudi , M Tajfard , M Tayefi , H Qazizade , A Mohammadi , N Ferydouni . 2017 Jul. 11 p. .

[Cochrane and O'regan ()] 'Legal harvest and illegal trade: Trends, challenges, and options in khat production in Ethiopia'. L Cochrane , D O'regan . *International Journal of Drug Policy* 2016. 30 p. .

[Mummadi et al. ()] *Smoking and Abnormalities in Complete Blood Count: Insights from The Nhanes*, S R Mummadi , R Mishra , A Kumbam , H Avella , P Hahn . 2004-2015. 2017 May. American Thoracic Society. p. .

[Wogtyla et al.] *smoking during pregnancy_heamatological obserbations in pregnant women and their now borns after delivery annals of Agricultural and Environmental Medicine*, C Wogtyla , L Gluszek , P Bilinski , P Warzocha , K . AAEM 2012:19:836_84.

[Vij ()] *Textbook of Forensic Medicine and Toxicology: Principles and Preactice*, Vij . 2012. India: Elsevier. p. 672.

[Turcotte and Laviolette ()] *The CB2 receptor and its role as regulator of inflammation. Cellualr and Molecular Life Sciences*, Caroline Turcotte , Marie Renee Michel Laviolette . 2016. 73 p. .

[Lu and Creager (2004)] *The relationship of cigarette smoking to peripheral arterial disease. Reviews in cardiovascular medicine*, J T Lu , M A Creager . 2004 Dec 30. 5 p. .

[Alkhedaide (2020)] 'Tobacco smoking causes secondary polycythemia and a mild leukocytosis among heavy smokers in Taif City in Saudi Arabia'. A Q Alkhedaide . *Saudi Journal of Biological Sciences* 2020 Jan 1. 27 (1) p. .