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Original Research

Exploring the Relationship Between Carboxyhemoglobin Levels and Yogic Breathing among Medical Undergraduate Students

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ABSTRACT
Carbon monoxide is generated when fuels such as charcoal, fuel gas, briquette and petroleum undergo incomplete combustion. This can occur when using appliances like burner, cooking equipment or heater in poorly ventilated area as well as due to faulty water heaters, faulty water heaters, vehicles exhaust emissions, industrial activities and cigarette smoke exposure, resulting in elevated Carboxyhemoglobin levels. The impact of minimal exposure to carbon monoxide on an individual's cognitive functions is not extensively documented as the clinical syndrome in hidden cases presents with a vague clinical picture and limited awareness and understanding in this particular field. A wide range of neurological may occur due to exposure to carbon monoxide including headache, dizziness, fatigue, lethargy, syncope, coma, seizures and potentially fatality at elevated levels. Research has shown that deep breathing exercises can assist in lowering the carboxyhemoglobin levels in indivisuals who smoke. The practice of Pranayama which involves regulating the breath, is a vital element of Yoga tradition. We carried out this research to examine association between Carboxyhemoglobin and Methhemoglobin levels with Yogic Breathing in healthy undergraduate medical students. This research comprises an analytical observational cross sectional study. Study was conducted at Rama Medical College, Hospital & Research Centre and Government Medical College, Jalaun (Orai) those are tertiary medical teaching institute of Uttar Pradesh State of India. Participating in the study were healthy undergraduate medical students. Study Period was scheduled for January 2023. The research was conducted on a group of 100 undergraduate medical students from two different medical institutions. The oxygen saturation level were found to be within normal range (>98%). We observed a notable difference in the Pulse rate ($p<0.05$) and carboxyhemoglobin level ($p<0.02$) across both groups. Practicing Yogic breathing is a beneficial approach to breathing, and therefore promoting the adoption of such healthy habits globally is highly encouraged.

Keywords: Yoga, Pranayama, Carboxyhemoglobin, Methhemoglobin

INTRODUCTION
Carbon monoxide is generated when fuel such as charcoal, fuel gas, briquette and petroleum undergo incomplete combustion. This can occur when using burners, cooking appliances such as heater without proper ventilation, as well as faulty water heaters, and from exhaust emission of vehicles. Industries such as chemical plants, iron foundries can also contribute to the production of this harmful gas. Cigarette smoking can release 3-4%/h COHb saturation in Heavy smokers reaching to 10-15%. The central nervous system is particularly vulnerable to the effects of carbon monoxide poisoning. The impact of mild exposure to carbon monoxide on a person's cognitive functions is not extensively documented as the clinical syndrome in hidden cases presents the vague clinical manifestations

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and limited awareness and understanding in this specific field. The range of neurological symptoms caused by exposure to carbon monoxide can include headache, fatigue, dizziness, fainting, tiredness, unconsciousness, seizures, and potentially death at high concentrations. The preferred treatment for elevated carboxyhemoglobin levels in the blood is respiration with 100% oxygen. Certain studies conducted overseas have suggested that practicing deep breathing exercise can lower the carboxyhemoglobin levels among smokers. Pranayama is a traditional practice from Yoga that involves controlling the breath through methods such as rapid diaphragmatic breathing, alternate nostril breathing, slow and deep breathing, and breathing with a contracted glottis. These exercises are typically performed while seated, ideally in ventilated space. Pranayam involves four elements of breathing: sequential and control inhalation, exhalation, internal breath retention, and external breath retention. It aids in enhancing oxygen level, eliminating toxins from the body and promoting a soothing effect on the mind. The current global fascination with this ancient Indian tradition that dates back 3000 years has sparked a series of research studies exploring the therapeutic benefits of these practices. The studies have shown how Pranayam positively impacts the cardiovascular system enhances respiratory functions and brings balance to nervous symptoms. Nonetheless, no study has been conducted in India exploring the impact of Yogic breathing exercises on carboxyhemoglobin levels. Therefore, we conducted this study to analyze the connection between Carboxyhemoglobn levels and Yogic Breathing among healthy undergraduate medical students.

MATERIALS AND METHODS

We conducted an analytical cross sectional study in January 2024 on medical undergraduate students after receiving approval from the institutional Research Ethical Committee. The participants were selected from undergraduate medical students in all stages following their provision of written informed consent. The study was conducted with 100 undergraduate medical students who (50 students from RMCH & RC, Kanpur and 50 from GMC, Jalaun) willingly agreed to take part by signing the informed consent form. The participants were divided into two groups–the Yoga groups and the Non-Yoga group consisting of an equal number of participants (50), all within the range of 18 to 26 years. Students who regularly engaged in Yogic breathing exercises (Pranayam) were selected to join group-1, also known as Yoga group. The Pranayam routine involves a variety of breathing techniques such as alternate nostril breathing (AnulomVilom), deep inhaling and exhaling with force (Bhastrika), controlled breathing with slight throat constriction (Ujaiyi), rapid exhalation (KapalBharti), and chanting “Ohm” (Bhramri). The students who were not participating in Yogic breathing exercises or Gym training were selected to be part of group-2, also known as the non-Yoga group. Having any hematological, acute, or chronic disease was regarded as an exclusion criterion for participants in both groups. The data collection involves gathering demographic information from both groups, as well as measuring their hematological parameters non-invasively. This included assessing oxygen saturation (SPO2), Pulse Rate (PR), Corboxyhemoglobin (COHb), Methhemoglobin (MethHb) and Perfusion Index (PI) using a Pulse CO-oximeter equipped with an adult type fingertip sensor. Statistical analysis was carried out using Microsoft Excel for data organization, descriptive examination, and data analysis. The student’s t-test was utilized to compare the reading of the participants in the Yoga group with those in non-Yoga group. A probability (*p* value) below 0.05 was regarded as being statistically significant.

RESULT

The mean age of Yoga group and Non Yoga group was found to be 22.4 and 24.6 years respectively. Most of the male belongs to age group 21 to 23 years and most of the female belongs to age group 18 to 20 years (Table No.1 and Graph No.1). Smokers and nonsmokers are mentioned in table no. 2 and graph no. 2. Out of 100 participants there were 65 male and 44 females. Out of 65 males, 49 were in Yoga group and 17 were in non-Yoga group, where out of 44 females 35 were in Yoga group and 9 were in non-Yoga group (Table No. 3). There is no any significant difference related to gender, for all variables statistically analyzed in this study. Smoking was seen only among the male participants (Table No. 4). The oxygen saturation levels in both groups found to be normal (>98%). On contrast, there was a significant difference observed between the Pulse rate ($p<0.05$), with lower value (77.82 ± 8.68) seen in the Yoga group. The average carboxyhemoglobin in the studied population was determined to be 3.7 with a highest level of 7 in yoga practitioners group and a peak of 15 in the non yogapractising participant. A significant difference ($p<0.03$) was observed in both groups. Upon evaluating the Perfusion Index and Methhemoglobin, all results fell below clinical reference, specifically less than 20 % (PI) and 2 % (MethHb).

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Table No. 1: Age and gender wise distribution of participants.		
Age group	**Male**	**Female**
18-20	19	23
21-23	22	19
24-26	15	02
Total	56	44

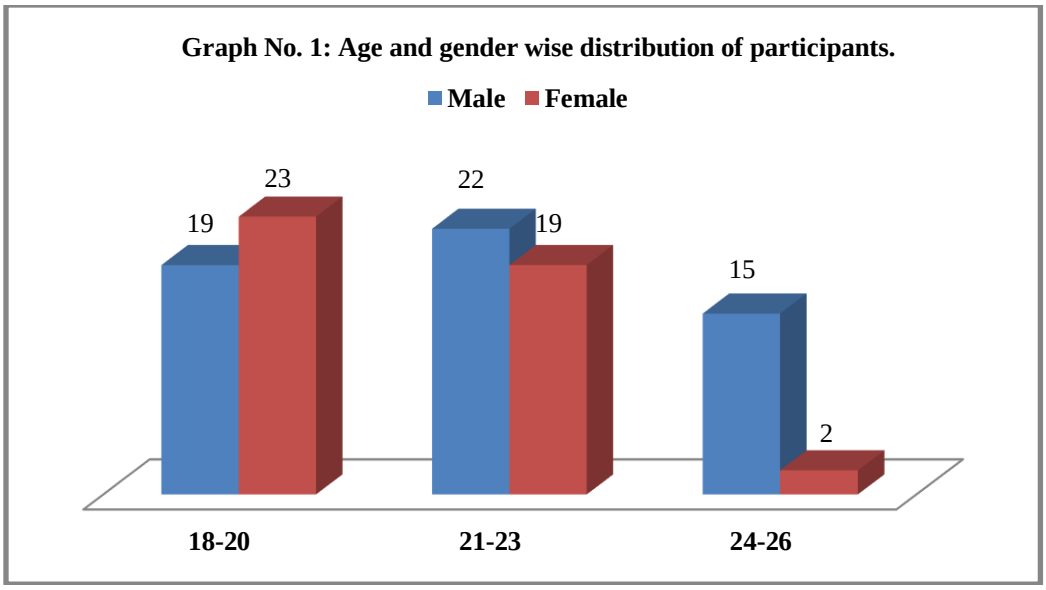

Table No.2: Age and Smoking habit wise distribution of participants		
Age group	**Smokers**	**None Smokers**
18-20	08	34
21-23	14	27
24-26	16	01
Total	38	62

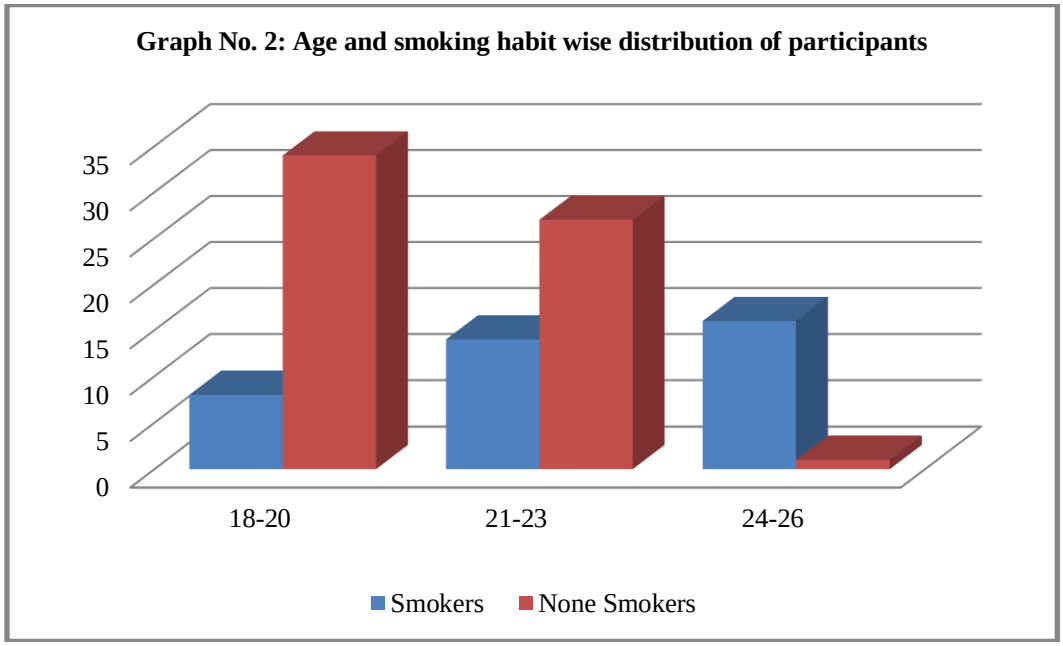

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Table No.3: Age and Gender wise distribution of participants in Yoga and Non-Yoga groups				
Variables		**Yoga Group**	**Non-Yoga Group**	***P*-value**
Age (Year)		22.8 (SD 0.9)	24.6 (SD 1.3)	0.001
Gender	Male	49	17	>0.5
	Females	35	09	
Smoking habit	Smokers	17	21	<0.05
	Nonsmokers	33	29	

Table No.4: Comparison of variables in the yoga and non-yoga groups			
Variables	**Yoga Group (Mean ± SD)**	**None-Yoga Group (Mean ± SD)**	***p*-value**
SPO_2	98.91 ± **0.51**	98.23 ± **1.14**	0.08
PR	77.82 ± **8.68**	89.13 ± **18.83**	<0.05
SPCO	2.41 ± **1.93**	5.13 ± **2.86**	<0.03
PI	1.71 ± **0.96**	1.84 ± **1.76**	0.84
Meth Hb	1.07 ± **0.38**	1.09 ± **0.52**	0.92
SPO_2- Saturation of Peripheral Oxygen; PR- Pulse Rate; SPCO- Saturation of Peripheral Carboxy hemoglobin; PI- Perfusion Index; MethHb- Meth hemoglobin			

DISCUSSION

In the current research, it was observed that even with a mere 30 minutes of consistent yogic breathing or Pranayama practices by healthy adults led to notable positive alteration in their haematological variables such as Saturated peripheral oxygen, Carboxyhemoglobin, Pulse rate, perfusion index and methhemoglobin. The mean age of our subjects was 23.7 years. The ratio of female to male in both the groups was found to be insignificant. Nevertheless, the habit of smoking was identified exclusively among the males in both groups. Although the mean partial pressure of oxygen did exhibit some variation in both the groups, the outcomes were not considered significant. Pulse Rate fluctuates in healthy individuals based on their physical, emotional or cognitive activity levels. According to various studies conducted on Yoga practices, heart rate decreases with consistent exercise since it enhances the heart's efficiency. Yogic practice promotes parasympathetic activity of the autonomic nervous system, thereby decreasing the heart rate. In present study, we noted that a significantly lower Pulse rate was recorded in the yoga group as well. In our investigation, we noted that the carboxyhemoglobin level recorded the mean value of 2.41 and 5.13 in yoga and non yoga group respectively. The observed values were also statistically significant (<0.03). We observed an elevation in carboxyhemoglobin within the smokers, aligning with the results from previous similar investigations [3,4,8]. Noruzian et al. assessed the impact of breathing exercise on carboxyhemoglobin level in male smokers, and their findings indicated that 6 weeks of breathing exercise intervention considerably diminished COHb (P=0.001). Our study revealed comparable results where the carboxyhemoglobin level of smokers in yoga group (mean 2.41) was found to be less than the non yoga group (mean 5.13). We did not observe any discrepancy in methhemoglobin levels across the two groups, and it was found to be within normal range for all the participants. This supports the comparative study of Nathalia et al. where no significant difference in methhemoglobinlevel between smokers and non smokers was reported. Limitations: the present study was an analytical cross sectional study where we gathered the data at a single point of time thus we were unable to establish a causal link between yogic breathing exercises and haematological variables. Our sample size was quite limited as most of the medical students showed little interest in yoga making it challenging task to obtain a representative sample. It is insufficient to comprehend the various haematological readings particularlycarboxyhemoglobin only based on an individual's exercise status Another limitation of our research is that we did not cross verify the information provided by the students; hence, our study is also subject to Information bias.

CONCLUSION

In present study, Pulse rate, SPO_2, Methhemoglobin, Carboxyhemoglobin were all observed to be influenced by the yogic breathing exercises. The reason for elevated levels of carboxyhemoglobin in nonsmokers required further investigation with a large sample size to provide suitable representation of both the groups. To sum up, we would assert that Yogic breathing is unquestionably a healthier method of breathing and such uncomplicated exercises can certainly result in long term overall advantage; therefore, the adoption of such healthful practices should be promoted globally.

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