Assessment of Pulmonary Function, Nutritional Status and Quality of Life of Elderly Men with COPD- A Pilot Study

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ABSTRACT

BACKGROUND

Chronic obstructive pulmonary disease (COPD) is characterized by progressive airflow limitation that is not fully reversible. COPD has important extrapulmonary manifestations such as weight loss, skeletal muscle dysfunction, oxidative stress etc that can lead to deterioration in the nutritional, functional and social status. The objectives of the current study were to assess the pulmonary function, nutritional status & quality of life of elderly subjects with COPD and to evaluate the association between them in elderly subjects with COPD.

METHODS

Elderly male subjects (n=36) with stable COPD visiting the outpatient department were assessed for nutritional status using Mini Nutritional Assessment-Short Form, lung function by spirometry, severity of dyspnoea, exercise capacity, health related quality of life and serum haemoglobin levels, using convenient sampling. Subjects were classified based on their nutritional status, stage of COPD and dyspnoea and were evaluated for association between the parameters.

RESULTS

Overall, 36 subjects were included in this pilot study. Fourteen subjects were at risk of malnutrition and 22 of them were malnourished. Decreased food intake was present in 15 subjects and gastrointestinal symptoms in 16 subjects. Majority of the subjects had moderate to severe COPD (88.9%). 21 subjects reported a perceived dyspnoea score of 3. Subjects with severe COPD had lower six-minute walk distance, and BMI and significantly higher dyspnoea score compared to subjects with moderate COPD. The lung function of subjects was found to decrease significantly with increase in severity of dyspnoea (p-value: % of FEV_1- 0.001, % of FVC- 0.026). Significant positive correlation was found between BMI, percentage of body weight and lung function parameters.

CONCLUSIONS

Majority of the subjects were found to be malnourished, and the reduction in food intake in a significant proportion of them was due to GI symptoms. BMI was positively associated with lung function. The severity of dyspnoea was found to negatively impact the health-related quality of life and BMI. Exercise capacity was influenced by the stage of COPD and severity of dyspnoea. Dyspnoea associated with COPD has important extrapulmonary effects.

KEY WORDS

Nutrition Status, Spirometry, Dyspnoea, Quality of Life, Walk Test

BACKGROUND

Chronic obstructive pulmonary disease (COPD) is characterized by persistent airflow limitation that is not fully reversible.[1] The global burden of COPD as reported by the global burden of disease study, 2017 is 299 million cases, with 247% increase in the rates compared to the prevalence rate of 199 million in the year 1990.[2] COPD is the third leading cause of death in the world in the year 2016.[3] In India, the COPD prevalence rate is reported to be 55.3 million in the year 2016, with an increase in the number of individuals in the year 1990 by 27.2 million. COPD was ranked as the second leading cause of death and disability-adjusted life year (DALY) in India in the year 2016.[4] COPD is a chronic inflammatory disease, and the inflammation is seen in the pulmonary and systemic components. Chronic inflammation is linked with the extrapulmonary manifestations, including weight loss, skeletal muscle dysfunction, cardiovascular disease, and osteoporosis. The systemic effects combined with the respiratory symptoms induce negative influence on exercise tolerance, nutritional status, health-related quality of life, and prognosis of the disease.[5]

The elderly population is at risk of developing malnutrition secondary to poor quality and quantity of diet consumed. The changes in physiological status, basal metabolic rate, lean body mass, digestive capacity, sensory abilities, mastication, functional status, and social status can precipitate malnutrition. Chronic illness and associated hospitalization can further increase the risk of nutritional inadequacy.[6] Changes in lung physiology with aging is known to reduce lung function.[7] The severity of airway obstruction in individuals with COPD combined with poor nutritional status, functional disability, and cognitive impairment can hamper the quality of life.[8,9] Thus, the objectives of the current study were to assess the pulmonary function, nutritional status & quality of life of elderly subjects with COPD and to evaluate the association between BMI, nutritional status, pulmonary function, dyspnoea, exercise capacity and health-related quality of life in elderly subjects with COPD.

METHODS

Study Design
The subjects were selected among the patients visiting the outpatient department of pulmonology for consultation after evaluation of their pulmonary function, using convenient sampling technique. Informed consent was obtained from the subjects after providing details on the purpose of the study, procedures, risks, benefits and rights of the subjects. Only stable subjects who were aged more than 60 years with well controlled symptoms and without exacerbations of COPD, were included in the study. After obtaining their informed consent. Clearance from the institutional human ethics committee of JSS Medical College was obtained (JSS/MC/PG/1971/2019-20). The study was carried out for a period of three months between January to March 2019. Spirometry was performed using Easy One Pro spirometer (ndd Medizintechnik, Zurich) by a trained nurse, according to the ATS guidelines.[10] The subjects were graded for severity of COPD using the GOLD criteria.[11] The subjects were categorized into various SES groups using their per capita income based on the updated BG Prasad scale for the year 2016.[12] The nutritional status of the subjects was assessed using mini nutritional assessment- short form (MNA-SF), which is a validated tool, recommended for use in the geriatric population.[13] The subjects were categorized into various groups based on BMI using cut-off's recommended for use in the South Asian population.[14] The health-related quality of life was assessed using St. George's respiratory questionnaire.[15] The severity of dyspnoea was evaluated using the MMRC dyspnoea scale[10] and the exercise tolerance by 6-minute walk test.[16] The data on the smoking habits, pattern, occupation, residence, and income using a structured questionnaire.

Statistical Analysis
The data are presented as mean and standard deviation or number and frequency as suitable. The independent samples t-test was used to measure the difference between the groups. A p-value of less than 0.05 was considered to be statistically significant. Pearson's correlation test was performed to evaluate the association between variables. The data obtained was analysed using SPSS version 19.0 for windows.

RESULTS

Demographic Profile
The demographic characteristics of the study population are presented in table no 1. The study group consisted of 36 male subjects, and 18 of them of them were in the 70-79 years age group; 17 subjects were in the 60-69 years category. All the subjects were ex-smokers and the pack years ranged between 12 - 120 years. According to the modified BG Prasad's classification, 13 (36%) subjects each belonged to the lower income group and lower-middle-income group. 10 (28%) of them were categorized as an upper-income group. All the subjects reported sedentary level of physical activity, out of whom 8 (22%) subjects reported very minimal physical activity restricted to movement in an indoor area.

Clinical Status
Majority of the subjects had moderate to severe stage of COPD. Severe dyspnoea (MMRC score- 3) was reported in 58% of the subjects, 11 subjects had a perceived dyspnoea score of 2 and 4 of them had perceived dyspnoea score of 1. 3 (8.3%) subjects had mild COPD, 14 (38.9%) of them had moderate COPD, 18 (50%) of them had severe COPD and 1 had very severe COPD. Among the subjects, 2 of them had diabetes mellitus, 4 of them had hypertension, and 26 of them pulmonary arterial hypertension. Majority of the subjects (n=24) were on inhaled drugs for the management of COPD. Among the subjects, 26 of them had a history of exacerbation in the previous year (Range 1-5). 11 subjects were anaemic, and 25 of them had normal haemoglobin. Elevated CRP (>5 mg/L) was found in 18 (50%) subjects.

Nutritional Status
Classification of subjects based on South Asian BMI cut-offs, revealed 14 (39%) subjects to be underweight, 14 subjects to have normal BMI (39%), 5 (14%) subjects to be overweight and 3 (8%) of them to be obese. 14 (38.9%) subjects were

found to be at risk of malnutrition and 22 (61.1%) of them were found to be malnourished after assessing using MNA-SF.

The nutritional status indicators, pulmonary function indicators, haemoglobin, quality of life scores, and 6-minute walk distance among the at risk and malnourished groups were compared. The data is presented in table no 2. Malnourished subjects had lower BMI, percentage of IBW, lower FVC, FEV_1, and FEV_1/FVC ratio compared to subjects at risk of malnutrition. The malnourished subjects had significantly lower MNA-SF score. Overall, 12 (33.3%) subjects reported weight loss during the last three months, and the mean weight loss was found to be 3.6 ± 2.5 kgs. Among the malnourished group, 15/22 subjects reported moderate to a severe decrease in food intake. Overall, 16 subjects reported the presence of gastrointestinal symptoms such as lack of appetite, early satiety, or fatigue during eating as the reasons for altered food intake. Differences in total SGRQ score, symptom score, and impact score was observed between the groups. The mean dyspnoea severity score was 2.21 ± 0.69 and 2.18 ± 0.59 in the at risk and malnourished groups, respectively. All the malnourished subjects and majority of the subjects (10) who were at risk of malnutrition reported an experience of psychological stress, related to a hospital visit or admission in the past three months.

Stage of Disease
The nutritional status indicators and quality of life scores of subjects with moderate and severe COPD were compared to evaluate the impact of severity of the disease. The data is shown in table no 3. The Mean MNA-SF score, BMI, percentage of ideal body weight, distance covered in six minutes, percentage of predicted distance were lower in the severe COPD group. Quality of life among the groups appeared to be similar. Subjects with severe COPD had significantly higher exacerbations of 2.3 in the previous year compared to 0.7 in the moderate COPD group (p<0.001). The severity of dyspnoea as perceived by the subjects, was also found to be higher in subjects with severe COPD. Subjects with mild COPD and very severe COPD were excluded due to insufficient number in the sub-groups.

Severity of Dyspnoea
The subjects were classified based on the severity of dyspnoea, and comparisons were made among the subgroups on pulmonary function, BMI, quality of life scores, and exercise capacity. The data is presented int table no 4. The majority (58%) of the subjects had a dyspnoea score of 2. The lung function indicators, BMI, percentage of ideal body weight, and exercise capacity indicators were found to decrease with increasing dyspnoea score. The SGRQ score increased with dyspnoea scores indicating lower quality of life in subjects with increasing severity of dyspnoea. Subjects with severe COPD had significantly higher level of perceived dyspnoea as assessed using MMRC scale. The correlation analysis of the selected clinical and nutritional parameters was analysed using Pearson's correlation coefficient test. The data is presented in table no 5. A significant positive correlation was found between BMI, percentage of body weight & lung function indicators.

Parameter	Mean±SD
Age (years)	69±5
Pack-years	43±33
Per capita income (rupees)	2677±1041

Parameter	Number (%)
Work Status	
Retired	26 (72.2)
Active	10 (27.8)
Area of Residence	
Rural	27 (75)
Urban	9 (25)
Smoking Habits	
Actively smoking	10 (27.8)
Ex-smokers	26 (72.2)

Table 1. Demographic Characteristics

Parameters	At risk of Malnutrition (n-14)	Malnourished (n-22)
	Mean±SD	Mean±SD
MNA score	9±1*	6±1*
BMI (kg/m²)	20.93±5.79	19.32±2.85
% of IBW	81±11	78.36±14.35
Symptom score	50±18	59±16
Activity score	68±17	69±21
Impact score	31±11	35±12
Total SGRQ score	45±11	49±13
6-minute walk distance (m)	419±128	417±110
% of predicted distance	81.11±11	78.36±14.35
FVC (L)	2.09±0.67	1.93±0.5
% FVC	72.50±23.2	72.23±19.03
FEV_1(L)	1.18±0.47	1.08±0.36
% FEV_1	53.80±21.5	52.56±16.39
FEV_1/FVC ratio	0.62±0.38	0.55±0.08
Haemoglobin (g/dl)	14±1.6	13.6±1.9

*indicates p-value of <0.01 between groups.
MNA- mini nutritional assessment, BMI – body mass index, IBW – ideal body weight, SGRQ – St. George's respiratory questionnaire, FVC - Forced vital capacity, FEV_1- Forced expiratory volume in 1 second

Table 2. Comparison of Nutritional and Clinical Parameters of Subjects Classified According to Nutritional Status

Parameters	Moderate COPD (n-14)	Severe COPD (n-18)	p-value
MNA score	6±1	7±2	0.159
BMI (kg/m²)	20.42±2.81	18.24±3.81	0.074
% of IBW	85.71±11.82	76.16±15.56	0.058
Total SGRQ score	48±15	48±11	0.988
6-minute walk distance (m)	457±134	391±105	0.142
% of predicted distance	81.81±13.78	77.63±12.57	0.385
MMRC dyspnoea score	1.93±0.475	2.44±0.511	**0.007**

MNA- mini nutritional assessment, BMI – body mass index, IBW – ideal body weight, SGRQ – St. George's respiratory questionnaire, MMRC- modified medical research council

Table 3. Comparison of Nutritional and Clinical Parameters of Subjects Classified According to the Severity of COPD

MMRC Dyspnoea Score	1 (n-4)	2 (n-21)	3 (n-11)	p-Value
FVC (L)	2.42±0.23	1.97±0.46	1.87±0.63	0.254
% FVC	91.75±10.78	74.33±18.16	61.45±21.75	**0.026**
FEV_1(L)	1.62±0.12	1.09±0.32	0.99±0.49	**0.020**
% FEV_1	81±10.49	52.4±14.38	44.11±17.91	**0.001**
FEV_1/FVC ratio	0.68±0.05	0.6±0.31	0.51±0.09	0.447
BMI (kg/m²)	22.77±7.79	20.05±3.59	18.7±3.72	0.261
% of IBW	96.75±32.99	83.9±15.28	78.27±14.63	0.208
Symptom score	51±24	55±18	58±15	0.728
Activity score	58±25	70±19	70±18	0.497
Impact score	23±10	34±13	36±9	0.140
Total SGRQ score	38±11	48±14	50±8	0.193
6-minute walk distance (m)	438±50	434±144	418±115	0.449
% of predicted distance	86.25±7.98	79.03±14.41	77.69±11.83	0.535

BMI – body mass index, IBW – ideal body weight, SGRQ – St. George's respiratory questionnaire, FVC - Forced vital capacity, FEV_1- Forced expiratory volume in 1 second,

Table 4. Comparison of Nutritional and Clinical Parameters of Subjects Classified According to the Severity of Dyspnoea

Parameter	FVC	FEV$_1$	% Post FVC	% Post FEV$_1$
Age	-0.074	-0.194	0.113	-0.015
MNA Score	0.048	-0.066	-0.066	-0.084
BMI	0.251	0.401*	0.334*	0.428**
% of IBW	0.218	0.375*	0.353*	0.443**

MNA- mini nutritional assessment, BMI – body mass index, IBW – ideal body weight, FVC - Forced vital capacity, FEV$_1$- Forced expiratory volume in 1 second

Table 5. Correlation Analysis of Age, Nutritional Status Indicators and Lung Function

DISCUSSION

Malnutrition is one of the important extra pulmonary manifestations of COPD that has a negative effect on the disease prognosis. Under nutrition is known to exist in 25-40% of patients with COPD.[17] The proportion of subjects with malnutrition in our study appears to be similar with reported values. Patients with weight loss are known to have poor respiratory mechanics and lower exercise capacity compared to patients with optimal body weight. Loss of body cell mass in the former is associated with the loss of respiratory muscle mass and diaphragm mass as well, which can lead to a reduction in both respiratory strength and endurance.[18] The prevalence of patients with malnutrition is known to increase with disease severity.[19] Skeletal muscle dysfunction is another important systemic manifestation seen in patients with COPD. Insufficient intake of nutrients, oxidative stress, chronic inflammation induced muscle protein breakdown, muscle atrophy are the causative factors of skeletal muscle dysfunction and can negatively impact the functional capacity of a patient with COPD, and the extent of the impact is dependent on the severity of disease.[20,21] This trend was evident in our study when subjects with moderate and severe COPD were compared. Mitra et al., have reported a significant positive correlation between BMI and FEV$_1$.[22] Shimray et al., have also reported a significant positive correlation between BMI and spirometry-based lung function measurements.[23] BMI is associated with a poor prognosis on patients with COPD and is known to be an independent predictor of mortality[24]. Results from the current study are in agreement with the positive association of BMI on lung function in subjects with COPD.

Dyspnoea during food intake is known to be one of the factors contributing to a reduction in food intake and in the long term, malnutrition.[25] Dyspnoea is known to be the most dominant respiratory symptom often associated with negative consequences on the quality of life in subjects with COPD. Numerous studies have reported this association. Okutan et al. have reported a positive correlation between stage of COPD and dyspnoea scale scores (<0.01) among 90 patients with stable COPD with a mean age of 68.5 ± 10.9 years.[26] Higher dyspnoea was also associated with activity impairment and lower quality of life among 245 out of 768 patients with COPD.[27] The presence of dyspnoea is reported to limit several daily activities as well as impair sleep in patients with COPD. Reduction in physical activity in order to avoid the development of dyspnoea has also been reported.[28] CRP is an acute phase protein primarily known to be elevated in the presence of infection and in the presence of inflammation. CRP is also known to be induced by interleukin-6 (IL-6), an inflammatory mediator which is elevated in smokers and patients with COPD. CRP is associated with the processes related with IL-6 and is considered as a systemic indicator of

lung inflammation.[29] Thus, elevated CRP may reflect alterations in metabolism patients with COPD.[30]

CONCLUSIONS

Although COPD is primarily a disease of the respiratory system, the systemic effects are varied and are important components that can modify the prognosis of the disease and other health-related aspects. In our study, the majority of subjects were found to be malnourished, and the state of malnutrition was identified with the use of MNA-SF. Problems associated with malnutrition were decreased food intake and the presence of GI symptoms. BMI was positively associated with lung function. Health-related quality of life decreased with increasing severity of dyspnoea, whereas exercise capacity was influenced by the stage of disease and severity of dyspnoea. The dyspnoea secondary to COPD was negatively associated with indicators of nutritional status, exercise capacity and health related quality of life in elderly male subjects with COPD.

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Page 2572