

Evaluation of Serum Levels of Carbon Monoxide and Lead in Smokers in Nnewi Metropolis

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DOI: <https://doi.org/10.51584/IJRIAS.2024.908005>

Received: 01 July 2024; Revised: 12 July 2024; Accepted: 17 July 2024; Published: 28 August 2024

ABSTRACT

Background: Cigarette smoking is a major source of exposure to carbon monoxide (CO). CO is a colourless, odourless gas that displaces oxygen in the blood, which can lead to a variety of health problems, including heart disease, stroke, peripheral vascular disease, cancer, reduced cognitive function, premature birth, and low birth weight. This study was conducted to evaluate the levels of Carbon monoxide (CO) in active smokers in Nnewi Metropolis.

Methods: This was a cross-sectional study involving 100 participants comprising of 50 smokers and 50 non-smokers, all within the age range of 18-45 years. The participants were recruited by simple random sampling technique. Recruited smokers were grouped based on duration of smoking into those who had smoked for less than 2 years (n = 20), those who had smoked for 2 years to 5 years (n = 19) and those who had smoked for more than 5 years (n = 11). The participants were also grouped based on type of substance smoked into those who smoke cigarette (n=12) alone, those who smoked weed alone (n=20) and those who smoked other substances aside from cigarette and weed (n=18). Carbon monoxide levels was determined by spectrophotometric measurement of carboxyhaemoglobin as it has been validated various researches as valuable for measurement of exposure to carbon monoxide. Independent sample test and Analysis of variance (ANOVA) were used for statistical analysis of data.

Results: The mean \pm SD carboxyhaemoglobin level (4.45 ± 0.86 %) smokers was significantly higher than in non-smokers (carboxyhaemoglobin 1.61 ± 0.21 %, $p < 0.001$). There were no differences in mean levels of carboxyhaemoglobin between individuals who smoke cigarette compared to individuals who smoke weed ($p > 0.05$), individuals who smoked cigarette compared to individuals who smoke other substances ($p > 0.05$) and individuals who smoked weed compared to individuals who smoke other substances ($p > 0.05$). Carboxyhaemoglobin was higher in individuals who have been smoking for more two years and above than in individuals who have been smoking for two years and above ($p > 0.05$).

Discussion And Conclusion: This study observed that carbon monoxide level was higher in active smokers than in non-smokers. This study also observed that carbon monoxide was not dependent on the type of substance smoked. However, duration smoking for less than 2years was characterised by lower COHB% compared with

duration of more than 2 years smoking. Although the levels of carboxyhaemoglobin observed in smoker was below WHO approved permissible level of carbon monoxide in active smokers, the outcome of this study further buttresses the fact that smoking predisposes individuals to carbon monoxide toxicity.

INTRODUCTION

Smoking is the act of inhaling and exhaling smoke from burning tobacco or other substances, such as marijuana and various other herbs and plants^[1]. According to the American Cancer Society^[2], smoking is a major cause of preventable disease and death worldwide and can lead to numerous health problems such as lung cancer, heart disease, stroke, respiratory diseases, and more. Over one billion people smoke globally (men 1 billion women, 250 million) resulting in over 8 million annual deaths with about 1.3 million people of these resulting from second-hand smoke^[3]. Smoke contains more than 7,000 different chemical compounds and about 250 are known to be harmful including carbon monoxide^[4]. Carbon monoxide (CO) is a colourless and odorless gas that is produced by the incomplete combustion of organic materials and it is rapidly absorbed into the bloodstream when inhaled. CO is a well-known toxicant, and exposure to this gas has been associated with a range of negative health outcomes, including headaches, dizziness, nausea, and even death^[5]. When CO is inhaled, it binds to haemoglobin in the blood, forming carboxyhaemoglobin (COHb) with affinity that is approximately 200 times greater than that of oxygen. This reduces the amount of oxygen that can be transported by the haemoglobin in the blood^[6,7]. This can lead to hypoxia, or oxygen deprivation, in vital organs such as the brain and heart, which can result in tissue damage or death^[8]. One pack of cigarettes per day can lead to COHb levels of up to 9% in the blood, which is a significant health risk^[9]. Some of the risk that smoking predisposes smokers to include increased risk of lung cancer, cardiovascular disease, respiratory diseases such as chronic obstructive pulmonary disease (COPD) and emphysema, reduced fertility^[10, 11, 12]. Thus, evaluation of CO in smokers inform the public on the level of exposure as well as the health implication that may be associated with their exposure levels. The study will contribute to the body of knowledge on cigarette smoking and help inform public health interventions aimed at reducing the prevalence of smoking and its associated health implications within the area of study and the society as large.

METHODOLOGY

This was a cross-sectional study designed to evaluate the blood levels of carbon monoxide in cigarette smokers in Nnewi metropolis, Anambra state, Nigeria. Participants were recruited by simple random simple random sampling. The ethical approval for this research was obtained from the Ethics Committee of Faculty of Health Sciences and Technology, Nnamdi Azikiwe University, Nnewi Campus and Ethics Committee of Nnamdi Azikiwe University Teaching Hospital, Nnewi. Written informed consent was obtained from all participants before recruiting them into the study. Fifty (50) male smokers defined as test participants and 50 non-smokers within the age range of 18 years to 45 years were recruited into this study. Non-smokers who live or work around smokers were excluded from the study. The test participants were further grouped based on the type of substance they smoke in those who smoke weed (20), cigarette (12) and other substances (18). Also, the test participants were further grouped based on their duration of smoking into less than 2 years (20), for 2 years to 5 years (19) and for more than 5 years (11). Five (5) millilitres of blood sample was collected from each participants and dispensed into an EDTA container. The blood sample was used for the measurement of Carbon monoxide (CO). Determination of Carboxyhaemoglobin (HbCO) level in the blood was carried out by spectrophotometric method. This spectrophotometric method for estimating carboxyhaemoglobin is based on the production of a two-pigment mixture by reducing oxyhaemoglobin and methaemoglobin with sodium hydrosulfite. These pigment are formed by treating crude hemolysates with sodium hydrosulfite (sodium dithionite). Absorbance of the pigment is measured at 420nm and 432 nm. The colour intensity of the pigment is directly proportional to the concentration of carboxyhaemoglobin in the sample. The statistical analysis was performed using Independent Student's T-test and ANOVA. Values were deemed significant if $p < 0.05$.

Table 1: Mean ± Standard deviation of Carbon monoxide (CO) in all participants

Parameter	Test (n = 50)	Controls (n = 50)	t-value	P-value
Carbon monoxide (%)	4.45 ± 0.86	2.84 ± 1.21	-7.65	<0.001

Table 2: ANOVA Analysis of data in test participants based on the substance smoked

Group	n	CO (%)
Cigarette (A)		3.62 ± 0.31
Weed (B)	12	3.75 ± 0.80
Other Substances (C)	20	3.94 ± 0.59
f-value	18	0.744
p-value		0.481

Table 3: ANOVA Analysis of data in test participants based on the duration of smoking

Group	N	CO (%)
Less than two years (A)		3.44 ± 0.83
Two to five years (B)		3.97 ± 0.56
More than five years (C)	20	3.94 ± 0.64
f-value	19	7.901
p-value	11	0.001
A vs B		0.001
A vs C		0.005
B vs C		0.876

DISCUSSION

Cigarette smoking is a major risk factor for both carbon monoxide (CO) and lead poisoning. Thus, this study was designed to evaluate the blood levels of carbon monoxide (CO) and lead (Pb) in cigarette smokers in Nnewi metropolis.

The result showed a higher blood levels of carbon monoxide in smokers compared to non-smokers. The difference observed in the carbon monoxide levels could be attributed to the fact that carbon monoxide is a toxic gas produced when tobacco is burned, and smokers are exposed to much higher levels of carbon monoxide during smoking than non-smokers. This finding is aligns with various studies that have reported that exhaled CO levels were significantly higher in smokers than in non-smokers, both in areas with high air pollution and in areas with low air pollution^[13]. A study by Ji *et al.*,^[14] found that smokers with higher levels of carbon monoxide in their blood were at increased risk of developing lung cancer. The results of this study suggests that exhaled carbon monoxide evaluation may be a useful biomarker for assessing the risk of lung cancer in smokers.

Also, blood levels of lead was observed to be higher in smokers compared to non-smokers. This could be attributed to a number of reasons; firstly, smoking increases the absorption of lead from the gut. Inhalation of lead-containing tobacco smoke and the absorption of lead from the saliva has been linked to increased levels of lead in the bloodstream^[15]. Secondly, smoking can increase the release of lead from the bones into the bloodstream. The acidity of the blood is increased by smoking, and this acidity may cause lead stored in the bones to be leached out. This could potentially lead to increased blood lead levels and an increased risk of lead-related health problems^[15]. Lastly, this higher levels of lead as observed in smokers could also be as a result of decreased excretion of lead by the kidney. Smoking can damage the kidneys, which can lead to a lower rate of lead excretion^[16]. According to scientific studies, lead is one of the many toxic substances present in tobacco smoke^[17]. The combustion of tobacco releases lead from the leaves of the plant, with an average of 1-2 micrograms of lead per cigarette. The exact amount of lead present in tobacco smoke can vary depending on the type of cigarette, with some brands containing more lead than others. However low-level environmental lead exposure such as blood lead level lower than 10 µg/dL) may accelerate progressive renal insufficiency and can be an important risk factor for cardiovascular mortality in adults^[18]. The available evidence indicates that smoking is associated with increased levels of lead in the blood, which is a concern due to the toxic effects of

lead on the nervous system, kidneys, and other organs^[19].

CONCLUSION

This study observed that carbon monoxide level was higher in active smokers than in non-smokers. This study also observed that carbon monoxide was not dependent on the type of substance smoked. However, duration smoking for less than 2 years was characterised by lower COHB% compared with duration of more than 2 years smoking. Daily consumption of 1 to 3 sticks had lowered CO% compared with those that consume more than 3 sticks per day. Although the levels of carboxyhaemoglobin observed in smokers was below WHO approved permissible level of 5% CO, the outcome of this study further buttresses the fact that smoking predisposes individuals to carbon monoxide toxicity.

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