Original Research Article

A study to assess nutritional profile in chronic obstructive pulmonary disease patients

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ABSTRACT

Background: The potential ill effects of malnutrition are numerous, such as decreased maximal respiratory muscle force, decreased hypoxic Ventilatory response and decreased resistance to infection. The objective was to assess nutritional profile in chronic obstructive pulmonary disease (COPD) patient.

Methods: The study was conducted at a tertiary care referral hospital. Period of study was one year. Present study was case control study. Institutional Ethics committee permission was taken. A total of 75 cases of chronic obstructive pulmonary disease and comparable controls were included in the study.

Results: Present study shows that there was significant difference in mid arm circumference and mid-thigh circumference between COPD cases and control groups as well as between serum pre-albumin and serum transferrin level, serum uric acid (p=0.018) and serum calcium level (p=0.002). There was no statistically difference with respect to serum total protein (p=0.308), serum albumin (p=0.533) and serum phosphorus level (p=0.064) between COPD patient and control groups. There was statistically significant difference in total lymphocyte count between COPD cases and control groups as well as between serum LDL and serum HDL, serum LDL and serum HDL with COPD grading. As COPD grading increased there was significant decrease in serum LDL and serum HDL level. There was no significant difference with respect serum TG (p=0.738), VLDL and total cholesterol level (p=0.063) between COPD cases and control groups.

Conclusions: Simple measurement of BMI, mid arm circumference and mid-thigh circumference can assess malnutrition in COPD patients and biochemical parameter like serum pre-albumin and serum transferrin may helpful in early detection of malnutrition.

Keywords: BMI, Mid arm circumference, Mid-thigh circumference

INTRODUCTION

The potential ill effects of malnutrition are numerous, such as decreased maximal respiratory muscle force, decreased hypoxic Ventilatory response and decreased resistance to infection.¹ Body weight and body mass index are useful screening tools in the initial nutritional evaluation, fat-free mass (FFM) may be a better marker of under nutrition in patients with COPD.² Active nutritional supplementation in undernourished patients with COPD can lead to weight gain and may lead to improvements in respiratory muscle function and exercise performance. This may be part of pulmonary rehabilitation program to increase respiratory function.
and to live symptom free life. COPD is characterized by a state of chronic illness. So, COPD is no longer to be considered to affect only the lungs and airways but also the rest of the body.

Thus we hypothesize that early detection of nutritional function in COPD patients and active intervention to correct the abnormalities may be helpful in correcting respiratory function and can be used as useful tool in pulmonary rehabilitation program for better management of COPD patients and active intervention can also prevent the further complication in COPD patients and thus may decrease the mortality and morbidity in COPD patients.

METHODS

The objective of the study was to assess the nutritional profile of patients with chronic obstructive pulmonary disease. The study was conducted at a tertiary care referral hospital. Period of study was one year. Present study was case control study. Institutional Ethics committee permission was taken. A total of 75 cases of chronic obstructive pulmonary disease and comparable controls were included in the study.

Inclusion criteria

Patients giving consent and age 18 to 75 years.

Exclusion criteria

COPD patients with family history of Diabetes mellitus, Known cases of congenital or acquired heart diseases, bronchial asthma, pulmonary tuberculosis, bronchiectasis, diabetes mellitus, hypertension & obesity, Patient taking any Anti-hyper lipidemic medications, Those not giving the consent, Non cooperative, Age less than 18 years and greater than 75 years.

Following evaluation was preformed

Liver and renal function test, complete blood count and differential leucocytes count, blood sugar, chest x ray, electrocardiogram and echocardiography (if required), Alpha 1 antitrypsin level (if required), Sputum for AFB, Serum protein, Serum pre-albumin, Serum transferrin, Serum uric acid, Serum calcium, Serum phosphorus, Total lipid profile.

GOLD classification of COPD on the basis of post bronchodilator FEV1.

Classification of severity of airflow limitation in COPD.

In patients with FEV1/FVC<0.70

- GOLD I - Mild (FEV1≥80% predicted)
- GOLD II- Moderate (50% ≤ FEV1 <80% predicted)
- GOLD III- Severe (30% ≤ FEV1 <50% predicted)
- GOLD IV- Very severe (FEV1 <30% predicted)

Nutritional assessment was done through following parameter

Clinical assessment

Body mass index, mid- arm circumference, mid –thigh circumference, other sign of malnutrition (if present).

Biochemical assessment

Total serum protein, Serum albumin, Serum pre-albumin, Serum transferrin, total lymphocyte count, Haemoglobin, Serum calcium, Serum uric acid, Serum phosphorus, Total lipid profile

Statistical analysis

Data was recorded and entered. Student t test was used and p value of less than 0.05 was considered significant.

RESULTS

Above data shows highly statistically significant difference with respect to total lymphocyte count, serum pre-albumin levels and serum transferrin levels (p<0.001) and fair significant with respect to serum uric acid level (p value 0.018) and serum calcium level (p value 0.002) between COPD cases and control groups. There was no significant difference with respect to total protein (p value 0.308), serum albumin (p value 0.533) serum phosphorus (p value 0.064) and hemoglobin (p value 0.653) between COPD cases and control (Table 1).

Mean LDL was significantly (=0.002) higher in COPD cases. And fair statistically significant low HDL level was observed between COPD cases and control (p=0.016). No significant difference was seen with respect to serum triglyceride level (=0.738), serum VLDL level (p=0.495) and total cholesterol level (p=0.06) between COPD cases and control groups (Table 2).

There was no significant difference between COPD grading in regards with serum albumin level (p=0.27) and serum total protein level (p=0.38) (Table 3).

There was a significant difference between COPD grading with respect to serum pre-albumin level and serum transferrin level (p<0.05). Serum pre-albumin was significantly different between moderate to very severe COPD grade and rest is not significant between grades of COPD (Table 4).

There was no significant difference between total lymphocyte count (p=0.99) and hemoglobin levels (p=0.23) between different grades of COPD (Table 5).
Table 1: Biochemical assessment of nutritional profile in COPD cases and controls.

| Variable                        | Group       | N   | Mean   | Standard deviation | P value |
|---------------------------------|-------------|-----|--------|--------------------|---------|
| Total protein (g/dl)            | Cases       | 75  | 7.67   | 0.54               | 0.308   |
|                                 | Control     | 25  | 7.53   | 0.64               |         |
| Serum albumin (mg/dl)           | Cases       | 75  | 3.62   | 0.62               | 0.533   |
|                                 | Control     | 25  | 3.71   | 0.78               |         |
| Total lymphocyte count (count/mm³) | Cases | 75  | 2748.41 | 679.97             | <0.001  |
|                                 | Control     | 25  | 1739.60| 543.05             |         |

Table 2: Lipid profile wise distribution of COPD cases and controls.

| Variable            | Group       | N   | Mean   | Standard deviation | P value |
|---------------------|-------------|-----|--------|--------------------|---------|
| Triglyceride (mg/dl)| Cases       | 75  | 123.21 | 48.35              | 0.738   |
|                     | Control     | 25  | 119.80 | 27.24              |         |
| LDL (mg/dl)         | Cases       | 75  | 120.55 | 43.15              | 0.002   |
|                     | Control     | 25  | 90.68  | 25.96              |         |
| HDL (mg/dl)         | Cases       | 75  | 34.20  | 7.90               | 0.016   |
|                     | Control     | 25  | 38.56  | 7.05               |         |
| VLDL (mg/dl)        | Cases       | 75  | 23.87  | 9.78               | 0.495   |
|                     | Control     | 25  | 25.31  | 6.75               |         |
| Total cholesterol (mg/dl)| Cases | 75  | 177.29 | 55.93             | 0.063   |
|                     | Control     | 25  | 155.48 | 26.32             |         |

Table 3: Comparison between different grades of COPD cases as regard to biochemical assessment of serum total protein and serum albumin.

| Variable                        | GOLD stage | N   | Mean   | Standard deviation | P value |
|---------------------------------|------------|-----|--------|--------------------|---------|
| Serum albumin (gm/dl)           | II         | 25  | 3.676  | 0.617              | 0.27    |
|                                 | III        | 25  | 3.720  | 0.664              |         |
|                                 | IV         | 25  | 3.452  | 0.581              |         |
| Serum total protein (gm/dl)     | II         | 25  | 7.658  | 0.611              | 0.38    |
|                                 | III        | 25  | 7.708  | 0.621              |         |
|                                 | IV         | 25  | 7.672  | 0.414              |         |

Table 4: Comparison between different grades of COPD cases as regard to biochemical assessment of serum pre-albumin and serum transferrin.

| Variable                        | GOLD stage | N   | Mean | Standard deviation | P value | II versus III | II versus IV | III versus IV |
|---------------------------------|------------|-----|------|--------------------|---------|---------------|--------------|---------------|
| Serum pre-albumin (mg/dl)       | II         | 25  | 17.16| 3.375              | 0.019   | NS            | S            | NS            |
|                                 | III        | 25  | 15.20| 2.708              |         |               |              |               |
|                                 | IV         | 25  | 14.32| 4.394              |         |               |              |               |
| Serum transferrin (mg/dl)       | II         | 25  | 91.48| 9.030              | 0.014   | NS            | NS           | S             |
|                                 | III        | 25  | 85.00| 13.13              |         |               |              |               |
|                                 | IV         | 25  | 94.88| 12.72              |         |               |              |               |
Table 5: Comparison between different grades of COPD cases as regard to biochemical assessment of total lymphocyte count and hemoglobin.

| Variable                  | GOLD stage | N  | Mean     | Standard deviation | P Value |
|---------------------------|------------|----|----------|--------------------|---------|
| Total lymphocyte count    | II         | 25 | 2751.96  | 848.52             | 0.99    |
|                           | III        | 25 | 2750.16  | 612.54             |         |
|                           | IV         | 25 | 2743.12  | 574.76             |         |
| Hemoglobin (gm %)         | II         | 25 | 12.58    | 1.09               | 0.23    |
|                           | III        | 25 | 14.62    | 1.07               |         |
|                           | IV         | 25 | 11.60    | 1.56               |         |

There was no significant difference within the grades of COPD with respect to serum uric acid level (p = 0.56), serum calcium level (p=0.27) and serum phosphorus levels (p=0.75) (Table 6).

There was significant difference between COPD grading with respect to LDL, HDL and total cholesterol level (p<0.05). And there was no significant difference with respect to VLDL (p value 0.802) and triglyceride level (p value 0.896) with grading of COPD patients (Table 7).

Significant negative correlation between the COPD grading and mid arm circumference (MAC) and mid thigh circumference (MTC), r = -0.334, p = 0.003, r = -0.329 n= 75 p =0.004 respectively. Overall, there was a strong, negative correlation between COPD grade to MAC and MTC. With Increases in COPD grading was correlated with decrease in MAC and MTC in COPD patients. But there was no statistically significant correlation between COPD grading and BMI (Table 8).

There was a significant negative correlation between the COPD grading and serum pre-albumin, r = -0.315, n= 75, p=0.006. Overall, there was a strong, negative correlation between COPD grade and pre-albumin. With Increases in COPD grade was correlated with decrease in pre-albumin level in COPD patient. But there was no statistically significant correlation between COPD grading and total protein, serum albumin and transferrin level in COPD patients (Table 9).

Table 6: Comparison between different grade of COPD cases as regard biochemical assessment of serum uric acid, serum calcium and serum phosphorus.

| Variable                  | GOLD stage | N  | Mean     | Standard deviation | P value |
|---------------------------|------------|----|----------|--------------------|---------|
| Serum uric acid (mg/dl)   | II         | 25 | 3.44     | 0.895              | 0.56    |
|                           | III        | 25 | 3.59     | 0.896              |         |
|                           | IV         | 25 | 3.28     | 0.747              |         |
| Serum calcium (mg/dl)     | II         | 25 | 9.54     | 0.79               | 0.27    |
|                           | III        | 25 | 9.15     | 0.86               |         |
|                           | IV         | 25 | 9.53     | 1.26               |         |
| Serum phosphorus (mg/dl)  | II         | 25 | 3.90     | 0.63               | 0.75    |
|                           | III        | 25 | 4.13     | 1.78               |         |
|                           | IV         | 25 | 4.05     | 0.82               |         |

Table 7: Comparison between different grades of COPD cases as regard to biochemical assessment of lipid profile.

| Variable                  | GOLD stage | N  | Mean     | SD | P Value | II versus III | II versus IV | III versus IV |
|---------------------------|------------|----|----------|----|---------|---------------|--------------|---------------|
| TG (mg/dl)                | II         | 25 | 126.64   | 62.58 | 0.896   | NS            | NS           | NS            |
|                           | III        | 25 | 120.20   | 47.16 |         |               |              |               |
|                           | IV         | 25 | 122.80   | 32.38 |         |               |              |               |
| LDL (mg/dl)               | II         | 25 | 141.88   | 63.86 | 0.009   | S             | S            | NS            |
|                           | III        | 25 | 109.72   | 19.40 |         |               |              |               |
|                           | IV         | 25 | 110.04   | 24.02 |         |               |              |               |
| HDL (mg/dl)               | II         | 25 | 36.92    | 7.12  | 0.045   | S             | NS           | NS            |
|                           | III        | 25 | 34.28    | 9.30  |         |               |              |               |
|                           | IV         | 25 | 31.40    | 6.28  |         |               |              |               |
| VLDL (mg/dl)              | II         | 25 | 24.36    | 12.79 | 0.802   | NS            | NS           | NS            |
|                           | III        | 25 | 22.79    | 8.98  |         |               |              |               |
|                           | IV         | 25 | 24.44    | 7.01  |         |               |              |               |
| Total cholesterol (mg/dl) | II         | 25 | 205.12   | 83.28 | 0.008   | S             | S            | NS            |
|                           | III        | 25 | 164.68   | 25.14 |         |               |              |               |
|                           | IV         | 25 | 162.08   | 29.42 |         |               |              |               |
There was a negative significant correlation between the COPD grading and serum total cholesterol, LDL and HDL levels. With increases in COPD grade correlated with decrease in total cholesterol and LDL and HDL level in COPD patients. But there was no statistically significant correlation between COPD grading and TG and VLDL level in COPD patients (Table 10).

Table 10: Correlation between COPD grade and serum lipid profile.

|     | TG     | Total cholesterol | LDL   | HDL   | VLDL  |
|-----|--------|-------------------|-------|-------|-------|
| N   | 75     | 75                | 75    | 75    | 75    |
| R value | -0.033 | -0.316            | -0.303| -0.287| 0.003 |
| P value | 0.781  | 0.006             | 0.008 | 0.013 | 0.978 |
| Significance | NS     | S                 | S     | S     | NS    |

DISCUSSION

In this study BMI shows significant difference between the cases and control groups. A significant decrease in BMI (p=0.015) was found in COPD cases group. There was significant difference observed between moderate to severe COPD but not between moderate to severe and severe to very severe COPD. BMI doesn’t correlate with severity of disease. This is in agreement with Karadag F et al and Yumin Zhou et al.5,6

There was highly significant difference was seen in mid arm circumference between COPD cases and control group (p<0.001). But there was a significant difference between moderate to severe and very severe and no significance observed between severe to very severe group of COPD patients. There was a significant negative correlation in relation to the severities of disease (p=0.003 and r = -0.334). Baccioglu et al observed that mid arm circumference, mid arm circumference area are significantly lower in COPD cases than control group (p<0.001) and no significant difference seen between the severities of disease. 7 Panda RK et al in 2015 observed that prevalence of under nutrition in COPD patient is (30/72) 41.6% based on body mass index (<18.5 kg/m²) and 63.8% (46/72) based on mid-upper arm circumference (<24 cm). But the author has not taken age matched control group as it is a cross sectional study.8

Highly statistical significant decrease in mid-thigh circumference was seen between COPD case and control group (p<0.001). There was significant negative correlation in relation to severity of disease (p=0.004 and r = -0.334). In comparison to our study Marquis K et al showed similar results.9 In a recent study done by Eduardo FM et al in 2014 observed that mid-thigh muscle area [Mid-thigh muscle area = mid-thigh circumference in cm* (0.314 *anterior thigh skin-fold in cm)^2/(4* 3.14)] was significantly low in COPD patients.10

There was no statistically significant difference seen in serum protein level between COPD cases and control group (p = 0.308). There was no significant difference seen between severities of disease. There was no significant correlation with severity of COPD grading. In comparison to our study, a recent Indian study has done by Agarwal et al in 2013 showed no significant difference in total protein level between COPD cases and control group. They also observed that there was no significant difference between severities of disease.11

There was no statistical significance seen in serum albumin levels between COPD cases and control group (p= 0.553). And no significant difference was seen between severities of disease. There was no significant correlation with severity of COPD grading. A similar study recently had done by Cingözler et al in 2014 showed no significant difference in serum albumin level in between COPD cases and control group.12

There was highly statistically significant increase seen in total lymphocyte count between COPD cases and control cases.
group (p<0.001). No significant difference was seen between severities of disease. In various study done by Koch A et al, Hodge SJ et al observed similar to our finding.13,14

Significant decrease was seen in serum pre-albumin level between COPD case and control group (p<0.001). Significant difference was seen between moderate to very severe COPD. There was significant negative correlation in relation to severity of disease (p = 0.006 and r = -0.315). Itoh T et al in 2004 showed decrease in pre-albumin level in underweight individuals whose BMI <18 kg/m² which was significant with p value <0.01 and also significant with control group which is consistent to our finding of decrease pre-albumin level as most of patient with COPD has low BMI <18 kg/m² in our study group.15 So pre-albumin can be used as an early indicator of malnutrition in COPD patients. But further study comparing serum carnitine level and serum pre-albumin is required to find which can be used as best indicator for malnutrition.

Significant decrease was seen in serum transferrin between COPD cases and control group as (p<0.001). Significant difference was seen between severe and very severe COPD according to severities of disease. There was no significant correlation to severity of COPD grading. A similar study done by Fiaccadori et al in 1994 showed significant decrease in serum transferrin level in COPD patients as compare to control group (p<0.001).16

Significant increase is seen in serum uric acid between COPD cases and control group as (p=0.018). No significant differences were seen between severities of disease. In a similar study done by Lopez IH et al in 2003 observed highly significant correlation between hypoxemia and uric acid levels in both stable and unstable COPD patients (p value<0.05), which is similar to our study but doesn’t correlate with severity of disease.17

No statistical significance was seen in serum calcium and phosphorus between COPD case and control group. No significant differences were seen between severities of disease. In contrary to our study done by Fiaccadori et al observed hypophosphatemia in COPD patient with respiratory failure.16

TG showed no significant difference between the cases and control groups. Our study results correlates with the study results of Hosney H et al in 2012 which showed no statically significant difference in TG level among cases and control group.18

TC showed no significant difference between the cases and control groups. The results of our study doesn’t correlate with study conducted by K Begum et al in 2010 which showed that TC concentration is statically significant in case group as compared with control group.19

HDL showed no significant difference between the cases and control groups. These findings are in accordance with study conducted by Attaran D et al in 2013 which showed that HDL concentration in COPD was significantly higher in cases as compared to control group.20

LDL shows significant difference between the cases and control groups. These findings are in accordance with Niranjan MR et al in 2011 where they found significant difference in LDL level in COPD case group and matched control group.21

VLDL shows no significant difference between the cases and control groups. In contrary, a study conducted by K Begum et al in 2010 showed that VLDL concentration in COPD patients was significantly higher than the controls (p = 0.001).18

Serum lipid TG, VLDL levels showed no statically significant difference in moderate (Grade II), severe (Grade III), very severe (Grade IV) (COPD according to GOLD criteria). Correlation of mean total cholesterol levels of patients with moderate, severe, very severe COPD was statically significant between moderate to severe and very severe but not between severe and very severe for both LDL and Total cholesterol level. To the best of our knowledge significance differences with severity of disease had not been well studied. Park et al in 2015 had demonstrated that there was significant increase in LDL and TG more for LDL cholesterol than TG.22

CONCLUSION

Simple measurement of BMI, mid arm circumference and mid-thigh circumference can assess mal-nutrition in COPD patients. For biochemical assessment serum pre-albumin may be used for early detection of nutritional abnormality in COPD patient. Serum transferrin can be used as alternative to serum pre-albumin for detection of nutritional abnormality in COPD patients

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REFERENCES

1. Law DK, Dudrick SJ, Abdou NI. Immuno-competence of patient’s with protein-calorie malnutrition: the effects of nutritional repletion. Ann Intern Med. 1979;79:545-50.
2. King DA, Cordova F, Scharf SM. Nutritional aspects of chronic obstructive pulmonary disease. Proceedings of the American Thoracic Society. 2008;5(4):519-23.
3. Roberto CA, Larsen PD, Agnew H, Baik J, Brownell KD. Evaluating the impact of menu labeling on food choices and intake. Am J Public Health. 2010;100(2):312-8.
4. Laghi F, Adiguzel N, Tobin MJ. Endocrinological derangements in COPD. Eur Respir J. 2009;34: 975-96.
5. Karadag F, Ozcan H, Karul AB, Yilmaz M, Cildag O. Correlates of non-thyroidal illness syndrome in chronic obstructive pulmonary disease. Respir Med. 2007;101:1439-46.
6. Zhou Y, Wang D, Liu S. The association between BMI and COPD: the results of two population-based studies in Guangzhou, China COPD. 2013;10(5):567-72.
7. Baccioglu A, Gurbay BE, Acican T. Body composition in patients with stable chronic obstructive pulmonary disease: comparison with malnutrition in healthy smokers. Eurasian J Med. 2014;46(3):169.
8. Panda RK, Sharma MK. Nutritional Status in Patients with Chronic Obstructive Pulmonary Disease: A Cross Sectional Study. J Evidence based Med Healthcare. 2015;2(42):7185-9.
9. Marquis K, Debigare R, Lacasse Y, LeBlanc P, Jobin J, Carrier G, et al. Mid thigh muscle cross-sectional area is a better predictor of mortality than body mass index in patients with chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 2002;166:809-13.
10. Miranda EF, Malaguti C, Marchetti PH, Dal Corso S. Upper and lower limb muscles in patients with COPD: similarities in muscle efficiency but differences in fatigue resistance. Resp Care. 2014;1:39(1):62-9.
11. Agarwal K, Sharma L, Menon B, Gaur SN. Comparison of nutritional status in chronic obstructive pulmonary disease and asthma. Indian J Allergy, Asthma and Immunol. 2013;27(2):115.
12. Cingözler O, Özge C, Tamer L. The Relation of Weight Loss with Hyperinflation, Serum Adiponectin, Ghrelin and Leptin Levels in Chronic Obstructive Pulmonary Disease. Eurasian J Pulmonol. 2014;16:21-6.
13. Miller LG, Goldstein G, Murphy M, Ginnis LC. Reversible alterations in immunoregulatory T cells in smoking: analysis by monoclonal antibodies and flow cytometry. Chest. 1982;82(5):526-9.
14. Koch A, Gazczkowski M, Sturton G, Staib P, Schinköthe T, Klein E, et al. Modification of surface antigens in blood CD8+ T-lymphocytes in COPD: effects of smoking. Eur Respir J. 2007;29:42-50.
15. Itoh T, Nagaya N, Yoshikawa M, Fukuoka A, Takenaka H, Shimizu Y, et al. Elevated plasma Ghrelin level in underweight patients with chronic obstructive pulmonary disease. Am J Resp Crit Care Med. 2004;170(8):879-82.
16. Fiaccadori E, Coffrini E, Fraccchia C, Rampulla C, Montagna T, Borghetti A. Hypophosphatemia and phosphorus depletion in respiratory and peripheral muscles of patients with respiratory failure due to COPD. Chest. 1994;105(5):1392-8.
17. Lopez IH. Serum uric acid levels among patients with chronic obstructive pulmonary disease. Chest 2003;124(4_MeetingAbstracts):168S-a.
18. Hosny H, Abdel-Hafiz H, Moussa H, Soliman A, et al. Metabolic syndrome and systemic inflammation in patients with chronic obstructive pulmonary disease. Egyptian J Chest Dis Tuberc. 2013;62(1):85-9.
19. Begum K, Begum MK, Sarker ZH, Dewan MRK, Siddique MJH. Lipid Profile Status of Chronic Obstructive Pulmonary Disease in Hospitalized Patients. Bangladesh J Med Biochem. 2010;3(2):42-5.
20. Attaran D, Towhidi M, Lari SM, Ayatollahi H, Asadi A, Majid Ghayour-Mobarhan, et al. Lipid Profile Status in Mustard Lung Patients and Its Relation to Severity of Airflow Obstruction. J Cardiothorac Med. 2014;2(1):113-7.
21. Niranja NM, Dapeer K, Rashmi BK. Lipoprotein Profile in Patients with Chronic Obstructive Pulmonary Disease in a Tertiary Care Hospital. South India J Clin Diagnost Res. 2011;5(5):990-3.
22. Park HJ, Leem AY, Lee SH, Song JH, Park MS, Kim YS, et al. Co-morbidities in obstructive lung disease in Korea: data from the fourth and fifth Korean National Health and Nutrition Examination Survey. Int J Chronic Obst Pulm Dis. 2015;10:1571.

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