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ORIGINAL ARTICLE

Relation of Body Mass Index with Arterial Blood Gases in Acute Exacerbation of Chronic Obstructive Pulmonary Disease

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Abstract:

Background: *Chronic Obstructive Pulmonary Disease (COPD) exacerbation results in hypoxaemia and hypercapnoea that can be debilitating to the patient. Management of acute exacerbation of COPD depends largely on the diagnosis of hypoxaemia and hypercapnoea. The question lies, which patients have this hypoxaemia/hypercapnoea during an exacerbation?*

Methods: *This is a Group comparison study conducted between January'12 to December'12 and included 162 COPD patients with acute exacerbation. History taking, clinical examination & measurement of BMI were done and simultaneously investigated with ABG analyses and some routine investigations.Datawere analyzed by Statistical Package for Social Sciences (SPSS) software.*

Results:*Patients were grouped into 3 groups: Group I(low BMI group,BMI< 18.5 kg/m²) and Group II(normal BMI group,BMI >18.5-22.9 kg/m²) and Group III(overweight group,BMI >23.0-29.9 kg/m²).There was no statistically significant difference between groups regarding demographic data e.g. age, sex, education, occupation. The number of underweight patientswas 52 (32.1%), number of patients with normal BMI was 94 (58%)& number of overweight patient is only 16 (9.9%).No obese patient was found(i.e. BMI >30 kg/m²).In Group I Mean BMI ±SD was 15.73±2.26 kg/m² (range 11.48-18.46 kg/m²) and in Group II Mean BMI ±SD was 20.07±1.20 kg/m² (range 18.7 – 22.8 kg/m²) and in Group III Mean BMI ±SD was 25.98±2.05 kg/m² (range 23.0-28.89 kg/m²).*

The mean PaO_2 was 58.9±16.7 mmHg with range from 32.8 – 91.2 mmHg in group I, 102.6±50.1 mmHg with range from 32.0 – 256.0 mmHg in group II and 122.7±48.7 mmHg with range from 53.0 – 223.3 mmHg in group III respectively which was statistically significant (P<0.05). The mean $PaCO_2$ was

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53.0±26.4 mmHg with range from 23.0 – 139.7 mmHg in group I, 51.09±17.4 mmHg with range from 22.7 – 96.0 mmHg in group II and 65.78±24.6 mmHg with range from 29.0 – 100.6 mmHg in group III respectively which was statistically significant (P<0.05).

Conclusion: *There was positive significant correlation between BMI with PaO_2 in Group of underweight and normal weight but positive non-significant correlation between BMI with PaO_2 in group of overweight. Butthere was negative significant correlation between BMI with $PaCO_2$ in group of underweight, negative non-significant correlation between BMI with $PaCO_2$ in group of normal weight but positive non-significant correlation between BMI with $PaCO_2$ in group of overweight.*

Key words: *COPD, BMI, ABG.*

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Introduction:

Chronic Obstructive Pulmonary Disease (COPD) is characterized by chronic airflow limitation and a range of pathological Changes in the lung, some significant extra-pulmonary effects and important co morbidities which may contribute to the severity of the disease in individual patients.[1] An exacerbation of COPD is defined as an event in the natural course of the disease characterized by a change in the patients baseline dyspnoea, cough, and or sputum that is beyond normal day-to-day variations, is acute in onset, and may warrant change in regular medication in a patient with underlying COPD.[2] COPD exacerbation results in hypoxaemia and hypercapnoea that can be debilitating to the patient. Management of acute exacerbation of COPD depends largely on the diagnosis of hypoxaemia and hypercapnoea. The question lies, which patients have this hypoxaemia/ hypercapnoea during an exacerbation?

Arterial Blood Gas (ABG) analysis is a major monitoring tool in severe airflow obstruction in COPD. It is likely that obesity modifies the clinical picture of COPD because of its effects on the perception of dyspnoea and exercise tolerance.[3] Antoine Cuvelie stated said that Obesity is a risk factor for acute hypercapnic respiratory failure.[4] Congleton J. also stated that In COPD, malnutrition causes reduced ventilatory response to hypoxia and hypercapnia, structural and metabolic changes in respiratory muscles and decreased alveolar ventilation, thereby worsens ABG.[5,6] Malnutrition and obesity i.e. nutritional status can be measured by body Mass Index (BMI).The relation of Body mass index (BMI) with ABG in Acute exacerbation of COPD has evaluated in this group comparison study with COPD.This study shows which patients have hypoxaemia with or without Hypercapnoea during an exacerbation.We know that there is a negative relation of low BMI with severity of COPD patients.[6] Again acute exacerbation of COPD influences arterial blood gas levels. So, it can be assume that there is a relation of BMI on ABG in acute exacerbation of COPD. There were different studies done regarding relation of BMI with ABG in acute exacerbation of COPD in different races. This study also aimed to show what would be the relation of BMI with ABG in acute exacerbation of COPD in Bangladeshi patients.

Objectives: (i)To know the relation of Body Mass Index (BMI) with Arterial Blood Gas in patients with acute exacerbation of chronic obstructive pulmonary disease.(ii)To find out which patients have hypoxaemia with or without hypercapnoea during an exacerbation of COPD.

Methodology:

This is a Group Comparison study , carried out during the period from January'2012 to December'2012 in in-patient department of National Institute of Diseases of the Chest and Hospital(NIDCH),Mohakhali, Dhaka.Study population was men and women aged above 40 years suffering from acute exacerbation of COPD admitted in in-patient department of NIDCH,Dhaka. Sampling Method was Simple random sampling. Data was collected through History taking, clinical examination ,BMI calculation and ABG analysis.

Inclusion criteria:

1. Acute exacerbation of COPD admitting the wards of NIDCH.
2. Patient aged above 40 years.
3. Patient of both sexes.
4. Patient suffering from moderate to severe COPD

Exclusion criteria:

1. Patients suffering from stable COPD.
2. Patients with COPD but also suffering from other concomitant medical illness such as pneumonia, pulmonary oedema,mass lesion in lung,pleural effusion, acute myocardial infarction, LVF etc.

This study finally included 162 COPD patients with acute exacerbation according to inclusion & exclusion criteria. Proper history taking,clinical examination & measurement of BMI were done and simultaneously investigated with ABG analyses and some routine investigations.

Data were compiled in computer and analyzed by Statistical Package for Social Sciences(SPSS) software program version 17.0.Patients were grouped into 3 groups: Group-I i.e. Low BMI group (BMI < 18.5kg/m2) ,Group II: normal BMI group(BMI ³18.5 - 22.9 kg/m2) and Group III: i.e. overweight group(BMI ³23.0 - 29.9kg/m2)

Observations and Results:

Table-I

Mean± SD and range of BMI of study population (n=162)

BMI (kg/m^2)	Group I(n=52) Mean±SD	Group II(n=94) Mean±SD	Group III(n=16) Mean±SD
Mean± SD	15.73±2.26	20.07±1.20	25.98±2.05
Range (min-max)	11.48-18.46	18.7-22.8	23.0-28.9

Group I: BMI <18.5 kg/m2
Group II: BMI ³18.5 - 22.9 kg/m2
Group III: BMI ³23.0 - 29.9kg/m2

Table-II

$PaO_2$and $PaCO_2$ among study population (n=162)

Variables	Group I(n=52) Mean±SD	Group II(n=94) Mean±SD	Group III(n=16) Mean±SD	P value
PaO_2(mmHg)	58.9±16.7	102.6±50.1	122.7±48.7	0.001s
Range (min-max)	(32.8-91.2)	(32.0-256.0)	(53.0-223.3)	
$PaCO_2$(mmHg)	53.0±26.4	51.09±17.4	65.78±24.6	0.042s
Range (min-max)	(23.0-139.7)	(22.7-96.0)	(29.0-100.6)	

s=significant
P value reached from ANOVA test

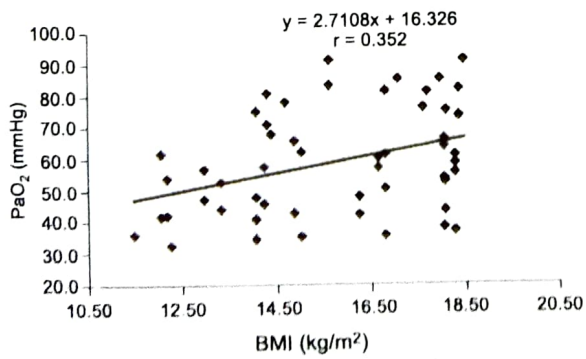

Fig.-1: *Scatter diagram showing positive significant correlation (r=0.352; p=0.011) between BMI with PaO_2 in Group I.*

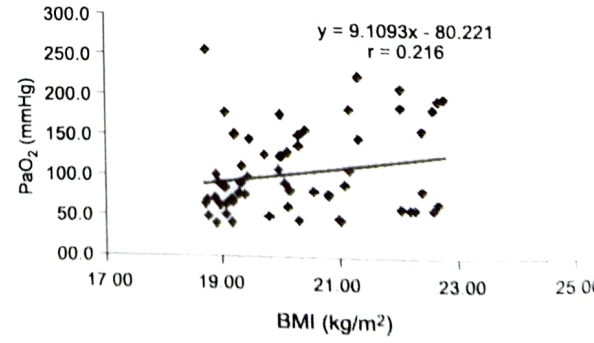

Fig.-2: *Scatter diagram showing positive significant correlation (r=0.216;p=0.036)between BMI with PaO_2in Group II.*

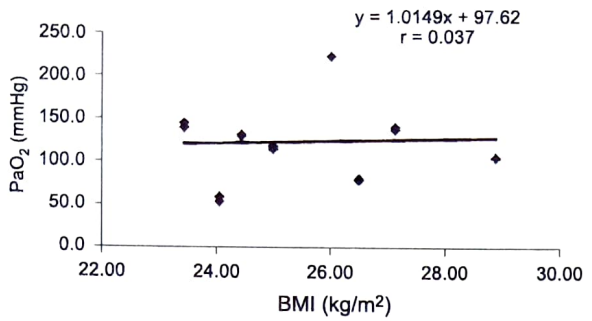

Fig.-3: *Scatter diagram showing positive but not significant correlation (r=0.037; p=0.892) between BMI with PaO_2 in Group III.*

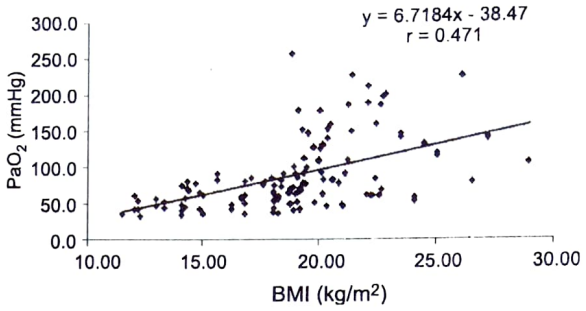

Fig.-4: *Scatter diagram showing positive significant correlation (r=0.471; p=0.001) between BMI with P_aO_2 in all BMI groups.*

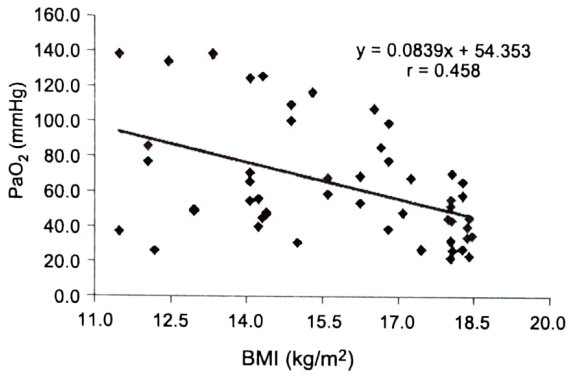

Fig.-5: *Scatter diagram showing negative significant correlation (r=-0.458; p=0.001) between BMI with $PaCO_2$ in group I.*

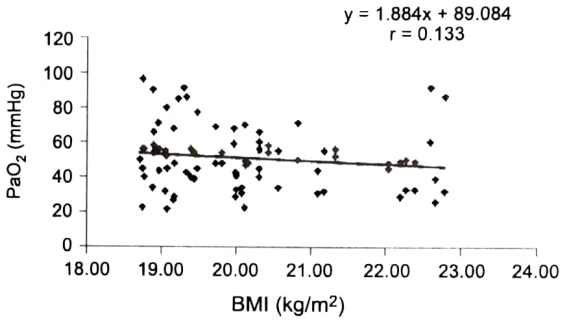

Fig.-6: *Scatter diagram showing negative but not significant correlation (r=-0.133; p=0.228) between BMI with $PaCO_2$ in Group II.*

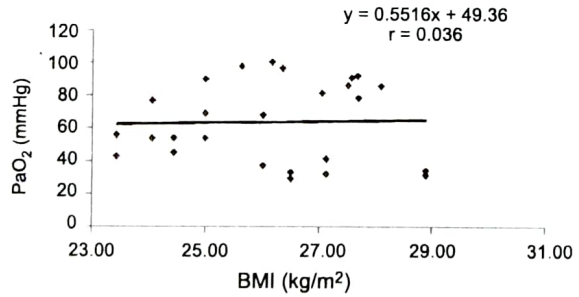

Fig.-7: *Scatter diagram showing positive but not significant correlation (r=0.036; p=0.862) between BMI with $PaCO_2$ in Group III.*

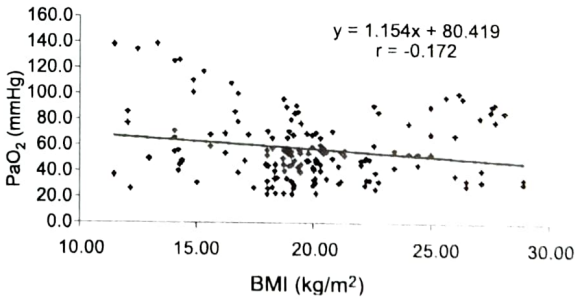

Fig.-8: *Scatter diagram showing negative significant correlation (r=-0.172; p=0.029) between BMI with P_aCO_2 in all BMI groups.*

Discussion:

This study was carried out with an aim to find out the relation between low, normal and high BMI and arterial blood gases (ABG) in patients with acute exacerbation of COPD, in addition to forecast the exacerbations and to predict hypoxaemia/ hypercapnoea in patients of COPD.

In this present study the study population was divided in to Group I (underweight, BMI < 18.5 kg/m2), Group II (normal, BMI 18.50 - 22.9 kg/ m2) and Group III (overweight BMI e"23.0-29.9 kg/m2) and it was observed that number of underweight patients was 52(32.1%) , number of patients with normal BMI was 94(58.0%) &

number of overweight patients was only 16(9.9%). No obese patient was found (i.e. BMI e"30 kg/m2). In the PLATINO STUDY (7) about 7% patient had underweight, 30% normal BMI, and 64% overweight or obesity.

In Group I MeanBMI ±SD was 15.73±2.26 kg/m2 (range 11.48-18.46 kg/m2) and in Group II Mean BMI ±SD was 20.07±1.20 kg/m2 (range 18.7 – 22.8 kg/m2) and in Group III Mean BMI ±SD was 25.98±2.05 kg/m2 (range 23.0-28.89 kg/m2) in comparison to 19.910 ± 0.985 kg/m2 and 25.72 ± 1.75 kg/m2 in underweight and normal to obese group respectively found by SALEPÇÝ B et al.[6]

There was no statistically significant difference between groups regarding demographic data e.g. age, sex, education, occupation. Male to female ratio was 5.6:1 in the whole study patients.

Illiterate patients were most common among three groups, where 32(61.5%) in group I, 59(62.8%) in group II and 11(68.7%) in group III where Primary and Secondary (SSC) education level held 2nd and 3rd position respectively. In contrast to this result in PLATINO Study(7) underweight group took 4.6±4.0 years education, normal BMI group took 6.8±4.7 years education and overweight group reached 7.1±4.8 years education and their difference was not statistically significant(P=0.104). This dissimilarity reflects the difference between developmental status of Bangladesh and of these country.

This study found that Ex-smoker was more common group I and group III, which was 34(65.4%) and 10(62.5%) respectively but current smoker was found more 43(45.7%) in group II. There were no Nonsmoker in group I but in group II, 14 and in group III 4 patients were non-smoker — among them 1 patient is male and 17 were female and all had history of exposure to Biomass fuel burning. Ling Yang et al found most patients are current smoker in all BMI groups.[8]

Among study population the mean PaO2 was 58.9±16.7 mmHg with range from 32.8 – 91.2 mm Hg in group I, 102.6±50.1 mmHg with range from 32.0 – 256.0 mmHg in group II and 122.7±48.7 mm Hg with range from 53.0 – 223.3 mmHg in group III respectively. The mean difference was statistically significant between three groups. SALEPÇI B et al[6] found mean PaO2 was 66.93 ± 10.26mmHg in underweight group and 68.80 ± 11.58mmHg in normal BMI to obese group which is not significant statistically. But in another study, malnourished subjects had significantly lower PaO2 values.[9] Ma Zhen et al showed PaO2 in low BMI group was significantly lower than those of the normal BMI group and high BMI group(Pdþ0.05).[10]

The mean PaCO2 was 53.0±26.4 mmHg with range from 23.0 – 139.7 mmHg in group I, 51.09±17.4 mmHg with range from 22.7 – 96.0 mmHg in group II and 65.78±24.6 mmHg with range from 29.0 – 100.6 mmHg in group III respectively. The mean difference was statistically significant (P<0.05) between three groups. Shahebjami et al found mean PaCO2 as 38.0±3.7 and 39.4±4.0 mmHg in underweight and normal weight group respectively which was not statistically significant.[11] SALEPÇI B et al[6] also found mean PaCO2 43.65 ± 5.37 and 43.97 ± 5.73mmHg in underweight and normal weight group respectively which was not statistically significant. But Ma Zhen et al[10] showed the PaCO2 in the low BMI group was significantly (Pdþ0.05) higher than the other two groups.

In this study it was found that there was positive significant correlation(p<0.05) between BMI with PaO2 in Group I and Group II but positive non-significant correlation (p>0.05) between BMI with PaO2 in Group III .And regarding all study population there was positive significant correlation(p<0.05) between BMI with PaO2. SALEPÇI B et al found no such correlation.[6] Study of Ma Zhen has similarity to our results.[10]

It was also found that there was negative significant correlation (p< 0.05) between BMI with PaCO2 in group I, negative non-significant correlation (p>0.05) between BMI with PaCO2 in Group II but Positive non-significant correlation (p>0.05) between BMI with PaCO2 in Group III.And regarding all study population there was negative significant correlation (p<0.05) between BMI with PaCO2.But result of SALEPÇI et al is not similar to this finding.[8] Similar to the present study findings, Ma Zhen and Fiaccadori et al showed significant inverse relationship between PaCO2 and body weight.[10,12]

Conclusion:

The study concludes that there was positive significant correlation between BMI with PaO2 in group of underweight and normal weight but positive non-significant correlation between BMI with PaO2 in group of overweight. And regarding all study population there was positive significant correlation between BMI with PaO2.

There was negative significant correlation between BMI with PaCO2 in group of underweight, negative non-significant correlation between BMI with PaCO2 in group of normal weight but positive non-significant correlation between BMI with PaCO2 in group of overweight. And regarding all study population there was negative significant correlation between BMI with PaCO2.

Study Limitation:

1. Sample size was small especially in overweight group and there was no obese patient.
2. Arterial blood of study patients was collected for analysis from in-patient department instead of collecting from emergency department due to shortage of manpower.

Recommendation:

1. Identification and prevention of underweight/ overweight/ obesity should be considered one of a main goal in the management of COPD.
2. Management of COPD should include improvement of nutritional status of underweight COPD patients in addition to medical treatment.
3. A large scale Follow up study should be carried out on underweight COPD patients after giving nutritional supplement for several months for further evaluation.

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