



## Original article

## Association between cigarette &amp; shisha smoking and the severity of polycythemia: A cross sectional study

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## ABSTRACT

Tobacco cigarette smoking is assumed to be a key reason of death all over the world. Smoking had both severe as well long-lasting effects on hematological constraints. As per the data available from World Health Organization, every year nearly 5 million individuals die around the world due to the diseases triggered by smoking. Cigarette smoking is linked with an elevated risk of cardiovascular diseases. To examine the association between shisha or cigarette smoking and the severity of polycythemia, present study is a cross-sectional organized at King Saud University Medical City during the period from October 2017 to April 2018. Participants were patients who have hemoglobin level above 160 g/L on multiple reading in KSUMC between May 2015–February 2018. The sample size (227 patients) was computed on single proportion formula. Data were collected through questionnaires and from medical record of the patients. A pilot study was conducted to evaluate the validity of the questionnaire. A statistical analysis was performed using SPSS 21.0 version. A p-value of  $\leq 0.05$  considered as statistically significant. Out of 227 study subjects, 86 (37.8%) were smokers, (61.6%) were cigarette smokers while (29%), shisha smokers. Total (9.3%) were smoking both cigarette and Shisha. 29% patients had high normal hemoglobin between the ranges of (160–168 g/L), 17.6% patients had pre-polycythemic hemoglobin between the range of (169–171 g/L) and 53% patients were having polycythemic hemoglobin ( $>172$  g/L). The hemoglobin level in non-smokers was 168.74 g/L, hemoglobin level in cigarette smokers was 170.7 g/L, hemoglobin level in shisha smokers was 171.4 g/L while hemoglobin level in those who smokes both cigarette and shisha was 175 g/L. Smoking has adverse effects on hemoglobin. Shisha or cigarette Smoking is associated with increase in the hemoglobin levels and the severity of polycythemia. The findings may help in raising the awareness of tobacco smokers.

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## 1. Introduction

Tobacco cigarette smoking is assumed to be a key reason of death all over the universe. Smoking has both severe and long-lasting consequence on hematological constraints. As per the

available data of World Health Organization, every year nearly 5 million individuals die around the world due to the diseases triggered by smoking. Cigarette smoking is linked with an elevated cardiovascular risk diseases, as well as coronary artery disease, peripheral vascular disease ischaemic heart disease, atherosclerosis, myocardial infarction and stroke (Lu et al., 2004; Law et al., 1997; Messner and Bernhard, 2014; Shah and Cole, 2010). The cigarettes are vastly effective source of bringing the addictive nicotine drug by flaming tobacco. It forms an aerosol of ultrafine elements which takes nicotine to the lungs and it is quickly immersed, moves to the left heart and reaches the brain within a short seconds (Glantz and Bareham, 2018). The devastating reason of tobacco-associated disease and death around the world is due to

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the breath of the toxic smoke which is formed by tobacco products especially cigarettes (Abrams et al., 2018). More than 5 million deaths globally were documented with exposure to second-hand tobacco smoke (SHS) (Frazer and Kelleher, 2018). In Arab Countries, the smoking frequency among adolescents is growing depends upon countries. In Saudi Arabia, it ranges from 12 to 29.8%, while in Lebanon 53%, Kuwait 18%, Yemen 43%, and 7% in Oman (Mohammed et al., 2018). The smoking uptake rate follows a pattern which is classified into first, second and third stages. In the first stage, smoking is mainly top within inhabitants in higher socio-economic positions. In the second stage, the behaviour of the population decreases due to elevated occurrence within less rich socio-economic groups. In stage three, the occurrence drops within higher socio-economic groups but remains higher among lower socio-economic status (Mohammed et al., 2018) (see Fig. 1).

Polycythemia or erythrocytosis, indicates an abnormal increase in the circulating red blood cells (RBCs) associated with abnormal increase in hemoglobin levels and total RBC volume. It has two main types: Primary polycythemia, in which affected patients have an inherited or acquired mutation that causes an abnormal proliferation of RBCs progenitors, and Secondary polycythemia where patients have decreased oxygen supply to tissues, resulting the body to compensate by increasing erythropoietin hormone level that causes excessive production of RBCs and elevated levels of hemoglobin (Kumar et al., 2012). Shisha smoking - a kind of tobacco smoking that is originated from the middle east - also called narghile, argileh, hookah, hubble-bubble, and goza, is rapidly gaining more popularity worldwide (Aslam et al., 2014). A cross-sectional study results from Saudi Arabia shows that 4.3% of the inhabitants (7.3% of males and 1.3% of females) using cigarette/cigar and shisha (Moradi-Lakeh et al., 2015). The induced hypoxemia by the elevated level of Carboxy hemoglobin in both cigarette and shisha smoking can contribute in the development of polycythemia (Verma and Patel, 2005). Cigarette smoking has severe adverse effects on haematological parameters e.g., hemoglobin (Malenica et al., 2017).

This study was conducted to raise and promote the awareness about the association between the severity of polycythemia and

shisha smoking. Confirming these correlations may change society's views and attitudes towards shisha usage, and it is actually beneficial to formulate better lifestyle interventions as part of the management to their diagnosis.

## 2. Methodology

The study is a cross-sectional and was conducted at "King Saud University Medical City(KSUMC)" from October 2017 to April 2018. The study was approved by committee of CMED305-F19- 2017-18.

The Inclusion and Exclusion criteria of participants in the study were selected by a Simple random sample of all patients' males and females above 14 years of age and whose hemoglobin level above 16 gm/L on multiple reading at KSUMC during the period between May 2015-February 2018. While those who had a hemoglobin level below 160 g/L, have cancer or hematological diseases other than polycythemia or had no polycythemia's symptoms were excluded.

The population was 10,816 males and 744 females. The size was computed on single proportion formula  $N = Z^2aP(1 - P)/D^2$  at a confidence level of 95% (two- sided) and precision of 5%,  $Z = 1.96$  with adding 10% on the original number to compensate possible losses the sample size is (227 patients). The mobile phone numbers of the patients were chosen as a sampling frame. Phone numbers of the patients were collected from patient's medical records. Random list of numbers were generated by the computer. Patients' mobile phone numbers were the sampling element.

### 2.1. Statistical analyses

Statistical analyses were performed using SPSS version 21. Univariate analyses were performed to compare the hemoglobin ranges between the average age of males, female and both as well as to evaluate the hemoglobin levels in all the groups. A p-value of  $\leq 0.05$  and 95% confidence intervals was used for statistical significance. A Pearson product-moment correlation coefficient was computed to assess the relationship between hemoglobin and smoking.

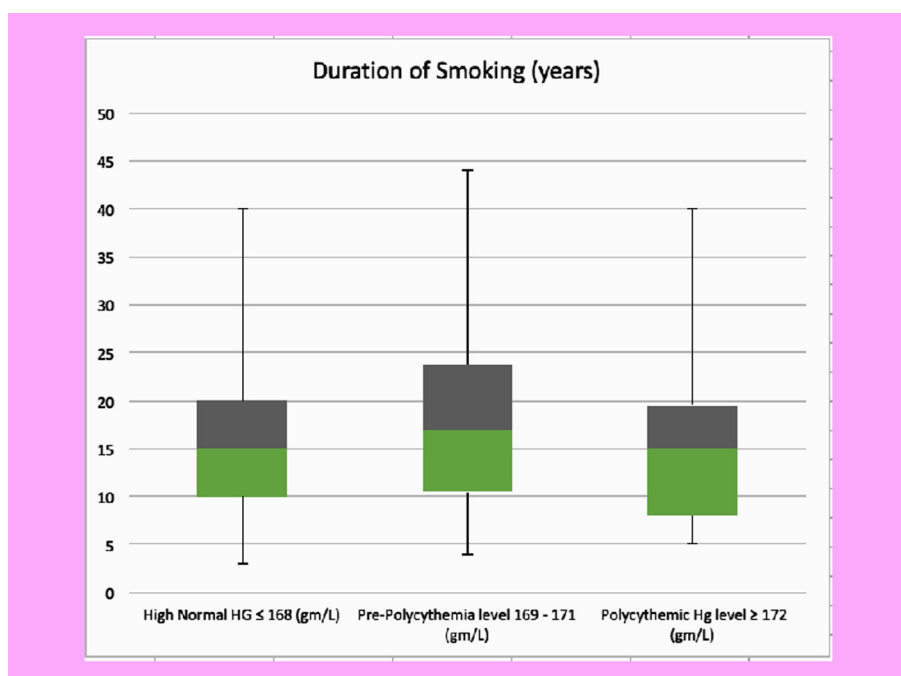


Fig. 1. Distribution of smoking duration among hemoglobin ranges.

### 3. Results

Out of 227 study subjects, 86(37.8%) were smokers including 76 (33.48%) males and 10(0.04%) females. Total 53(23.34%) were cigarette smokers including 52 males and 1 females. 25(11.01%) (17 males and 8 females) were shisha smokers and 8(3.52%) (7 males and 1 female) were both shisha and cigarette smokers.

#### 3.1. High normal hemoglobin range

Out of the 227, 66 (29.7%) had high normal hemoglobin between the range of (160–168 g/L). and among them 54.5% (36 out of 66) was found to be non-smokers, 37.8% (25 out of 66) cigarette smokers, 6% (4 out of 66) shisha smokers and 1.5% (1 out of 66) was both shisha and cigarette smoker. Also, among the non-smokers, 25% mentioned exposure to cigarette and 8% mentioned exposure to both cigarette and shisha on daily basis (Table 5).

#### 3.2. Pre-polycythemic hemoglobin range

Out of the 227, 40 (17.6%) had pre-polycythemic hemoglobin between the range of (169–171 g/L). including 20(50%) non smokers, 10(25% cigarette smokers, 6(15%) were shisha smokers and 4 (10%) were both shisha and cigarette smokers. Also, among the non-smokers, 20% mentioned exposure to cigarette and other 20% mentioned exposure to both cigarette and shisha on daily basis (Table 6).

#### 3.3. Polycythemic hemoglobin range

Out of the 227, 121 (53%) of the sample) had polycythemic hemoglobin (>172 gm/L) and among them 85(70%) be smokers, 14.8% (18 out of 121) cigarette smokers, 12% (15 out of 121) shisha smokers and 2% (3 out of 121) was both shisha and cigarette smokers. Also, among the non smokers, 22% mentioned exposure to cigarette and 3.5% mentioned exposure to both cigarette and shisha on daily basis.

#### 3.4. Average hemoglobin

Among all age groups the average hemoglobin for non smokers is 168.74 gm/L, for cigarette smokers is 170.7 gm/L and for shisha smokers is 171.4 gm/L. Also, interestingly, the average hemoglobin for those who smoked both cigarette and shisha is 175 gm/L. details of mean age for both genders and corresponding mean hemoglobin (Table 1).

#### 3.5. Correlation

There is significant relationship between hemoglobin and smoking,  $r(225) = -0.169$ ,  $p = 0.01$ . The odds of polycythemia severity is 1.114 times higher among smokers than among non smokers (see Table 3).

#### 3.6. Average of smoking habit

In Table 4 we can see that patients with high normal hemoglobin smoke about 1 cigarette per day or 1.6 shisha per day, patients with Pre-Polycythemia hemoglobin smoke about 1.3 cigarette per day or 2 shisha per day and patients with Polycythemic hemoglobin smoke about 1.3 cigarette per day or 2 shisha per day (see Table 2).

### 4. Discussion

Smoking produces decreased oxygen supply to tissues, resulting in increase in erythropoietin hormone causing excessive production of RBCs and elevated levels of hemoglobin, which is a hyper-Coagulable state. This increases the risk of cardiovascular and cerebrovascular catastrophe. In the present study, it was found that hemoglobin concentration, was elevated significantly in cigarette and shisha smokers as compared to non-smokers ( $p < 0.01$ ). The finding of the study are in agreement with study conducted in Sudan which showed significantly elevated hemoglobin content in smokers compared to non-smokers. The study results shows that the level of Hb, HCT, RBCs, TWBC count and MCHC is significantly higher in cigarette and shisha smokers (Shah et al., 2012; Asif et al., 2013; Nadia et al., 2015; Lakshmi et al., 2014).

The previous study results shows that level of hemoglobin in the group of smokers was higher compared to the non-smoker group (Shah et al., 2012). The study recommends that further ample studies in outsized population should be done to take a broad view of these findings (Shah et al., 2012).

The highest percentage of smokers on the basis of number of cigarettes smoked per day were 45% (1–5 cigarettes/day) and showed a significant increase in Hb, PCV, MCV, MCHC and blood cell counts with that of non-smokers. But there is no significance difference related to quantity of cigarettes smoked per day (Whitehead et al., 1995).

Similar to the current study, the study results from India shows that 'elevated hemoglobin', 'total leucocyte count', 'hematocrit', and 'dyslipidemia' were significantly found among the smokers. On the other hand, the elevated RBC count, total leukocyte count, neutrophils and dyslipidemia were significantly found among heavy smokers and forecast that these fluctuations may direct to upcoming serious cardiac diseases among the smokers (Verma and Patel, 2005).

The hemoglobin concentration in blood is often considered as laboratory parameters in clinical practice. The evidence shows that tobacco smoking has influences on hemoglobin parameters in both males and females, which is relative to the quantity of smoked tobacco. Its effect is more noticeable in female genders (Milman and Pedersen, 2009; Verma and Patel, 2005).

It is documented in the previous studies that the elevation in the hemoglobin level in smokers is due to the hypoxemia caused by the elevated level of Carboxy-hemoglobin in both cigarette and shisha smoking leading to the development of polycythaemia.

**Table 1**  
The Socio-demographical and clinical characteristics of Polycythemia.

Variables	Mean (SD)			95% C.I
	Male	Female	Both	
Age	42(15)	53(18)	45(17)	(44.9–45.1)
Hemoglobin level (gm/L)	171(5.9)	166.9(5.7)	169.7(6.2)	(169.6–169.8)
Hemoglobin level in non-smokers	171(6)	167(6.3)	168.74(6.2)	(168.9–169.1)
Hemoglobin level in shisha smokers	169(7)	165(19)	171.4(6.4)	(171.9–172.1)
Hemoglobin level in cigarette smokers	168.9(12.4)	169(0)	170.7(5.6)	(170.3–170.5)
Hemoglobin level in shisha and cigarette smokers	88(2)	168(0)	175(5.5)	(171.9–172)

**Table 2**  
Relation between ranges of Hemoglobin and average age.

Variables	Mean		Both
	Male	Female	
Ranges of Hg (g/L)			
High Normal (<=168)	40	53	50
Pre-Polycythemia (169–171)	42	53	48
Polycythemia(>=172)	42	53	47

**Table 3**  
Odds ratio of polycythemia severity and smoking1: The demographical and clinical characteristics of patients: A descriptive analysis.

Outcome/exposure	Polycythemic Patient	High normal and pre-polycythemic patient	Total
Smokers	36	46	82
Non-smokers	85	121	206
Total	121	167	288

Odds ratio =  $ad/bc = (36 * 121)/(46 * 85) = 4356/3910 = 1.114$ .

**Table 4**  
The average of smoking per day in relation with Hg ranges: characteristics of patients: A descriptive analysis.

Ranges of hemoglobin	Cigarette (Packet)	Shisha (Head)	Both (Packet/Head)
High Normal Hg: 168 (gm/L)	1	1.6	1/0.75
Pre-Polycythemia Hg level: 169–171 (g/L)	1.3	2	0.9/1.2
Polycythemic Hg level:172 (g/L)	1.3	2	3/1.25

**Table 5**  
Cigarette smokers, non-smokers, Shisha and cigarette smokers with high normal hemoglobin range.

SL #	Particulars	(n = 66)
		(%)
1	Cigarette Smokers	54.5
2	Non-smokers	37.8
	(a) Exposure to Cigarette (25%)	
	(b) Exposure to Both Cigarette and Shisha (8%)	
3	Shisha	6
4	Shisha & Cigarette Smokers	1.5

**Table 6**  
Cigarette smokers, non-smokers, Shisha and cigarette smokers with Pre-Polycythemic Hemoglobin Range.

SL #	Particulars	(n = 40)
		(%)
1	Cigarette Smokers	25
2	Non-smokers	50
	(a) Exposure to Cigarette (20%)	
	(b) Exposure to Both Cigarette and Shisha (20%)	
3	Shisha	15
4	Shisha & Cigarette Smokers	10

Further average hemoglobin level for shisha smokers was significantly more in comparison to non-smokers and it is markedly higher for those who are smoking both shisha and cigarette (Khan et al., 2014).

It is important to mention the limitations we faced as there were only few studies done to support our literature review and that is why we suggest further research in this area. For the smoking status we relied on interviews, which are considered as a self-reported data, which contain potential sources of bias.

## 5. Conclusion

Present study concludes that smoking alters hematological parameter. It increases RBC count which can increase viscosity and elevated levels of hemoglobin, which is a hyper-Coagulable state. Which are injurious to health and increases the risk of cardiovascular and cerebrovascular catastrophe.

We found that smoking both shisha and cigarette is a possible risk factor for elevating hemoglobin levels and increasing the severity of polycythemia. This is a serious problem since shisha smoking is gaining more popularity among society. This increase of smoking exposure among individuals is a matter of concern to public health that requires serious implications and policies to prevent further increase of smoking exposure. Awareness campaigns are highly desired.

## Declaration of Competing Interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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