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ASSESSMENT OF NUTRITIONAL STATUS IN CHRONIC OBSTRUCTIVE AIRWAY DISEASE PATIENTS WITH RESPECT TO SEVERITY

General Medicine

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ABSTRACT

Introduction: Chronic obstructive pulmonary disease (COPD), the fourth leading cause of death in the world, represents an important public health challenge that is both preventable and treatable. Weight loss, muscle mass and fat mass depletion are common nutritional problems in COPD patients. **Objective:** To investigate the nutritional status of COPD patients with anthropometric parameters such as Body Mass Index (BMI), muscle mass, skin fold thickness, percentage of fat and Mini Nutritional Assessment (MNA), and biochemical parameters such as total protein and serum albumin. All the above parameters were then correlated with the severity of pulmonary dysfunction using a Pulmonary Function Test (PFT). **Methodology:** The present cross sectional study was conducted on 65 patients with stable COPD status, satisfying inclusion and exclusion criteria and admitted in hospitals attached to Bangalore Medical College & Research Institute. **Result:** With increasing severity of COPD a significant decrease in BMI, skin fold thickness, muscle mass, percentage of fat, mean MNA score, hemoglobin, total protein, albumin and lipid were noted. Conclusion: Malnutrition worsens the severity of airway obstruction in COPD patients. Therefore, nutritional status should be evaluated and nutritional intake should be tailored individually for every COPD patient.

KEYWORDS

Nutritional Status, Chronic Obstructive Pulmonary Disease (COPD), Body Mass Index (BMI), Mid Arm Circumference, muscle mass, Mini Nutritional Assessment (MNA).

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is characterized by airflow limitation that is not fully reversible. The airflow limitation is usually progressive and associated with an abnormal response of the lung to noxious particles or gases. It is the 4th major cause of morbidity and mortality throughout the world. It is a preventable and treatable disease with some significant extra pulmonary effects that may contribute to severity in some patients[1].

Nutritional depletion is a prevalent finding in patients who have COPD. Several studies have demonstrated that malnutrition is an independent predictor of respiratory morbidity and mortality in COPD and has an additive effect with other factors as well which increases the mortality rate. Investigators have identified a positive correlation between body weight and the Forced Expiratory Volume in the 1st second[2,3]. A high proportion of stable COPD patients are also found to be malnourished.

COPD patients are at risk of weight loss and nutritional deficiencies because of a 15 to 25% increase in resting energy expenditure from breathing; a higher energy cost of daily activities; reduced caloric intake relative to need because of dyspnea; and the catabolic effect of inflammatory cytokines such as TNF-α[4,5].

The exact prevalence of malnutrition in COPD is currently unknown because there is no diagnostic method that serves as a reference and no widely accepted definition. Various biochemical parameters level have also been used in assessing the severity of malnutrition. The present study attempts to determine if there is an association between the degree of malnutrition and severity of airflow obstruction in COPD patients.

Methodology

The present cross sectional study was conducted on 65 COPD patients who satisfied the inclusion and exclusion criteria and were admitted to hospitals which were attached to Bangalore Medical College and Research Institute (BMCRI) during the study period.

After obtaining ethical clearance and approval from the Institutional Ethics Committee of BMCRI, written informed consent was taken from the patients. Demographic profile, clinical examination and investigations were done, and data was collected using a study proforma. For all COPD patients the severity was measured using the Pulmonary Function Test (PFT). Anthropometric parameters like height, weight, mid arm circumference and thickness of supra iliac skin fold were noted along with lab parameters, radiographic assessment and calculation of Mini Nutritional Assessment (MNA) score. Percentage body fat levels were calculated using the Body Fat Calculator. Data collected from various aspects was analyzed and conclusions were drawn.

RESULTS

The average age of the study population was 55 years. Most of the patients (44.6 %) were in the age group between 50 and 59 years. 46(70.8%) males and 19(29.2%) females were enrolled for the study. The height of the male patients varied from 150-160cms while the height of the females varied from 160-180cms. The average weight (kg) of subjects with Stage 1 COPD was 61.41±7.41, in subjects with Stage 2 COPD was 48.67 ± 5.22, stage 3 COPD was 51.35± 7.86 and in subjects with stage 4 COPD the average weight was 47.57 ± 3.15 (Fig. 1). The mean BMI (kg/cm2) in stage 1 subjects was found to be 20.55± 2.05, in stage 2 subjects 19.52 ± 1.23, in stage 3 subjects, 18.79 ± 1.74 and in stage 4 subjects it was 16.25 ± 0.35 (Fig. 2). The mean mid arm circumference (cm) in stage 1 subjects was 25.78 ±1.01, stage 2 subjects was 21.35 ± 1.70, stage 3 subjects was 20.71± 1.85 and stage 4 subjects was 18.25 ± 0.14 (Fig. 3).The average mid-thigh circumference (cm) in stage 1 subjects was 42.15 ±1.69, in stage 2 subjects was 41.1± 1.34, stage 3 subjects was 39.85 ± 2.53 and in stage 4 subjects was 34.74 ± 0.13 (Fig. 4). The average mid-calf circumference (cm) in stage 1 subjects was 33.78 ± 1.01, in stage 2 subjects was 30.83 ± 1.01, in stage 3 subjects was 29.33 ± 2.69 and in stage 4 subjects it was found to be 27.25 ± 0.14 (Fig. 5). Mean skin fold thickness was minimum in stage 4 COPD which was 11.3 mm, mean skin fold thickness was maximum for stage 1 COPD (13.7mm) (Fig. 6). Mean percentage of fat was minimum in stage 4 COPD patients (21%). Mean percentage of fat was maximum for stage 1 COPD (38% female, 29% male) (Fig. 7).

In stage 1 COPD there were 13 male patients and 1 female patient who had normal nutritional status and 2 patients were at risk of malnutrition. In stage 2 COPD there were 13 male patients and 7 female patients who were at risk of malnutrition and 1 male patient was malnourished. In stage 3 COPD, 4 male patients and 13 female patients were at risk of malnutrition, 7 male patients and 7 female patients were malnourished and only 1 Male patient had normal nutritional status. In stage 4 COPD there were 7 male patient, all of them were malnourished (Fig. 8). Mean serum albumin levels were lowest in stage 4 COPD (2.6 gm/dl), while the maximum mean serum albumin was seen in stage 1 COPD (3.6 gm/dl) (Fig. 9). Mean serum total protein levels were lowest (5.7 gm/dl) in stage 4 COPD, and highest (6.6 gm/dl) in stage 1 COPD (Fig. 10). Mean serum triglyceride levels were lowest (97.1 mg/dl) in stage 4 COPD, and highest (149.7mg/dl) in stage 1 COPD (Fig. 11). Mean serum Low Density Lipoprotein (LDL) levels were lowest (97.7 mg/dl) in stage 4 COPD, and highest (121.1 mg/dl) in stage 1 COPD (Fig. 12). Mean serum High Density Lipoprotein (HDL) levels were lowest (32.9 mg/dl) in stage 4 COPD,

and highest (51.3 mg/dl) in stage 1 COPD (Fig. 13). Mean serum total cholesterol levels were lowest (147.5 mg/dl) in stage 4 COPD, and mean serum cholesterol levels were highest (197.9 mg/dl) in stage 1 COPD (Fig. 14). It was observed that total protein, LDL, HDL, and total cholesterol decreased with increase in the severity of COPD (Fig. 15).

Mean hemoglobin concentration was minimum in stage 4 COPD (10.5mg/dl) in 20% of male patient. Mean Hemoglobin concentration was highest in stage 1 COPD, 13.7gm/dl in 30% of total female patients and 14.1gm/dl in 26% of total male patients (Fig. 16). Average percentage of predicted Forced Expiratory Volume in first minute (FEV1) was minimum in stage 4 COPD (25 %). Maximum percentage of predicted FEV1 was seen in stage 1 COPD (91%) (Fig. 17). A statistically significant association was noted between all parameters and the stage of COPD except MNA, height, BMI, triceps skin fold thickness ($p>0.05$). It was observed that there was a significant correlation ($p<0.05$) between FEV1 and other variables (Hb, ALB, TP, TG, LDL, HDL, and TC).

DISCUSSION

The average age of the present study population was 55 years. In a similar study done by Chaudhary S et al.[6], the age ranged between 40 to 80 years. In this study, there was no statistically significant difference in the various nutritional parameters and biochemical parameters among the different age groups. A total of 65 COPD patients were enrolled in the present study. Out of 65 patients 46 (70.8%) were males and 19 (29.2%) were females. In the study by Chaudhary S et al. male to female ratio of the study population was 3.2. The average weight of the population in the present study was 52.24 kg. There was a positive association between weight and severity of airway disease ($p <0.05$). The average height of the population in the present study was 166.7cm. No correlation between height and different parameters was noted ($p>0.05$). The average BMI of the present population study was 18.77 kg/m^2 as compared to 19.17 kg/m^2 in the study done by Chaudhary S et al.

In the present study, significant correlation was found between BMI and the severity of airway obstruction($p<0.005$). A significant association between malnutrition indication score and BMI (p value=0.000) was also noted. Study done by Chaudhary S et al. reported significant decrease in mean MNA and BMI levels with increasing stage of COPD.

Mid arm circumference was used to assess the muscle mass of the patient. The average mid-arm circumference in the present study was 21.5 cm. Anthropometric study revealed that average mid-arm circumference was maximum in stage I COPD and minimum in stage IV COPD (18.25cm).The present study showed a correlation between decrease in muscle mass and severity of airway obstruction (P=0.000). A statistically significant difference in MAC between the different stages of COPD population group (p=0.000) was also observed. In a study done by Chaudhary S et al. mean arm circumference and mean calf circumference showed a significant decline with increasing severity of COPD ($p<0.001$).

It also reported a significant association between MAC and COPD severity ($p<0.001$). A study done by Mjid et al.[7] concluded that prognosis and severity of disease had significant association with MAC among the COPD patients. Mid-thigh circumference (MTC) was used to assess the muscle mass of the patient.

The mean MTC in the present study is found to be 39.46cm, maximum in stage I (42.15cm) and minimum in stage IV COPD (34.74cm). This reveals that MTC decreases as severity of airway obstruction increases. There was a statistically significant association between MTC and severity of COPD (p=0.002). Marquis et al.[8] concluded that there was significant difference in mid-thigh circumference between COPD cases and control groups. In a recent study Eduardo FM et al.[9] observed that mid-thigh muscle area was significantly low in COPD patients (p= -0.03).

Mid-calf circumference (MCC) was also used to assess the muscle mass of the patient. The average mid-calf circumference in the present study was 21.5 cm. It was maximum in stage I (25.78cm), and minimum in stage IV COPD patients (18.25cm). This concludes that the average MCC decreases as severity of airway obstruction progresses (p=0.000). The study done by Chaudhary S et al. showed that mean calf circumference declines with the increase in severity of COPD ($p<0.001$).

Triceps skin fold thickness was measured by using the Herpender Skin Fold Caliper, which is a precision instrument designed for use in skin-fold thickness measurements (from which estimates of body fat are derived). This study showed that triceps skin fold thickness decreases as severity of airway disease increases. There was a significant association between COPD severity and decreased levels of skin fold thickness (p =0.008, and there was also a significant correlation between skin fold thickness and BMI (p=0.000). Similarly, the study conducted by Chaudhary S et al showed that there was a decrease in skin fold thickness in severe COPD cases. Percentage of fat was calculated by using Body Fat Calculator which was based on U.S navy method. It had the following components – gender, age, weight, height, neck circumference, waist circumference and in female it also has hip circumference. This study revealed that the fat percentage was minimum in stage 4 COPD. Therefore, as the severity of COPD increases the fat percentage decreases (p= 0.000). A similar study done by Chaudhary S et al. showed that mean fat levels declined with increase in the severity of COPD and this association was statistically significant ($p<0.001$).

Mini Nutritional Assessment (MNA) questionnaire explores 18 items. It has questions related to the patient's medical, lifestyle, dietary, anthropometric and psychosocial factors

There was no correlation between MNA screening score and nutrition status of COPD patients and even there was no significant relation between different stages of COPD (p=- 0.492). Significant correlation between MNA assessment score and nutrition status of COPD patients was observed, along with a significant correlation between different stages of COPD and MNA score (p=- 0.000). A significant correlation between Malnutrition Indication score and different stages of COPD (p=- 0.000) was noted. As MNA score decreased the severity of COPD increased. Chaudhary S et al. showed that a significant decrease in mean MNA and BMI along with an increase in mean SGA values was associated with increasing stage of COPD ($p<0.001$).

The present study revealed that as serum albumin levels decreases severity of COPD will increase (p=-0.000). A study done by Sahithi Reddy Challa et al.[10] showed a statistically significant and strong correlation of serum pre-albumin ($r = - 0.315$ and $p = 0.006$), and albumin ($r = 0.74$) when compared with severity of airway obstruction. Lipid profile was used to assess the fat store of the body. A study done by Gunay S[11], reported associations of blood lipid profiles with COPD as positive, negative, or no association. Sibel et al.[12] found that serum HDL level was significantly lower, while total globulin level was significantly higher in subjects with stable COPD than in control subjects. The present study showed that as COPD severity progresses, serum triglycerides levels will decrease (p=0.000). Similar results were also obtained by Chaudhary S et al.

It was observed that as COPD severity progressed serum LDL and HDL levels decreased. There was a significant correlation between COPD severity and serum triglyceride level (p=0.000). Similarly, Chaudhary S et al. reported a significant correlation between HDL, LDL level and COPD severity. A study done by Ummugulsum Can et al.[13] investigated the association between disease severity and serum lipid levels in COPD patients. They found that patients with GOLD Stages III and IV had significantly lower HDL levels than control individuals. However, they saw no difference between patients with GOLD Stages II and healthy controls with respect to HDL levels. A study by Arora et al.[14] reported HDL levels in moderate, severe and very severe COPD to be 43.2 ± 5.3, 44.9 ± 8.4, and 43.1 ± 9.5 mg/dl respectively (statistically significant).

The present study observed that as COPD severity progressed serum total cholesterol levels decreased. There was a significant correlation between COPD severity and serum total cholesterol level (p=0.000). The study by Chaudhary S et al. also showed a significant correlation between total cholesterol level and COPD severity.

Forced Expiratory Volume in the first second (FEV1) for study population was divided into mild, moderate, severe and very severe airway obstruction based on GOLD criteria1. In the present study it was seen that FEV1 values significantly decreased with increase in the severity of COPD (p=0.000). As FEV1 values decreased lab parameters (serum total protein, albumin levels and lipid profiles)

levels also decreased. Lab parameters and anthropometric parameters were noted to be significantly correlated with COPD severity (p=-0.000).

CONCLUSION

A significant number of patients with COPD were found to be undernourished. Mini nutritional assessment is an easy and simple questionnaire to assess nutritional status of patients at bed side. Mini nutritional indicator scores positively correlates with COPD severity. The anthropometric measures of nutrition (Body Mass Index, Body muscle mass, triceps skin fold thickness, and fat percentage) and measures of serum protein and lipids (total protein, serum albumin, total cholesterol, LDL, HDL and triglyceride) correlated inversely with the severity of COPD.

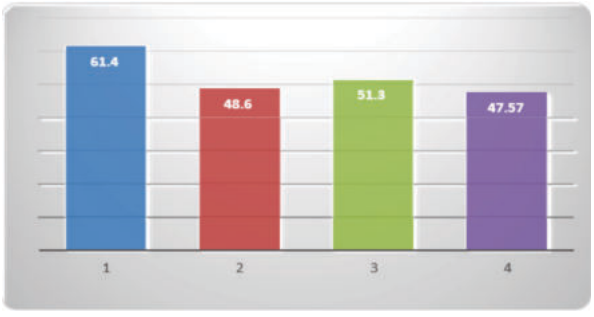

Fig: 1 Relationship between COPD severity and weight

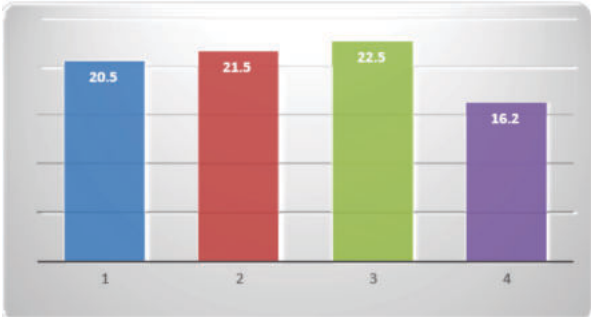

Fig: 2 Relationship between COPD severity and BMI

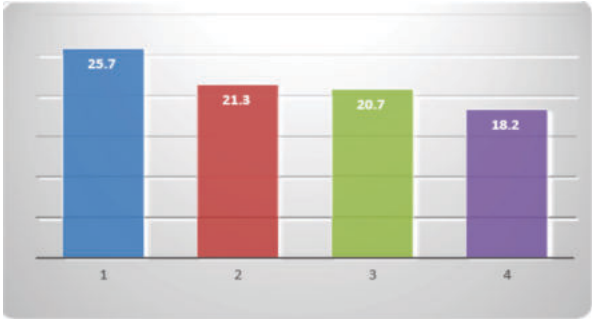

Fig: 3 Relationship between COPD severity and Mid-arm circumference

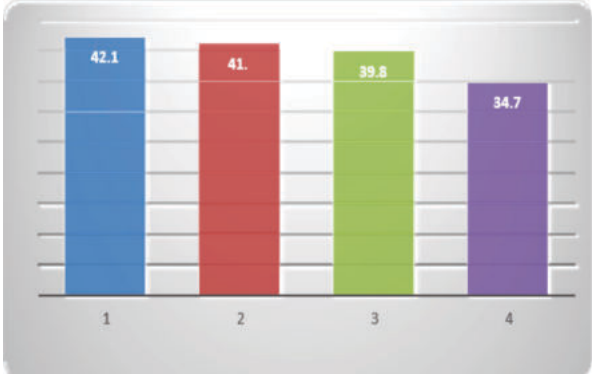

Fig: 4 Relationship between COPD severity and Mid-thigh circumference

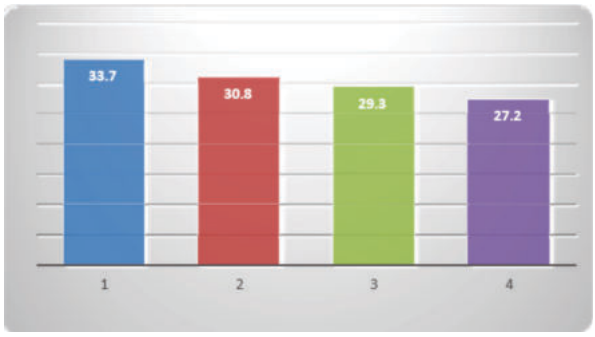

Fig: 5 Relationship between COPD severity and Mid-calf circumference

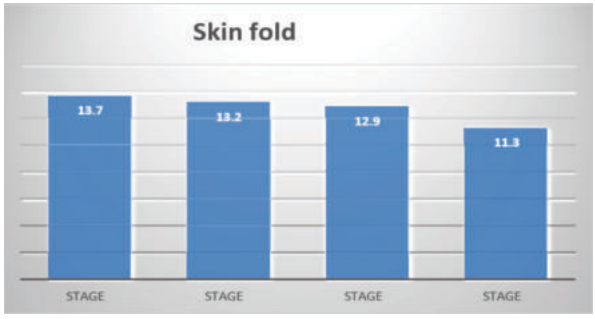

Fig: 6 Relationship between COPD severity and Triceps skin fold thickness

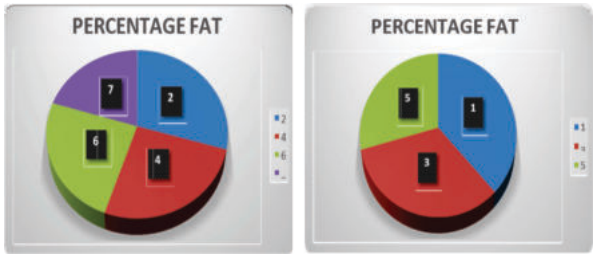

Fig: 7 Relationship between COPD severity and fat percentage in (a) Male (b) Female

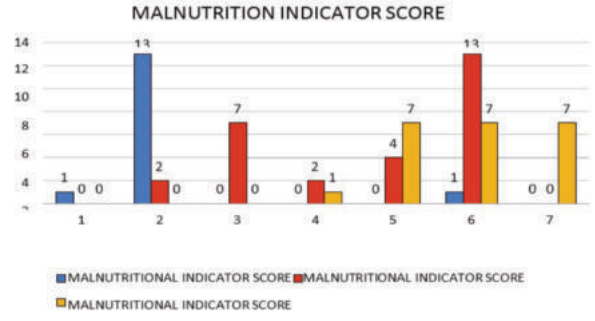

Fig: 8 Relationship between COPD severity and Malnutrition Indicator Score with respect to sex

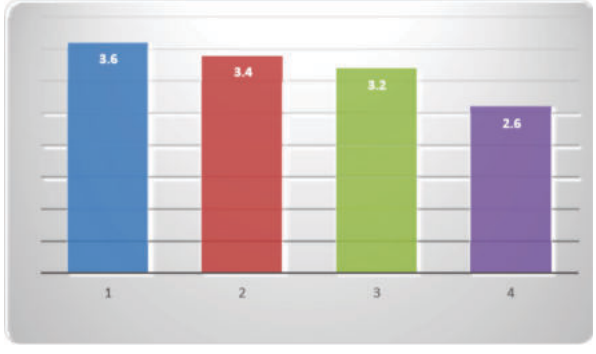

Fig: 9 Relationship between COPD severity and serum albumin levels

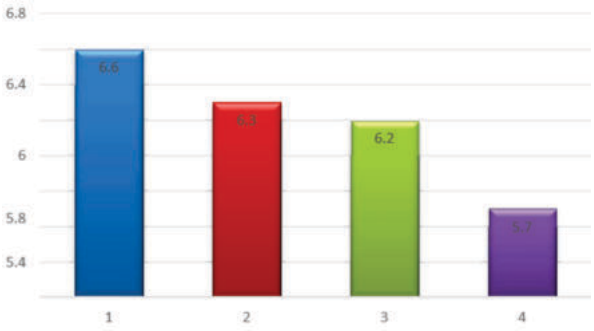

Fig: 10 Relationship between COPD severity and serum total protein levels

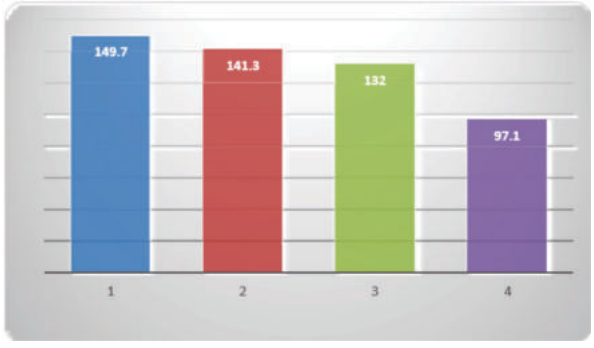

Fig: 11 Relationship between COPD severity and serum triglycerides levels

Fig: 12 Relationship between COPD severity and serum LDL levels

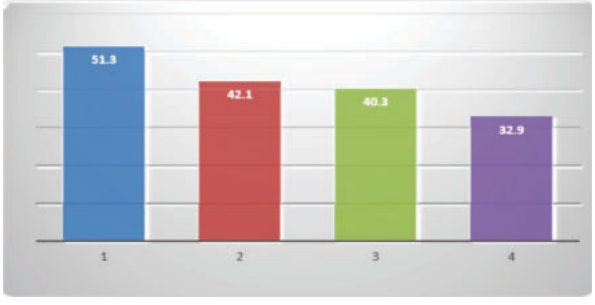

Fig: 13 Relationship between COPD severity and serum HDL levels

Fig: 14 Relationship between COPD severity and total cholesterol levels

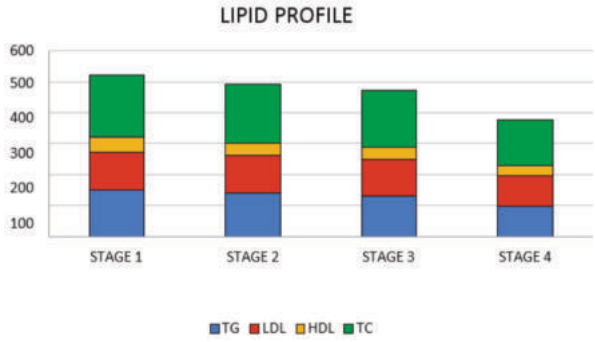

Fig: 15 Relationship between COPD severity and lipid profile

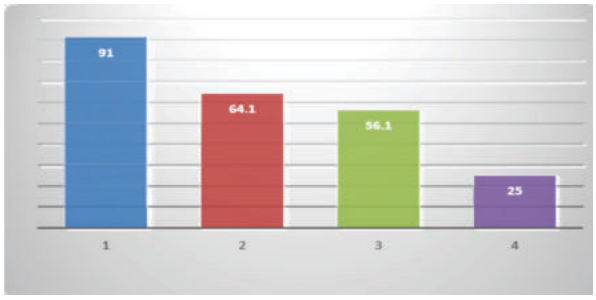

Fig: 16 Relationship between COPD severity and hemoglobin concentration in (a) Male (b) Female

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