



CODEN [USA]: IAJPBB

ISSN: 2349-7750

**INDO AMERICAN JOURNAL OF  
PHARMACEUTICAL SCIENCES**<http://doi.org/10.5281/zenodo.1239874>Available online at: <http://www.iajps.com>**Research Article****A STUDY ON THE EFFECTS OF SMOKING ON SERUM C-  
REACTIVE PROTEIN, COMPLETE BLOOD COUNTS AND  
MAGNESIUM LEVELS AMONG HEALTHY ADULT MALE  
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**Abstract:**

**Objective:** To examine the effects of smoking on complete blood count, serum C-reactive protein and magnesium levels in adult male smokers.

**Methods:** The control study was conducted in two villages of Gujranwala district in Punjab, Pakistan, from July to December 2016. The subjects used in this study were healthy adult male smokers and equal number of matching non-smokers as controls. The complete blood count, serum C-reactive protein and magnesium levels in all the subjects were measured in order to assess the effect of smoking on these parameters.

**Results:** The 48 subjects had an overall age range of 20-40 years. The complete blood count results were comparable except for lymphocyte. It was significantly higher ( $p < 0.001$ ), and neutrophil was lower ( $p < 0.001$ ) in smokers than in the non-smokers. Serum C-reactive protein concentrations among the cases ( $14.62 \pm 0.16 \text{ mg/L}$ ) compared to the controls ( $4.81 \pm 0.38 \text{ mg/L}$ ) were significantly higher ( $p < 0.001$ ). However, reverse was true for serum magnesium levels which were significantly higher ( $p < 0.001$ ) in the controls ( $2.52 \pm 0.18 \text{ mg/L}$ ) as against the cases ( $1.09 \pm 0.38 \text{ mg/dl}$ ). Serum C-reactive protein-to-magnesium ratio was significantly higher ( $p < 0.001$ ) in smokers than in the non-smokers.

**Conclusion:** Lymphocyte count was found higher while neutrophil count was lower in smokers. Smoking also caused major increase in serum C-reactive protein concentration concomitant to decrease in magnesium concentration in the smokers.

**Keywords:** Smoking, Complete blood counts, C-reactive protein, Magnesium.

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Please cite this article in press Myda Muzaffar et al., A Study On The Effects Of Smoking On Serum C-Reactive Protein, Complete Blood Counts And Magnesium Levels Among Healthy Adult Male Smokers, Indo Am. J. P. Sci, 2018; 05(05).

**INTRODUCTION:**

Smoking is viewed as a noteworthy hazard factor in the pathogenesis of several diseases with an inflammatory component, such as cardiovascular disease (CVD) and chronic obstructive pulmonary disease (COPD) [1,2]. Smoking activates inflammation which is shown by raised plasma levels of inflammatory markers e.g., C-reactive protein (CRP) and white blood cell (WBC) counts [3,4]. CRP synthesis increases dramatically in the liver in response to cytokines released by adipocytes and macrophages [5,6]. It has been observed in a recent study that serum CRP was found at elevated levels in adult males smokers as compared to non-smokers [7]. Moreover, it was also noted that people who had high basal levels of CRP were found at increased risk of developing obesity, diabetes, hypertension and CVD[8,9]. It was also noted that healthy smokers have more insulin resistance as compared to non-smokers. They also had increased glucose levels, much raised insulin levels, almost twice more very low-density lipoprotein (VLDL) cholesterol and 30 percent lower high-density lipoprotein (HDL) cholesterol. Despite the fact that these variables are not immediate measures of magnesium status in smokers but they clearly point out that smoking decreases cellular magnesium levels[10]. There seems to be a connection between hypomagnesaemia and elevated plasma levels of CRP in cellular processes which affect vascular endothelial function in people with obesity[12] and in people with blood pressure (BP) alterations[13].

The current study aimed at finding out the effects of smoking on complete blood count (CBC) and serum levels of CRP and magnesium in healthy adult male smokers. This area of investigating the effect of smoking on CBC and blood levels of magnesium and CRP in healthy adult male smokers has not been examined before, particularly in rural areas.

**MATERIAL AND METHODS**

The prospective case-control study was conducted in two villages of Gujranwala district in Punjab,

Pakistan, from July to December 2016. The subjects of the study were healthy adult male smokers and an equal number of matching non-smokers as controls. The selection of two villages was made on the grounds that majority of the tendencies of male inhabitants towards either active or passive smoking. Whereas the case of other village was opposite. At first the size of population was 125 and with a 0.5 margin of error, the needed sample size calculated by using simplified formula for proportions[14] was 95.24.

The subjects from both the villages were randomly recruited. Their age, weight, height and socioeconomic status were matched. Subjects suffering from any inflammatory diseases or using any medication were excluded. Smokers who were smoking 10 or more cigarettes per day and for three or more years without indication of the exclusion criteria were termed as healthy smokers. Those who never smoked were termed as nonsmokers. CBC along with serum CRP and magnesium levels in all the subjects were measured to assess the effect of smoking on these parameters. Informed written consent was obtained from each subject before taking blood samples, while the approval was obtained from the Ethical Committee of Sheikh Zayed Hospital Lahore. CBC was analyzed using Sysmex Haematology Analyser, while serum CRP and magnesium levels were determined by standard methods using Nyocard and Diasys kits respectively. Data was presented as mean  $\pm$  standard deviation (SD). Comparison of mean values between the cases and the controls was done using student's t- test. Differences were considered significant at  $p < 0.001$ .

**RESULTS:**

Out of total 96 subjects, 48 (50%) each represented the two groups. The age range remained 20-40 years. CBC values for each group were comparable except for neutrophils, which were significantly higher ( $p < 0.001$ ), and lymphocytes, which were significantly raised ( $p < 0.001$ ), in smokers than in non-smokers (Table-1).

**Table-1: Blood CP values compared between healthy adult male smokers and nonsmokers.**

Blood CP	Smokers (n=48)	Non-Smokers (n=48)	P value
Hb g/dl	12.89 ± 2.09	12.70 ± 2.17	0.400
HCT %	40.34 ± 5.94	41.49 ± 4.78	0.342
MCV fl	83.05 ± 9.27	83.07 ± 11.82	0.226
MCH pg	26.55 ± 4.23	25.37 ± 5.09	0.137
MCHC g/dl	31.94 ± 2.19	30.50 ± 2.65	0.315
WBC %	8.38 ± 2.45	8.90 ± 2.62	0.294
Neutrophils %	45.74 ± 1.14	56.65 ± 9.80	<0.001
Lymphocytes %	48.39 ± 1.30	31.10 ± 7.14	<0.001
Platelets x103/ $\mu$ l	273.73 ± 9.01	322.85 ± 9.52	0.223

Hb: Haemoglobin

HCT:Hematocrit

MCV:Mean corpuscular volume

MCH: Mean corpuscular haemoglobin

MCHC:Mean corpuscular haemoglobin concentration WBC: White blood cell Results are presented as Mean ± S.D.

**Table-2: Comparison of serum C-reactive protein and magnesium levels between healthy adult male smokers and non-smokers.**

Serum variable	Smokers (n=48)	Non-Smokers (n=48)	P value
C- reactive protein Normal range			
(<5mg/L)	14.62±0.16	4.81±0.16	<0.001
Magnesium Normal range			
(1.8-2.6mg/dl)	1.09±0.38	2.52±0.18	<0.001

Results are presented as Mean ± S.D.

The mean serum CRP concentration in smokers (14.62±0.16mg/L) was significantly higher (p<0.001) as compared to non-smokers (4.81±0.38mg/L). The mean serum magnesium concentration in non-smokers (2.52±0.18mg/L) compared to smokers (1.09±0.38 mg/L ) was significantly higher (p<0.001) (Table-2).

Serum magnesium level in all smokers was found to be less than 1.8mg/dl, while serum CRP level higher than 10 mg/l. Quite the reverse, all non-smokers had their serum magnesium concentration greater than 2.0mg/dl and serum CRP less than 7.5 mg/L.

The mean CRP-to-magnesium ratio in serum samples of the smokers was 1.63±1.02 against 0.20±0.04 in nonsmokers (p<0.001).

## DISCUSSION:

It was found in the present study that male smokers had significantly higher lymphocytes count and lower counts of neutrophils as compared to healthy adult male nonsmokers. It is in full concurrence with earlier findings[15].

It was also noted in the present study that serum magnesium levels were significantly decreased in smokers. This could happen be due to increased

demand for magnesium by smokers owing to increased release of adrenaline and thermogenic effect of nicotine, which is the important constituent of tobacco. Also, smokers may get less magnesium than nonsmokers because they tend to eat less.

One study[7 ]stated the raised levels of serum CRP in smokers. This is upheld by the findings of the present study.

Another study carried out on magnesium-deficient rats[16] indicated that inflammatory response was an early outcome of magnesium deficiency in rats. This finding is supported by the idea that magnesium inhibits inflammation and decreases CRP levels in chronic diseases[17].

According to one study,18 individuals with less intakeof magnesium were more likely to have had raised serum CRP. The relationship between the low serum magnesium levels and raised CRP concentrations in smokers in the present study suggest that hypomagnesaemia might be responsible for the activated state of immune cells. With a purpose to clarify the role of plasma magnesium deficiency in the aetiology of the inflammatory processes, interventional prospective studies are

needed to be carried out with an aim to examine the effects of magnesium supplementation on serum magnesium and CRP levels in healthy adult male smokers.

In the current study the difference in the mean CRP-to-magnesium ratio in the two groups clearly specifies that smoking increased inflammation. In any case, it will be interesting to see whether the ratio could be used to examine additive effects of smoking on severity and prognosis of diseases with inflammatory component.

#### CONCLUSION:

Smoking decreased serum magnesium concentration significantly and also increased serum CRP concentration, resulting in an inverse relationship between the two in healthy adult male smokers.

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