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ORIGINAL ARTICLE

Association of Carboxyhemoglobin Levels with Yogic Breathing in Medical Undergraduate Students- An Observational Cross-sectional Study

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Abstract:

Carbon monoxide is produced from incomplete combustion of fuels like charcoal, briquette, fuel gas, petroleum, using a burner, heater or cooking equipment with inadequate ventilation, faulty water heaters, exhaust fumes from vehicles, industries and cigarette smoking leading to high Carboxyhemoglobin levels. The effect of low-level exposure to carbon monoxide on the cognitive functions of an individual is not very well documented as the clinical syndrome in occult cases have a very obscure clinical presentation with little awareness and knowledge in this particular domain. The various neurological manifestations resulting from carbon monoxide exposure could range from headache, fatigue, dizziness, syncope, lethargy, coma, seizures and death at high levels. It has been observed that deep breathing exercises help in reducing the carboxyhemoglobin levels in smokers. Pranayama or yogic method of breath regulation is an important component of Yoga. We had conducted this study with the objective of analysing the association of Carboxyhemoglobin and Methhemoglobin levels with Yogic Breathing in healthy undergraduate medical students. Design- Analytical observational cross sectional study. Setting- Tertiary Medical teaching Institute. Participants- Healthy undergraduate medical students. Study Period- September 2023. Our study was carried out on a total of 42 undergraduate medical students. The oxygen saturation pattern in both the groups came out to be normal (>98%). We found a significant difference between the Pulse rate ($p<0.05$) and carboxyhemoglobin ($p<0.02$) in both groups. Yogic breathing is definitely a healthier way of breathing; hence adoption of such healthy practices should be encouraged worldwide.

Keywords: Pranayama, Carboxyhemoglobin, Methhemoglobin.

Introduction:

Carbon monoxide is produced from incomplete combustion of fuels like charcoal, briquette, fuel gas, petroleum, using a burner, heater or cooking equipment with inadequate ventilation, faulty water heaters, exhaust fumes from vehicles, industries like iron foundries, chemical plants, etc.[1] Carbon monoxide is also released through cigarette smoking (3-4%), with COHb saturation in Heavy smokers reaching to 10-15%.[2,3] The CNS is the organ system that is most sensitive to CO poisoning. The effect of low-level exposure to carbon monoxide on the cognitive functions of an individual is not very well documented as the clinical syndrome in occult cases have a very obscure clinical presentation with little awareness and knowledge in this particular domain. The various neurological manifestations resulting from carbon monoxide exposure could range from headache, fatigue, dizziness, syncope, lethargy, coma, seizures and death at high levels.[4] Respiration using 100% oxygen is the preferred treatment in case of high carboxyhemoglobin levels in blood. Some studies done abroad have pointed towards the effect of deep breathing exercises in reducing the carboxyhemoglobin levels in smokers.

Pranayama is an ancient yogic method of breath regulation by rapid breathing through diaphragm, alternate nostril breathing, slow and deep breathing and breathing with glottis contraction. All these exercises are usually done in a seated posture preferably in a well ventilated environment. Pranayama consist of four aspects of breathing comprising of sequential and controlled inhalation, exhalation, internal breath retention and external breath retention.[5,6] It helps in improving the oxygen reserves and removes the toxins from the body along with calming effect on the mind. The recent popularity of this 3000 year old Indian tradition across the globe has led to various research studies on the therapeutic effects of such practices.[7-10] These studies have demonstrated the beneficial effects of Pranayama on cardiovascular system, improved respiratory functions, balancing of nervous symptoms. However, there was no such study done in India where the effects of Yogic breathing exercises on carboxyhemoglobin levels were studied. Hence, we had conducted this study with the objective of analysing the association of Carboxyhemoglobin levels with Yogic Breathing in healthy undergraduate medical students.

Materials and methods:

Ours is an analytical observational cross sectional study done during the month of September 2023, on Medical undergraduates after approval from the institutional Research Ethical

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Committee. The participants were recruited from the undergraduate medical students of all phases after getting their written informed consent. Our study was carried out on a total of 42 undergraduate medical students who agreed to participate in the study by signing the informed consent form. They were divided into two groups-Yoga group and the Non Yoga group, each containing the same number of participants (21) in the age group of 21-30 years. Those students who had been practising Yogic breathing exercises (Pranayama) regularly were recruited in Group 1, or the Yoga Group. The Pranayama exercises included Alternate Nostril Breathing (Anulom vilom), forced inspiration and forced expiration (Bhastrika), Inspiration and expiration with slight contraction of glottis (Ujaiyi), forced expiration (Kapalbhati), OM chanting (Bhramari). The other students who were not doing any yogic breathing exercises or gym training were recruited in Group 2 or the Non Yoga group. Presence of any haematological, acute or chronic disease was considered as exclusion criteria for both the groups.

Data collection: After collecting the demographic data of both groups, their haematological parameters comprising of Oxygen Saturation (SPO2), Pulse Rate (PR), Carboxyhemoglobin (COHb), Methhemoglobin (MethHb), and Perfusion Index (PI) were measured non-invasively through Pulse CO-oximeter of Masimo brand using an adult type finger tip sensor.

Statistical Analysis: Microsoft Excel was used for arrangement of data and descriptive analysis. Statistical analysis was done using SPSS 22 software. Student's t test was used to compare the readings between the Yoga group and Non Yoga group. Probability (p value) of <0.05 was considered as significant.

Results:

The mean age of Yoga group and Non Yoga group was found to be 23.09 and 25.09 years respectively. There were 11 females and 10 males in the Yoga group and 9 females and 11 males in the Non Yoga group. We didn't find any significant difference related to gender, for all parameters analysed in our study. However, we found smoking prevalence only among the males in both the groups. The oxygen saturation pattern in both the groups came out to be normal (>98%). On the contrary, there was a significant difference between the Pulse rate ($p<0.05$), with lower value seen in the Yoga group. The mean carboxyhemoglobin in the study population came out to 3.6, with a maximum of 8 in yoga practitioners 'group and maximum of 14 in the non yoga practising participant. We found a significant difference ($p<0.02$) in both groups. On assessing Perfusion Index and Methhemoglobin, all values were below clinical reference, that is, less than 20 % (PI) and 2 % (MethHb).

Table 1. Age and sex related distribution in the yoga and non yoga groups.

Parameters		Yoga Group	Non Yoga Group	p-value
Age		23.09±1.5781	25.09±2.1425	0.001
Sex	Females	11	9	>1
	Males	10	12	
Smoking status	NS	18	15	<0.05
	S	3	6	

NS: Non smokers; S: smokers.

Table 2. Comparison of various parameters in the yoga and non yoga groups.

Parameters	Yoga Group (Mean ± SD)	Non Yoga Group (Mean ± SD)	p-value
SPO2	98.8095±0.6796	98.333±1.0646	0.09
PR	77.8095±8.84888	89.0476±17.9695	<0.05
SPCO	2.619±2.3974	4.619±2.9407	<0.02
PI	1.6219±1.1839	1.7633±1.7496	0.7606
Meth Hb	1.0619±0.4599	1.0857±0.4912	0.872

SPO_2-Saturation of Peripheral Oxygen; PR-Pulse Rate; SPCO-Saturation of Peripheral Carboxyhemoglobin; PI-Perfusion Index; MethHb-Methhemoglobin.

Discussion:

In the present study, it was noted that even with as little as 25 minutes of regular yogic breathing or Pranayama done by healthy adults resulted in significant positive changes in their haematological parameters like SPO2, Pulse rate, Carboxyhemoglobin, perfusion index and methhemoglobin. The mean age of our participants was 24.09 years. The female to male ratio in both the groups was not significant. However, smoking habit was found only among the males in both the groups. Though the mean partial pressure of oxygen did vary a bit in both the groups, but the results were not found to be significant.

PR varies in healthy individuals depending upon the physical, emotional or cognitive activity status. According to various studies done on Yoga practices, heart rate is reduced with regular exercise as it improves the heart's efficiency.[11-13] Yogic exercise stimulates the parasympathetic activity of the autonomic nervous system, thus reducing the heart rate.[14-16] In our study too, a significantly lower Pulse rate was observed in the yoga group. In our study, we noted that the carboxyhemoglobin concentration had the mean value of 2.619 and 4.619 in yoga and non yoga group respectively. The results were also statistically significant (<0.02).

We observed an increase in carboxyhemoglobin in the smokers which was in consistent with the findings of previous similar studies.[17,18] Noruzian et al. studied the effects of breathing exercise on carboxyhemoglobin level in men smokers and their results showed that 6 weeks of breathing exercise intervention significantly reduced COHb (P=0.001).[19] We got the similar findings in our study where the carboxyhemoglobin level of smokers in yoga group (mean 7.0) was found to be less than the non yoga group (mean 8.3). We didn't see any difference in methhemoglobin levels in the two groups and it was found to within normal range in all the participants. This is in accordance to comparative study of Nathalia et al. where he didn't report any significant difference in methhemoglobin level of smokers and non smokers.[20]

Limitations: Ours was an Analytical observational cross sectional study where we collected the data at a single point of time hence we couldn't determine the causal relationship between yogic breathing exercises and haematological parameters. Our sample size was very small as majority of the medical students were not inclined towards yoga and obtaining a representative sample was not an easy task. It is not sufficient to understand the various haematological readings especially carboxyhemoglobin solely on the basis of exercise status of an individual. Another limitation of our study is that we didn't cross verify the information given by the students hence, our research is also subjected to Information bias.

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Conclusion:

In our research, Pulse rate, SPO_2, Carboxyhemoglobin, Methhemoglobin were all found to be affected by the yogic breathing exercises. The cause of higher levels of carboxyhemoglobin in non-smokers needs to be explored further with a large sample size to give appropriate representativeness of both the groups. To conclude, we would say that Yogic breathing is certainly a healthier way of breathing and such simple exercises can definitely lead to long term overall benefits; hence adoption of such healthy practices should be encouraged worldwide.

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Authors' Roles: Dr. Richa Choudhary conceived and designed the study, analysed and interpreted the data and wrote the manuscript; Dr. Pradeep Kumar Yadav helped in data collection and statistical analyses. Both the authors reviewed and approved the final manuscript.

Conflict of Interest: The Authors declare that there are no conflicts of Interests.

Research Ethics & Patient's consent: The research was approved by Institutional Ethical Committee (IEC 225/22) and written Informed consent was obtained from the participants.

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