بسم الله الرحمن الرحيم

Sudan University of Science and Technology
College of Graduate Studies

Evaluation Of The Impact Of Cigarette Smoking On Platelets Parameters Among Sudanese Males In Khartoum State

تقويم تأثير التدخين علي تعداد ومؤشرات الصفائح الدمويه عند المدخنين السودانيين في ولاية الخرطوم

Thesis submitted for partial fulfillment of the requirement for M.Sc degree in Medical Laboratory Sciences - Hematology and Immunohematology

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(2016)

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الآية

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قال تعالى:-

(قَالُواْ سُبْحَانَكَ لاَ عِلْمَ لَنَا إِلاَّ مَا عَلَّمْتَنَا إِنَّكَ أنتَ الْعَلِيمُ الْحَكِيمُ)

صدق الله العظيم

سورة البقرة ـ الآية(32).

Dedication

I dedicate this research study to all of my teachers who teach me any letter in any steps in my learning levels, to my family who help and stand with me to collect my samples, to my friends and college, to my faculty members in the Haematology laboratory, to everyone who wish the best for me.

Acknowledgment

Thanks at first and last for the light of our life our God Allah who gave us the strength and good health while doing this   project and guided us through the way in this life and for Prophet Mohammed the prayer and peace from Allah to him. Then i would like to express my special thanks for my family, friends and for Dr:Munsoor Mohammed Munsoor for this great efforts of supervising and leading us through this project, for all person who trust with me and allowed me to take the sample and complete the study. Finally to every person gave me something to light my pathway, we thank them for believing in me and who gave my study the importance that deserved.

Abstract

This is analytical cross sectional study conducted in Khartoum state during the period from March 2019 to February 2020 to evaluate the effect of cigarette smoking on platelet count and indices on Sudanese males.

Materials and methods: Fifty (50) samples were collected from smokers and fifty (50) samples were collected from non-smokers as control, all participants were informed about the study and informed consent for participation was obtained. The age of smokers between eighteen (18) and sixty (60) years and consume one cigarette per day, and not suffer from bleeding, diabetes mellitus or hypertension.

Three millimeters venous blood samples were collected in ethylene diamine tetra acetic acid (EDTA) containers. The platelet count (PLT), mean platelet volume (MPV), plateletcrit (PCT) and platelet distribution width (PDW) were investigated using haematological analyzer (sysmex KX-21N) and obtain data by (SPSS) computer program version 20 was used for data analysis.

Results: The result of this study revealed that was significant decrease in PLT count (Mean ± SD 216.1 ± 67.9, P.value =0.01), and significant decrease in PCT (Mean ± SD 205.5 ± 59.2, P.value=0.04) and MPV (Mean ± SD 11.0 ± 9.6, P.value=0.21) in the smokers when comparing to nonsmokers (Mean ± SD 245.8 ± 47.5), (Mean ± SD 226.5 ± 45.2), (Mean ± SD 9.3 ± 1.2) respectively. While PDW (P.value=0.23) showed no significant difference between smokers and non-smokers (Mean ± SD 13.1 ± 3.0) ((Mean ± SD 13.8 ± 2.5) respectively.

This decrease was related to the number of cigarettes per day and intensity of smoking but not related to the age.

Conclusion: There is statistical decrease in platelet count, PCT and MPV among cigarette smokers when compared with nonsmokers. PDW show no differences between smokers and nonsmokers.

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الخلاصه

هذه دراسة مقطعية تحليلية أجريت في ولاية الخرطوم خلال الفترة من مارس 2019 إلى فبراير2020 لتقييم تأثير تدخين السجائر على تعداد الصفائح الدموية والمؤشرات على الذكور السودانيين.

المواد والطرق: تم جمع خمسين (50) عينة من المدخنين وخمسين (50) عينة من غير المدخنين كمجموعة تحكم ، وتم إبلاغ جميع المشاركين بالدراسة وتم الحصول على الموافقة المسبقة للمشاركة. تتراوح أعمار المدخنين بين ثمانية عشر (18) وستين (60) سنة ويستهلكون سيجارة واحدة في اليوم ولا يعانون من نزيف أو داء السكري أو ارتفاع ضغط الدم.

تم جمع عينات دم وريدية بثلاثة مليمترات في حاويات إيثيلين ديامين تترا حمض الخليك (EDTA). تم فحص عدد الصفائح الدموية (PLT) ، متوسط حجم الصفائح الدموية (MPV) ، الصفائح الدموية (PCT) وعرض توزيع الصفائح الدموية (PDW) باستخدام محلل الدم (sysmex KX-21N) وتم استخدام الإصدار 20 من برنامج الكمبيوتر (SPSS) للحصول على البيانات.

النتائج: أظهرت نتيجة هذه الدراسة انخفاض معنوي في عدد PLT (متوسط ± SD 216.1 ± 67.9 ، قيمة.P=0.01) ، وانخفاض معنوي في PCT (متوسط ± SD 205.5 ± 59.2 ، قيمة .P = 0.04) و MPV (المتوسط ± SD 11.0 ± 9.6 ، القيمة = 0.21)لدى المدخنين عند المقارنة مع غير المدخنين (المتوسط ± 245.8 ± 47.5) ، (المتوسط ± SD 226.5 ± 45.2) ، (المتوسط ± SD 9.3 ± 1.2) على التوالي.

بينما لم يظهر PDW (قيمة.p= 0.23) فرق معنوي بين المدخنين وغير المدخنين (المتوسط ± SD 13.1 ± 3.0) (المتوسط ± SD 13.8 ± 2.5) على التوالي.كان هذا الانخفاض مرتبطًا بعدد السجائر في اليوم ومدة التدخين ولكن لا يرتبط بالعمر .

الخلاصة: هناك انخفاض احصائي في عدد الصفائح الدموية ، PCT و MPV بين مدخني السجائر بالمقارنة مع غير المدخنين. لا تظهر PDW أي اختلافات بين المدخنين وغير المدخنين.

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List of abbreviations

Abbreviation	Term
μm	Micrometer
CBC	Complete blood count
CNS	Central nervous system
DC	Direct current
EDTA	Ethylene diamine tetra acitic acid
FL	Femtolitre
LCD	Liquid crystal display
MPV	Mean platelet volume
PCT	Plateletcrit
PDW	Platelet distribution width
PLT	Platelet
RBCs	Red blood cells
WBCs	White blood cells
WHO	Word health organization

Chapter One

Introduction

Chapter One

Introduction

1.1 Introduction:

Smoking is one of the most preventable causes of death in our society. The chemicals in cigarettes and tobacco make the smoke which is emitted from smoking them, harmful. Cigarette smoking is the most common type of tobacco use. In average, to date 47.5 % of men and 10.3 % of women are current smokers. Tobacco continues to be the second major cause of death in the world (Yanbaeva,*et al,* 2007). WHO in 2004 projected 58.8 million deaths to occur globally, from which 5.4 million is tobacco -attributed and 4.9 million as of 2007? As of 2002, 70% of the deaths are in   developing countries (WHO, 2008; WHO, 2009). Scientists have identified about 4,000 different substances in tobacco all of which have certain degree of toxic effects. At least 43 of them are known carcinogens.Smoking has both acute and chronic effect on haematological parameters (Mcbride, 1992).A cigarette smoker is exposed to a number of harmful substances including nicotine, free radicals, carbon monoxide and other gaseous products. All these substances potentially affect atherogenesis and thrombosis (Freman,*et al*, 1985). Nicotine is now speculated to be responsible for development of dependence and suppresses immunity while carbon monoxide and other combustion substances are responsible for smoking related cardiovascular disorders (Prince,*etal*, 1999)Cigarette smoking alter blood parameters and as well that leads to death. Agents in smoke have a direct irritant effect on the tracheobronchial mucosa, producing inflammation. Atherosclerosis, myocardial infarction, also been strongly linked to cigarette smoking; causal including increased platelet aggregation (Vinay, *et al*, 2003)

The hyper thrombotic state in smokers may be due to increase in the platelet agreeability and increased platelet activity which initiate clot formation leading to occlusive vascular disease, the most aggregating agent elevated in smokers is epinephrine and nor epinephrine and this due to nicotine induced stimulation of adrenal medulla, epinephrine bind to specific receptor on platelet, stimulates prostaglandin synthesis from the platelets (Yanbaeva, *et al*, 2007).The health effects of smoking includes; wrinkling of the skin, bad breath, smelling cloths and hair, yellowish fingers and finger nail, increased risk of

macular degeneration (cause blindness in the elderly due to vascular degeneration, stained teeth, tobacco associated with chronic obstructive pulmonary disease, increased airway reactivity, and increased frequency of pulmonary infection (Oni, *et al*, 2007)

1.2 Rationale:

Cigarette smoking is one of the major life style factors affecting the health and the incidence is still increased. Cigarette smoking is considered as a risk factor for hyper thrombotic state and this study to know the effect of smoking on platelet count and its parameters because many studies have been included to study the effect of smoking on platelet count but different results were obtained. Also to highlight the importance and role of platelets indices in diagnosis platelets disorders

1.3 Objectives:

1.3.1 General objective:

Evaluation of the effect of cigarette smoking on platelets parameters among smokers in Khartoum, Sudan.

1.3.2 Specific objectives:

1. To measurement of Platelets count, Mean Platelets Volume, Plateletcrit, Platelet Distribution width in the study population.

2. To determine the relationship between intensity and duration of cigarette use and platelets count and indices.

3. Tocompare Platelets count, Mean Platelets Volume, Plateletcrit, Platelet Distribution width between cigarette smokers and non-smokers group.

Chapter two

Literature review

Chapter two
Literature review

2.1Blood:

Blood is a body fluid in humans and other animals that delivers necessary substances such as nutrients and oxygen to the cells and transports metabolic waste products away from those same cells.In vertebrates, it is composed of blood cells suspended in blood plasma. Plasma, which constitutes 55% of blood fluid, is mostly water 92% by volume(Alberts,2012)and contains proteins, glucose, mineral ions, hormones, carbon dioxide (plasma being the main medium for excretory product transportation), and blood cells themselves.The blood cells are mainly red blood cells (also called RBCs or erythrocytes), white blood cells (also called WBCs or leukocytes) and platelets (also called thrombocytes).

2.2Platelets:

Also called thrombocytes is a component of blood whose function along with the coagulation factors is to react to bleeding from blood vessel injury by clumping, thereby initiating a blood clot (Laki,1972) platelets have no cell nucleus, they are fragments of cytoplasm that are derived from the megakaryocytes(Machlus,*et al,* 2014)of the bone marrow, which then enter the circulation. Circulating inactivated platelets are biconvex discoid (lens-shaped) structures (Elert, 2012):117–18 2–3 µm in greatest diameter (Machlus, *et al*,2014) Activated platelets have cell membrane projections covering their surface. Platelets are found only in mammals, whereas in other vertebrates (e.g. birds, amphibians) thrombocytes circulate as intact mononuclear cells (Laki, 1972).

2.3 Platelet function:

One major function of platelets is to contribute to hemostasis: the process of stopping bleeding at the site of interrupted endothelium. They gather at the site and unless the interruption is physically too large, they plug the hole. First, platelets attach to substances outside the interrupted endothelium: adhesion. Second, they change shape, turn on receptors and secrete chemical messengers: activation. Third, they connect to each other through receptor bridges: aggregation (Jain, 1975). Formation of this platelet plug (primary hemostasis) is

associated with activation of the coagulation cascade, with resultant fibrin deposition and linking (secondary hemostasis). These processes may overlap: the spectrum is from a predominantly platelet plug, or "white clot" to a predominantly fibrin, or "red clot" or the more typical mixture. Some would add the subsequent retraction and platelet inhibition as fourth and fifth steps to the completion of the process and still others would add a sixth step, wound repair (Michelson andAlan, 2013).Platelets also participate in both innate and adaptive intravascular immune responses (Paulus, 1975).

2.4 Platelet count (PLT):

Anormal platelet count ranges from 150,000 to 450,000 platelets per microliter of blood. Having more than 450,000 platelets is a condition called thrombocytosis having less than 150,000 is known as thrombocytopenia. You get your platelet number from a routine blood test called complete blood count (CBC).

2.5 Platelet indices:

Circulatory platelets are very different in size, metabolism and functional activity. The largest are more reactive and produce a great quantity of thrombogenic factor(Martin, *et al*, 1983; Thompson, *et al*, 1984).

The platelet parameter which includes the platelet distribution width, mean platelet volume, platelet large cell ratio and Plateletcrit,have been available in the laboratory routine using blood cell counters (Giovanetti, *et al*, 2011).

When blood comes in contact with EDTA, platelet rapidly change shape from disk with diameters of 2 to 4 micron to spheroids covered with filamentous extension. The platelet spherical transformation is initially iso-volumetric, but within 1to2 hours, the volume progressively changes to reach an equilibrium condition (Bowles, *et al*, 2005).

2.6 Plateletcrit (PCT):

PCT is the volume occupied by platelets in the blood as a percentage and calculated according to the formula PCT = platelet count × MPV / 10,000. Under physiological conditions, the amount of platelets in the blood is maintained in an equilibrium state by regeneration and elimination. The normal range for PCT is 0.22–0.24%. In healthy subjects, platelet mass is closely regulated to keep it constant, while MPV is inversely related to platelet counts. Genetic and acquired factors, such as race, age, smoking status, alcohol consumption, and physical activity, modify blood platelet count and MPV.

2.7 Platelet distribution width(PDW):

PDW is an indicator of volume variability in platelets size and is increased in the presence of platelet anisocytosis(Osselaer,*et al,1997*). PDW is a distribution curve of platelets measured at the level of 20% relative height in a platelet-size distribution curve, with a total curve height of 100 %(Sachdev,*et al,* 2014).

PDW directly measures variability in platelet size, changes with platelet activation, and reflects the heterogeneity in platelet morphology (Wiwanitkit, 2004; Vagdatli, *et al, 2010*). Under physiological conditions, there is a direct relationship between MPV and PDW; both usually change in the same direction (Vagdatli,*et al*,2010).Normal range of PDW 8.7-15.7FL (Awad, *et al*, 2015).

2.8 Mean platelet volume (MPV):

MPV is a reflection of megakaryocyte. Its increased in conditions associated with increased platelet turnover. The platelet mass remains constant in normal individuals. The MPV falls with increasing platelet counts in a non-linear manner. The effect of storage in EDTA on MPV depends on the method use to perform the platelet count. The MPV increase if measured in an impedancecounter because of a change in volume of platelets.When measured by optical methods the MPV decrease nearly 10% possible because of a fall in the retractile index of the platelets because of dilution of cytoplasmic contents(Bowles *et al*,2005).normal range of MPV 8.4-11.4 FL (Awad, *et al*, 2015).

2.9 Smoking:

Is a practice in which a substance is burned and the resulting smoke breathed in to be tasted and absorbed into the bloodstream. Most commonly, the substance used is the dried leaves of the tobaccoplant, which have been rolled into a small square of rice paper to create a small, round cylinder called a "cigarette". Smoking is primarily practiced as a route of administrationfor recreational drug use because the combustion of the dried plant leaves vaporizes and delivers active substances into the lungs where they are rapidly absorbed into the bloodstream and reach bodily tissue.

2.10 Difinition of cigarette:

Is a narrow cylinder containing psychoactive material, usually tobacco, that is rolled into thin paper for smoking. Most cigarettes contain a "reconstituted tobacco" product known as "sheet", which consists of "recycled [tobacco] stems, stalks, scraps, collected dust, and floor sweepings", to which are added glue, chemicals and fillers; the product is then sprayed with nicotine that was extracted from the tobacco scraps, and shaped into curls (Abinoff, *et al,*2007).

The term cigarette, as commonly used, refers to a tobacco cigarette but is sometimes used to refer to other substances, such as a cannabis cigarette. A cigarette is distinguished from a cigar by its usually smaller size, use of processed leaf, and paper wrapping, which is typically white. Cigar wrappers are typically composed of tobacco leaf or paper dipped in tobacco extract.

2.11Chemicals in Cigarette Smoke:

Experts say that cigarette smoke contains over 4,000 different compounds. A significant number of them are toxic (poisonous) and can damage our cells and many of them are carcinogenic (cause cancer). The most abundant ones are:

- Lead - lead damages the nerves in the brain, as well as the kidneys and the human reproductive system.
- Nitric Oxide - this is a major contributor to smog and acid rain. It is made by gasoline combustion.
- Phenol - this highly toxic substance is harmful for the CNS, cardiovascular system, respiratory system, the kidneys and liver.

- Pyridine - irritates the eyes and upper respiratory tract. It also causes nervousness, headaches and nausea.
- Toluene - causes confusion, memory loss, nausea, weakness, anorexia, and drunken movements.
- Nicotine - this is not carcinogenic. However, it is highly addictive. Smokers find it very hard to quit because they are hooked on the nicotine. Nicotine is an extremely fast-acting drug. It reaches the brain within 15 seconds of being inhaled. If cigarettes and other tobacco products had no nicotine, the number of people who smoke every day would drop drastically. Without nicotine, the tobacco industry would collapse. Nicotine is used as a highly controlled insecticide. Exposure to sufficient amounts can lead to vomiting, seizures, depressionof the CNS (central nervous system), and growth retardation.
- Carbon Monoxide - this is a poisonous gas. It has no smell or taste. The body finds it hard to differentiate carbon monoxide from oxygen and absorbs it into the bloodstream.

Tar - consists of several cancer-causing chemicals. When a smoker inhales cigarette smoke, 70% of the tar remains in the lungs. Try the handkerchief test. Fill the mouth with smoke, don't inhale, and blow the smoke through the handkerchief (Christian, 2015).

2.12Previous studies:

The result of study conducted in Nigerian by (Aghaji M *et al*.1990) involved 176 smokers and 176 non-smokers to determine the relationship of white cells and platelet count in cigarette smoking. Showed that platelet count was higher for regular Nigerian smoker than for non-smoker was statistically significant (t=2.64 p= 0.0046).

The result of cross sectional study conducted in Thai police in Bangkok by (Sirwansaksri J *et al*.2004) to compare platelet count and parameters in 25 smokers and 5 non-smokers. Showed that platelet count and parameters of the subjects were not significantly different.

In 2013, Varol E *et al* studied the value of MPV in 116regular smokers (57 females & 59 males) and 90 healthy non-smokers (49 females and 41 males) The MPV values were significantly higher in smokers than non-smokers (8.8 ±0.9 vs. 8.0 ±0.8 fl, respectively; p< 0.001).

Gitte RN *et al* in 2011, studied the effect of cigarette smoking on plasma fibrinogen and platelet count in 125 healthy smokers and 125 healthy non-smokers in India, the platelet count was done by using Beckman Coulter Automatic Analyzer; AcT5diffCP. The mean platelet count for smokers was 257325 per mm^3 and for non-smokers were 215483.3 per mm^3. Platelet count of smokers and non-smokers was statistically significant (p < 0.0001).

The result of study conducted by Parlak A and Kilci H involved 60 smoker's and55 non-smokers to determine the relation between platelet parameters and smoking status. Showed that platelet count were not significantly different between groups. MPV levels were higher in smokers than non-smokers (7.80 ±0.90 vs. 7.57 ± 0.74 respectively, p > 0.05) but statistically not significant.

 PDW levels were also high in smokers compared non-smokers (13.98 ± 1.49 vs. 13.51 ±1.19 respectively, p> 0.05).but not significant difference.

The result obtained by Arslan E *et al* in 2008, in the study which included 56 smokers and 46 non-smokerson MPV and lipid profile in youngmale subjects showed that no significant difference was found for MPV between the groups smoking (8.57±0.8fl) non-smoking (8.67±0.8fl, P =0.66).

The result of study conducted by (Butkiewicz AM *et al*.2006) to study if the smoking affects Thrombopoiesis and platelet activation in women and men. Showed that lower platelet count in smokers than non-smokers (237±39.52 vs. 258±40.81×10^9/L, P=0.0002).

Other study was carried out by (JAMSAI S et al .2004) aimed to compare the PLT count and PLT indices of smoking and non-smoking , there was no significant difference of any parameter between smokers and non-smokers.

Chapter Three

Materials and methods

Chapter Three

Materials and methods

3.1 Study design:

This is descriptive cross sectional analytical study involving smoking males.

3.2 Study area and duration:

The study was conducted in Khartoum, sudan and samples were collected from males attending different places.The study was carried on the duration between March 2019 to February 2020.

3.3 Study population:

A total of 100 healthy adult male subjects aged 18-60 years were recruited as subjects for this study. fifty of them were smokers .Subjects were categorized into three groups; heavy smokers, moderate smokers and light smokers.

Fifty male matched non-cigarette smokers as control. Smokers with bleeding disorders, cardiovascular diseases and diabetes were excluded from the study.

3.4 Inclusion criteria:

Case group were smokers for a minimum period of one year. And must not be smoking any other kinds of smoking (as Shish).

3.5 Exclusion criteria:

Previous history of thrombosis, cardiovascular diseases hypertension and or diabetes mellitus.

3.6 Data collection:

Demographic data was collected from each participant in data collection sheet. Furthermore information's about age, duration and frequency of cigarette smoke use were obtained, a heavy smokers (H) is one that smokes at least 10 sticks of cigarette per day, moderate (M) smokers is one who smokes 5-10 sticks of cigarette per day and light smokers is one who smokes 1-5 sticks of cigarette per day (Loprinzi, *et al,* 2013).

3.7 Ethical consideration:

Written informed consent was obtained from all partivipence who were selected to participate in this study.

3.8 Statistical analysis:

SPSS Software program for analysis of data (mean,standard deviations and P.value) using independent T. test and correlation.

3.9 Sample collection:

Three millimeters of venous blood was drown from each participant into EDTA containers. Platelets count and indices was done using CBC Automatic analyzer in pathology laboratory.

3.10 Methods:

Laboratory analysis was done within 2 hours from the time of collection. On each blood sample, PLT count, MPV, PDW, PCT were obtained by automated cell counter (KX-21).

A blood cell counter sysmex kx21 was used is an automatic multi –parameter cell counter for vitro diagnostic use in clinical laboratories.

The kx-21processes approximately 60 samples per hour. It gives data of 18parameters, as the analysis of results.This is donein fast, accurate and precise way.

3.11 principle of sysmex:

Use DC detection method .The mode, which was chosen, was the whole blood mode. After mixing well, the blood sample was aspirated to pre-determined volume, diluted at the specified ratio, and then fed into each transducer. On both sides of aperture, there are the electrodes between which flows a direct current. Blood cell suspended in the diluent sample pass through the aperture causing adirect currentresistance change between the electrodes. As direct current resistance change, the blood cell size was detected as electric pulse. Blood cell count was calculated by counting the pulse number.

3-12 Reagents and materials:

Commercial close system reagents were provided by sysmex KX-21N operators and consist of: cell pack and stromatolyser: diluents and lysing reagent for use sysmex. Detergent and cell cleaner: use for cleaning solution to remove lysing reagents, cellular residuals and blood proteins remaining in the hydraulics of sysmex automated analyzer (Lewis *et* al, 2006).

3.13 Procedure of the test:

1. The reagent needed was checked for expiry date before use.

2. The power switch was turned on, self-auto rinse background check was automatically performed and vend (vend for analysis) appeared number inputted by pressing sample number then number of sample was entered.

3. Sample was mixed sufficiently, the tube was sited to the sample probe, and in that condition the start switch was pressed, when the LCD screen display analyzing, the tube was removed.

4. After that the unit executes automatic analyses and the result was displayed in the LCD screen, the result was printed out.

Chapter four

Result

Chapter four

4. Result

One hundred healthy Sudanese males were participating in this study.Divided into two groups 50 casesand 50 controls. All participants was in age ranged of 18-60 years old, group the age to see the effect of it and compared with parameters, the most frequent group fall in age range 18-28 year (45%) shown in figure(4-1) . According to gender all participants were male. Intensity of smoking with highest frequency between 10-15years (34%) figure (4-2).

The result of platelets in smokers was higher than non smokers, significant decrease in PLT count (*P.value* =0.01), significant decrease in PCT (*P.value*=0.04) and insignificant decrease in MPV (*P.value*=0.21) in the smokers, while PDW (*P.value*=0.23), showed no significant difference between smokers and non-smokers Table (4-1).

Age had no effect on platelets and parameters; MPV,PDW andPCT had negative correlation with age table(4-2).

The effect of back years smoking (duration) on blood values investigated and show significant difference between groups; PLT count and PCT had positive correlation, while MPV and PDW had negative correlation, table (4-3).

 The group of smokers divided to four sub group according to the number of cigarettes taken per day (less than 5 cigarette\day), (5-10 cigarette\day), (10-15 cigarette\day),(more than 15 cigarette\day) the effect of number of cigarette taken per day on blood value is also investigated and show significant difference; PLT count and PCT had positive correlation, while PMV and PDW had negative correlation, table (4-4).
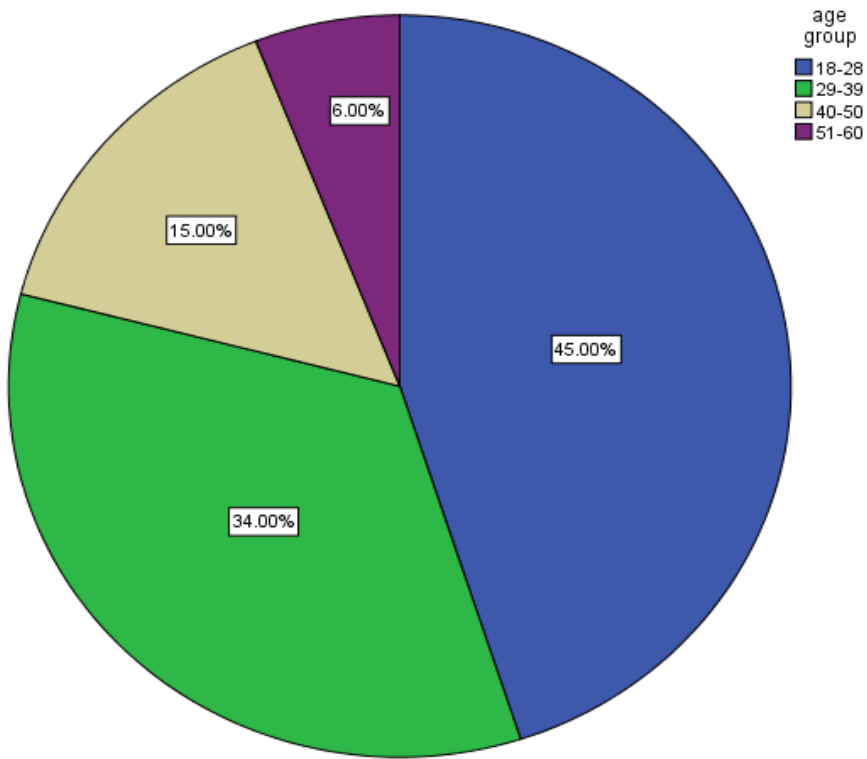
Figure (4-1): Distribution of participants according to their age
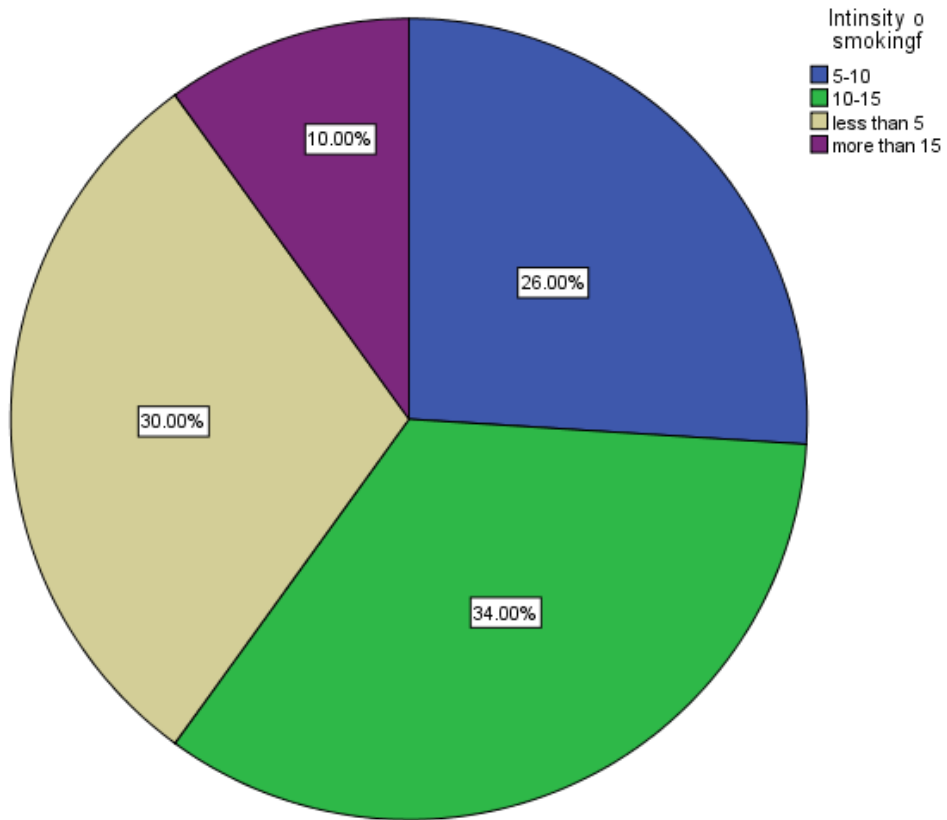
Figure (4-2): Distribution of participants according to the intensity of smoking

Table (4-1) Mean of effect of smoking on platelet parameters among study population:

PLT parameters	Smokers Mean ± SD	Non smokers Mean ± SD	*P.value*
PLT ($\times 10^3$ /µL)	216.1 ± 67.9	245.8 ± 47.5	0.01
MPV(FL)	11.0 ± 9.6	9.3 ± 1.2	0.21
PCT (%)	205.5 ± 59.2	226.5 ± 45.4	0.04
PDW (FL)	13.1± 3.0	13.8 ± 2.5	0.23

Table (4-2) correlation between age and PLT parameters:

PLT parameters	Mean ±STD	P.value
PLT	245.6±47.9	0.78
MPV	9.3±1.2	0.68
PDW	13.7±2.5	0.66
PCT	22.2±3.9	0.69

Table (4-3) correlation between duration of smoking and PLT parameters:

PLT parameters	Mean ±STD	P.value
PLT	216.1±67.8	0.04
MPV	11.0±9.6	0.17
PDW	13.3±3.1	0.78
PCT	20.7±6.9	0.02

Table(4-4) correlation between intensity of smoking and PLT parameters:

PLT parameters	Mean ±STD	P.value
PLT	219.3±78.6	0.03
MPV	14.5±7.6	0.19
PDW	13.5±3.6	0.78
PCT	22.3±6.7	0.04

Chapter five
Discussion

Chapter five
5.1 Discussion

This study was conducted in group of healthy Sudanese smokers, to assess the effect of smoking on PLT parameters. One hundred healthy individuals were enrolled in this study all of them were male age between 18-60 years.

The study revealed significant decrease in platelet count due to among smokers (p=0.01), this result agree with (Butkiewicz, 2006) who stated that platelet count was significantly lower in smokers. And disagree with results obtained by Gitte RN*et al* in India who used Beckman coulter automatic analyzer and Aghaji M. *et al* in Niger who reported that platelet count was significantly higher in smokers. Also disagree with the result obtained by Sirwansaksri J *et al*in Thai police and result of Parlak A and Kilci H who showed that platelet count were not significantly different between smokers and non-smokers.

The MPV was decreased in smokers but statistically not significant (p=0.21), this is similar to a study done by Arslan E., *et al*. But differ from the result obtained by Varol E In 2013 which showsthe values of MPV were significantly higher in smokers than non-smokers. Also disagree with result conducted by Parlak A and Kilci H who showed that MPV levels were higher in smokers than non-smokers but statistically not significant.

The result of PCT show significant decrease between smokers and non -smokers (p=0.04) this result agree withFarahnaz G, *et al*.

The result of PDW showed that there was no differences between smokers and non -smokers (p=0.23) , this is similar to the result of Parlak A and Kilci H who reported that there was no significant differences in PDW between both.

The effect of the smoking on platelet count is not related to the age, but related withthe number of cigarette per day and to the duration of smoking (p= 0.78, p= 0.04, pv= 0.03respectively) as shown in table (4-1), (4-2) and (4-3).

5.2 Conclusion:

It was concluded that there is statistical significant decrease in platelet count,MPV and PCT among cigarettesmokers when compared with non-smokers.

The effect of smoking on them associated with the number of cigarette and the duration of smoking.

PDW showno differencesbetween smokers and non-smokers.

5.3 Recommendation:

1- Lower platelet count in smokers suggests that smoking is bad behaviour so must be stopped.

2-Another study should be done to see the effect of smoking on platelet function, may be due to coagulate state

3-More studies should be done to know which of the component of cigarette has the effect on platelets.

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Appendix I

Sudan University of Science and Technology

Faculty of Medical Laboratory Science

Department of Haematology

Questionnaire about:

Evaluation of the Effect of Cigarette Smoking on Platelet Count and Indices among Sudanese Smokers in Khartoum State.

Name -- age ----------

Sex --------------------------------- phone N -----------------------

History of smoking:

Duration:

Less than 5 years (   )   **5-10 years (   )**

10-15 years (   )   **more than15 years (   )**

 Number of cigarette per day:

Less than 5 per day (   )   **5-10 per day (   )**

10-15 per day (   )   **more than 15 per day(   )**

History of diseases:

Bleeding disorders: yes (   )   **no (   )**

Diabetes: **yes (   )**   **no (   )**

Cardiovascular diseases: yes (   )   **no (   )**

Hypertension: yes (   )   **no (   )**

Appendix Ⅰ Ⅰ

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