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Original Article

EXPLORING THE CORRELATION OF ISCHEMIA-MODIFIED ALBUMIN, LIPID PROFILE, AND BLOOD PRESSURE WITH OBESITY SEVERITY IN COPD PATIENTS: A CROSS-SECTIONAL STUDY AT LUMHS JAMSHORO

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ABSTRACT

Objectives: This study aimed to examine the associations between ischemia-modified albumin (IMA), lipid profile, blood pressure, and obesity severity in Chronic Obstructive Pulmonary Disease (COPD) patients.

Methodology: Conducted at the Physiology Department of Liaquat University of Medical and Health Sciences (LUMHS), Jamshoro, this cross-sectional study involved 200 obese COPD patients, with an equal distribution of males and females. Following ethical approval from the ERC LUMHS, participants underwent physical examinations and provided blood samples for analysis of IMA and lipid profiles using an ELISA-based microplate assay kit. The study classified obesity into Class I, II, and III, and data were analyzed using SPSS version 23.0.

Results: The distribution of obesity among participants was 59.0% in Class I, 21.0% in Class II, and 20.0% in Class III. Mean IMA levels increased with obesity severity, showing significant variations across classes ($p<0.05$). HDL levels decreased with increasing obesity, but without statistical significance ($p>0.05$). Significant variations were observed in LDL levels, peaking in Class II. No significant differences were found in triglyceride (TAG) and cholesterol levels across obesity classes. Additionally, diastolic BP, HDL, LDL, TAG, cholesterol, and BMI showed significant variations with IMA status, but systolic BP did not ($p=0.15$). There were negative correlations between HDL and IMA levels, and positive correlations of BMI, diastolic BP, LDL, TAG, and cholesterol with IMA levels.

Conclusion: A significant correlation was observed between ischemia-modified albumin levels and the severity of obesity, lipid profiles and diastolic blood pressure among patients with chronic obstructive pulmonary disease. Monitoring IMA levels may be essential for assessing and managing cardiovascular risks in obese COPD patients, according to these findings.

INTRODUCTION

IMA (ischemia-modified albumin) is a new tissue ischemia marker. IMA is now well recognized as an indicator of oxidative stress. IMA, a novel biochemical marker for detecting myocardial damage, has sparked a lot of attention in recent literature publications. The assessment of the IMA test for the identification and evaluation of ischemic insult to the myocardium and other acute coronary syndromes in emergency patients receives special emphasis. The IMA specificity for myocardial ischemia is unknown since ischemia and the accompanying biochemical alterations can occur in any artery [1].

Ischemia-modified albumin (IMA) is an albumin that has been "N-terminally modified" as a result of myocardial ischemia. Reduced cobalt binding affinity, due to a modified N-terminus on the albumin, is used to diagnose IMA. Although the albumin cobalt binding test was considered a potentially powerful diagnostic for distinguishing acute coronary syndrome from non-ischemic chest pain, it ineffective. Patients with acute myocardial ischemia have a fast rise in fatty acid levels in their blood. Almost all released FAs (fatty acids) bind tightly to albumin, causing structural changes in the protein and a reduction in cobalt binding affinity. The blood levels of fatty acids and ischemia-modified albumin, as assessed by albumin cobalt binding tests, have a strong metabolic and temporal connection. We conclude that "FA-occupied albumin" is a better representative of IMA in ACS [2-3].

Transition metal ions, like nickel, copper, and cobalt are known to bind to the N-terminal residues of human serum albumin. In the presence of ischemia, the N-terminal residues experience a loss in binding ability, most likely because of hypoxia, acidosis, damage due to free radicals, and membrane disruption (energy-dependent). IMA estimate is so easy that it may be done in a laboratory with very modest equipment, or even at the bedside. By adding a known quantity of cobalt to the patient's serum, the changes may be assessed. The quantity of free cobalt remaining in the combination, which is unable to attach to albumin owing to a change in the N-terminal binding residue, is used to bind to dithiothreitol (DTT), and the color formed as a result of DTT binding with cobalt is detected using a 470 nm colorimeter. As a result, the binding of albumin to cobalt varies depending on the level of damage in the N-terminal residue, and it is known that human albumin is less stable than that of other species. As a result, using albumin from different species to simulate the same circumstances as in the ischemia process will not operate in the same way [4-5]. In the initial phase of vascular injury, ischemia modified albumin rises, stays increased for several hours allowing detection before necrosis in the myocardium develops.This necrosis is also shown by isoenzyme creatine kinase (CK- MB), troponin, and myoglobin. IMA rises from a normal circulating value of 2% to a higher value of 8% in ischemic patients [6-7].

The N-terminal part of albumin was sequenced in several individuals with elevated IMA, and no indication of degradation of the N-terminal was detected. Other causes for the dramatic increase in IMA have been suggested. They observed fatty acids as they are produced in ischemic coronary conditions, they interact with albumin at its binding sites, blocking albumin from binding to cobalt, resulting in the appearance of IMA despite the absence of IMA. Although it was assumed to be an obvious biomarker for the process of ischemia in AMI and ACS, there is no question that the increases are also present in a variety of other conditions where ischemia is present. IMA is associated with systemic diseases like diabetes and hypertension. Smokers, and other individuals having peripheral vascular disease, ischemia of skeletal muscle, end-stage renal illness, cirrhosis of the liver, and systemic sclerosis, to mention a few, have all been linked to an increase in IMA[8-9] IMA, which was recently shown to be a marker for acute myocardial ischemia, aids in the early detection of cardiogenic ischemic disorders. The FDA (Food and Drug Administration) approved IMA as a diagnostic indicator of early coronary ischemia in patients with acute coronary syndrome (ACS), and it can help to lower the rate of missed diagnoses in patients with cardiovascular disease. Many new investigations have discovered that the blood level of IMA can also be dramatically elevated in non-cardiogenic ischemic disorders in recent years. Furthermore, IMA is a reliable indicator of the severity and prognosis of illnesses such as acute ischemic chest pain, continuous ambulatory peritoneal dialysis, and patients with profound sepsis [10].

If IMA can be utilized as a predictor of heart disease in a vulnerable population, it will be a

tremendous step forward in early detection and will help to reduce the burden of cardiac death in our society. Therefore, this study was designed to evaluate the relationship of IMA, severity of obesity, arterial BP, and lipid profile.

METHODOLOGY

Study Design and Setting

This cross-sectional study was designed to assess the association between lipid profile, Ischemia-Modified Albumin (IMA), hypertension and obesity severity in Chronic Obstructive Pulmonary Disease (COPD) patients. The study targeted obese individuals diagnosed with COPD from the general population, with the proportionate gender representation. Inclusion criteria were explicitly chosen to include those with a positive family history of cardiovascular disease (CVD). The participants were exempt from any cardiac medications, lipid-lowering drugs, and had no prior history of cardiac disease. Obesity was classified into Class I (30-34.9 kg/m²), Class II (35-39.9 kg/m²), and Class III (>40 kg/m²). This investigation was conducted at the Physiology Department, Liaquat University of Medical and Health Sciences (LUMHS), Jamshoro, in collaboration with the Diagnostic and investigation Lab.

Selection Criteria

Inclusion Criteria: Obese individuals diagnosed with COPD.
Positive family history for CVD.
Both genders.
Exclusion Criteria: Previous use of cardiac medications.
Use of lipid-lowering medications.
History of cardiac disease.

Sample Size and Data Collection

The study included 200 obese individuals diagnosed with COPD, ensuring an equal distribution between males and females (100 males and 100 females). The participants underwent an initial interview for consent and background information, followed by a comprehensive physical examination, including measurements of blood pressure, pulse, height, and weight. Then, 5cc blood samples were taken from each participant and analyzed in the laboratory to measure levels of IMA and various components of the lipid profile, using an ELISA-based microplate assay kit.

Statistical Analysis

Patient data were analyzed using IBM SPSS version 23.0. Quantitative variables were contrasted using ANOVA, and relationships between variables were assessed using Pearson correlation. A p-value of 0.05 was considered statistically significant for all tests.

Ethical Considerations

Ethical sanction was obtained from the Ethical Review Committee (ERC) at LUMHS before initiating the study. Informed consent was secured from all participants, who were thoroughly briefed about the study's purpose and procedures.

RESULTS

The research findings concerned obese individuals ranging in age from 35 to 50 years, with a mean age of 42 years and a moderate degree of age variability. The participants' Body Mass Index (BMI) varied between 30 and 44, with an average of 35.11. This suggests that obesity was prevalent among the group. The average Forced Expiratory Volume in 1 second (FEV1) was 2.00 liters, indicating that despite the diverse BMIs, the cohort exhibited a relatively consistent level of lung function. FEV1 ranged from 1.20 to 2.80 liters **in table: 01**

Table 1: Descriptive statistics of the study population of COPD patients (n=200)

	Minimum	Maximum	Mean	Std. Error	Std. Deviation
Age(in Years)	35.00	50.00	42.28	0.33	4.68
BMI	30.00	44.00	35.11	0.28	4.00
FEV1	1.20	2.80	2.00	0.04	0.40

The frequency (%) of the classes of obesity is shown in **Figure 1**. Fifty-nine percent obese people were suffering from class I obesity, while 20 % in class III and 21.0% in class II.

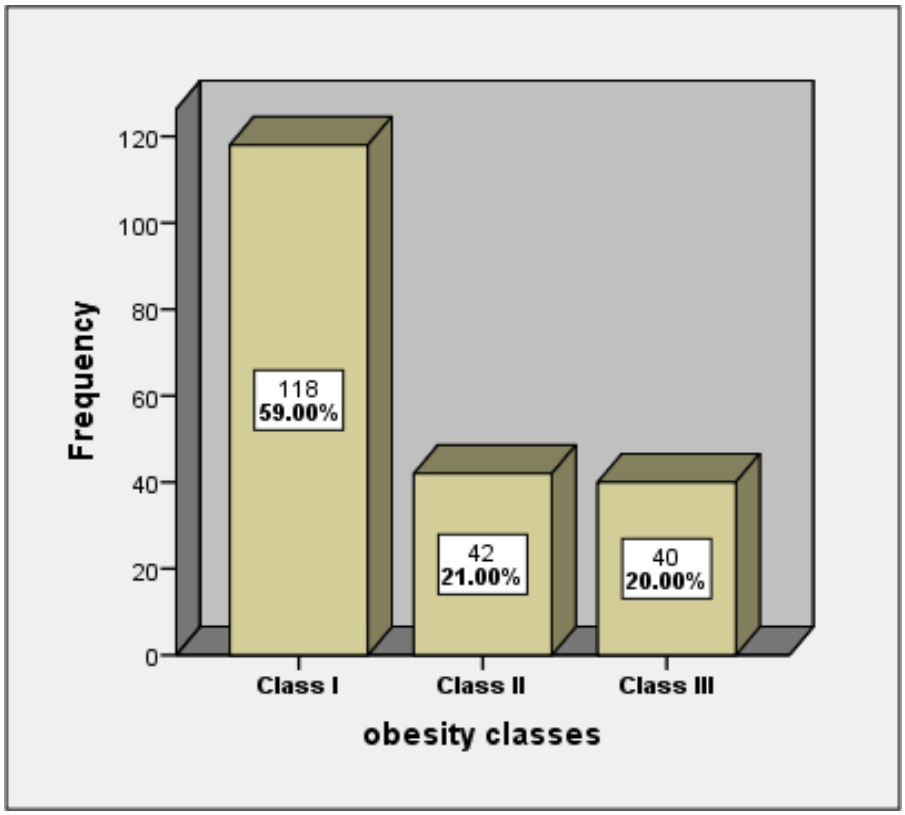

Figure 1: Distribution of study patients according to classes of obesity

The table illustrated the variation in health metrics among three classes of obese patients with COPD. An increase in IMA concentrations from Class I to III is indicative of a significant correlation with the severity of obesity ($p<0.05$). Although HDL levels do decline as obesity class increases, the difference does not reach statistical significance ($p>0.05$). There was Substantial variation in LDL levels among classes ($p<0.05$), with the climax observed in Class II. There was no significant variation in triglyceride (TAG) and cholesterol levels among the different obesity classes. As adiposity increases, FEV1 decreases, indicating statistically significant difference ($p<0.05$). The FEV1/FVC ratio exhibits a notable disparity ($p<0.05$) in its decline among classes, indicating a deterioration of pulmonary function in the more obese groups **Table 2**

Table 2: Comparison of IMA and lipid profiles in different classes of obesity in COPD patients

ANOVA						
	Classes of obesity in COPD patients	Mean	SD	SEM	F	Sig.
IMA	**Class I**	104.62	20.16	1.85	23.849	0.013
	Class II	120.50	15.10	2.33		
	Class III	124.12	12.76	2.01		
HDL	**Class I**	38.00	15.68	1.45	3.029	0.051
	Class II	33.50	8.59	1.32		
	Class III	33.10	8.64	1.36		
LDL	**Class I**	160.28	47.31	4.35	5.830	0.003
	Class II	189.52	61.42	9.47		
	Class III	165.75	29.26	4.62		
TAG	**Class I**	207.11	50.55	4.65	0.532	0.588
	Class II	212.00	52.52	8.10		
	Class III	200.60	46.54	7.35		
Chole sterol	**Class I**	309.35	55.95	5.15	0.004	0.996
	Class II	308.61	58.91	9.09		
	Class III	308.72	56.09	8.86		
FEV1	**Class I**	2.2	0.5	0.45	12.34	0.001
	Class II	1.8	0.4	0.13		
	Class III	1.5	0.3	0.02		
FEV1/ FVC ratio	**Class I**	0.81	0.06	0.008	9.67	0.015
	Class II	0.72	0.045	0.0034		
	Class III	0.65	0.003	0.006		

Systolic BP, Diastolic BP, HDL, LDL, TAG, Cholesterol and BMI were compared according to the status of IMA in study population, by analysis of variance and revealed statistically significant difference in diastolic BP, HDl, LDL, TAG, Cholesterol and BMI according to IMA status but insignificant difference in systolic BP, i.e., (*p*-value=0.15). As shown in **Table 3**

Table 3: Comparison of Systolic BP, Diastolic BP, HDL, LDL, TAG, Cholesterol and BMI according to IMA status of COPD patients

	ANOVA						
	IMA status in COPD patients	**N**	**Mean**	**SD**	**SEM**	**F**	**Sig.**
Systol ic BP	Normal(<80pg/ml)	21	147.52	11.32	2.47	1.89	0.1 5
	Borderline (81-100pg/ml)	27	153.81	11.52	2.21		
	Raised(>100pg/ml)	152	149.82	11.83	0.95		
Diasto lic BP	Normal(<80pg/ml)	21	89.90	4.99	1.09	34.01	0.0 1
	Borderline(81-100pg/ml)	27	97.40	6.36	1.22		
	Raised(>100pg/ml)	152	109.64	13.07	1.06		
HDL	Normal(<80pg/ml)	21	53.71	6.63	1.44	74.89	0.01
	Borderline(81-100pg/ml)	27	49.92	9.34	1.79		

	Raised(>100pg/ml)	151	31.13	10.64	0.86		
LDL	Normal(<80pg/ml)	21	109.66	14.31	3.12	40.63	0.01
	Borderline(81-100pg/ml)	27	130.62	41.37	7.96		
	Raised(>100pg/ml)	152	182.06	43.73	3.54		
TAG	Normal(<80pg/ml)	21	166.57	17.84	3.89	22.82	
	Borderline(81-100pg/ml)	27	169.62	22.16	4.26		
	Raised(>100pg/ml)	152	219.00	50.57	4.10		
Cholesterol	Normal(<80pg/ml)	21	269.09	37.61	8.20	17.11	
	Borderline(81-100pg/ml)	27	271.81	36.14	6.95		
	Raised(>100pg/ml)	152	321.21	56.12	4.55		
BMI	Normal(<80pg/ml)	21	32.74	2.96	0.64	12.02	
	Borderline(81-100pg/ml)	27	32.79	2.05	0.39		
	Raised(>100pg/ml)	152	35.85	4.11	0.33		

correlated with the levels of IMA and found a significant negative relation of HDL with IMA levels and a highly significant positive association of BMI, diastolic BP, LDL, TAG and cholesterol with levels of IMA. **As shown in Table 4**

Table 4: Correlation of BMI, HDL, LDL, TAG and Cholesterol with IMA levels in COPD patients

		IMA levels
BMI	r-value	0.408**
	p-value	0.69
Systolic BP	r-value	0.034
	p-value	0.63
Diastolic BP	r-value	0.479**
	p-value	0.01
HDL	r-value	-0.585**
	p-value	0.01
LDL	r-value	0.511**
	p-value	0.01
TAG	r-value	0.464**
	p-value	0.01
Cholesterol	r-value	0.401**
	p-value	0.01

DISCUSSION

This study was conducted on obese people of the COPD population having raised BP with a positive family history for cardiac disease and it has revealed that there is a strong positive correlation of serum IMA(Ischemia Modified Albumin) with hypertension (diastolic blood pressure) and severity of obesity.

One study conducted by Kandeel Fathei. [10] showed that IMA was significantly raised in chronic patients with stable angina who were subject to percutaneous coronary intervention due to single artery involvement, compared to coronary artery disease cases subject to diagnostic angiography.

A new indicator of ischemia produced by hypo- oxygenation and a rise in hydroxyl free radicals is IMA. Moreover, it has received approval for clinical usage in cardiology as an important indicator for cardiovascular events [11]. The function of IMA in individuals with hypertension and dyslipidemia has to be studied in a larger therapeutic context.

Similar to present study, Mengen E. [12] also found positive correlations between serum IMA levels and BMI. Joha SM [13] revealed that obese people had raised levels of IMA, putting them at a higher risk of developing cardiovascular disease. But they did not measure IMA levels according to the severity of obesity.

Thus, it should incorporate the IMA measurement regularly to monitor obese individuals. It was shown that HTN is also accompanied with a rise in IMA levels. In line with the present study, Kumar A. [14] also concluded from his research that patients with hypertension have higher levels of oxidative stress and IMA. To prevent future acute coronary problems, IMA might be used as a routine diagnostic variable in obese patients with raised BP.

One study conducted by, Menon B et al [15] have estimated the serum IMA levels in 50 stroke patients were found to be considerably higher than in controls, when compared to 50 age- and sex-matched controls. IMA levels in ischemic lesions of all sizes and areas were shown to rise, demonstrating that "IMA levels increase in stroke regardless of size and area." Both theZIMA levels and stroke severity did not change. This finding is consistent with the present research, which found that IMA is a predictive and determining factor in detecting ischemic changes earlier in hypertensive and obese people. Many studies have shown that obesity is the primary factor in the development of hypertension, and many studies have shown that hypertension leads to various inflammatory disorders such as stroke, aneurysm, heart failure, and various metabolic syndromes, so obesity is the leading cause of developing hypertension. Because stroke is still the biggest cause of death worldwide, symptoms must be identified and treated as quickly as feasible. As a consequence, the degree of oxidative stress decreases, resulting in a decrease in IMA levels, as proven by our study. As a result, having a biomarker at the primary care level is critical so that we can make some type of diagnostic conclusion and bring the patient to the hospital inside the window time. Incorporating biomarkers into the diagnosis process will undoubtedly result in the inclusion of new data, assisting in the prompt referral of the patient to a specialist for treatment. In conclusion, our data showed that IMA might be a reliable, quick, and cost- effective biomarker for early ischemic screening in obese individuals or having raised BP. More well-organized validation studies are required in order to develop blood biomarkers that will improve the treatment of people with hypertension.

CONCLUSION

A significant correlation was observed between ischemia-modified albumin levels and the severity of obesity, lipid profiles and diastolic blood pressure among patients with chronic obstructive pulmonary disease. Monitoring IMA levels may be essential for assessing and managing cardiovascular risks in obese COPD patients, according to these findings.

CONFLICT OF INTEREST

No conflict of interest.

DATA AVAILABILITY

The data used to support the findings of this study are available from the corresponding author upon request.

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