Original Research Paper

Volume -10 | Issue - 3 | March - 2020 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Medicine

SCREENING STRATEGIES FOR IDENTIFICATION OF COPD IN GERIATRIC POPULATION IN RURAL CENTRAL INDIA – A POPULATION BASED STUDY

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ABSTRACT Chronic obstructive pulmonary disease is leading cause of mortality and morbidity worldwide. The magnitude of problem is increasing but there are few population based studies from rural India about screening for early detection of COPD. The present study was undertaken focusing on identifying optimal screening strategy for identification of COPD in geriatric population of rural central India , based on screening with the history of smoking ,tobacco use, COPD clinical questionnaire ,PEFR and Spirometry testing . We studied 349 individuals. We analyzed the CCQ scores, PEFR values and the information about smoking exposure in spirometricaly confirmed COPD cases. The chance of detecting COPD is highest in the symptomatic population. Those with Symptom score more than 8 and those with reduced PEFR (less than 130) had higher chance of having COPD. When symptomatic participants with CCQ score >10 and smoking status were analyzed together, this strategy had maximum percentage yield for diagnosing COPD.

KEYWORDS : COPD, Geriatric, Screening

INTRODUCTION

Chronic obstructive pulmonary disease is leading cause of mortality and morbidity worldwide and its burden is projected to rank fifth in 2020 as a worldwide disease. Obstructive lung diseases are the most common causes of respiratory impairment in older adults.(1)

The Global Initiative for chronic obstructive lung disease guideline has defined COPD as a preventable and treatable disease with some significant extra pulmonary effects that may contribute to the severity in individual patients. The pulmonary component is characterized by airflow limitation which is not fully reversible. It is usually both progressive and associated with abnormal inflammatory response of lung to noxious particle or gases. (2)

Lung function declines with normal aging .The FEV1 decreases through the adult life and the decline accelerates somewhat past age 45.The rate of decline in FEV1 in longitudinal population studies of never smoking adults is about 20 to 40 ml per year. In smokers the rate of decline in lung function is accelerated and the FEV1 may decrease as much as 70 to 80 ml per year.(1)

Epidemiological studies show a clear relationship between pack years of smoking and loss of lung function, estimated at 7.4 ml per pack year in men. Generally symptoms of exertional dyspnoea become evident when FEV1 falls below 1.5 to 1.8 lit (approximately 60 % predicted) Exertional dyspnea becomes severe and patient is disabled when the FEV1 falls below 30 %. (1)

According to National centre for macroeconomics and health, Government of India, it has been estimated that there are 45 million Asthma and COPD sufferers in India and this number is expected to increase to 57.2 million over the next decade (4) The health burden is much higher than those due to other non communicable diseases such as hypertension, IHD, DM, and cancer. (5)

So although the magnitude of problem is increasing in the elderly age group, there are few population based studies from rural India about screening for early detection of COPD. It can help in early diagnosis of COPD. The present study was undertaken focusing on identifying optimal screening strategy for identification of COPD in geriatric population of rural central India , based on screening with the history of smoking ,tobacco use, COPD clinical questionnaire ,PEFR and Spirometry (FEV1,FVC,VEV1/FVC) testing . We are mainly focused on prevalence of COPD and optimal screening strategy for early detection since it is the only measure to decrease the healthcare burden of the disease.

AIM OF STUDY:

To determine the optimal screening strategy for diagnosis of COPD in geriatric population in rural central India.

MATERIALS AND METHODS

Setting

The study was conducted in 3 villages near MGIMS within 5 kms from the hospital. These are Nandora,Nagapur and Karanji Bhoge.

The total population of these villages is around 2800. The population base is the geriatric population in all three villages (383).

Study design

We used a community based cross sectional design for this study. The study base was all the elderly individuals (>60 years) with or without respiratory symptoms of chronic cough, or breathlessness. We screened all these people using history of smoking , COPD clinical questionnaire , PEFR ,and Spirometry to confirm presence of COPD by the GOLD criteria.(6)

Screening

INCLUSION CRITERIA

All above 60 individuals in the three villages - Nandora, Nagapur and Karanji Bhoge.

EXCLUSION CRITERIA

1) Recent eye surgery (Last 1 month)
2) Recent myocardial infarction (Within last 1 month)
3) Recent abdominal surgery (Last 1 month)
4) Stroke that is affecting the face
5) Refusal of consent

The individuals satisfying the above criteria were screened by performing pulmonary function testing. The pulmonary function testing was performed by using spirolab III portable spirometer.

Statistical analysis

Since this was a population based study, it was likely that the participants with a mild COPD having minimal symptoms will be detected by spirometry.

A baseline characteristic of the study cohort was analyzed. We analyzed the baseline Clinical COPD questionnaire scores, Smoking exposure, PEFR and various variables with the GOLD staging and spirometry parameter.

We identified COPD cases by Spiro metrically confirmed values of post bronchodilator FEV1/FVC <70 We studied the distribution of CCQ total score and divided them into tertiles. We identified tertile with higher COPD prevalence. We defined cut off of CCQ score by studying the detailed sensitivity and specificity analysis and likelihood ratio study. We also obtained ROC Curve to identify optimal cut offs. Similarly we studied the distribution of PEFR and determined optimal cut offs which would correctly identify most of COPD cases.

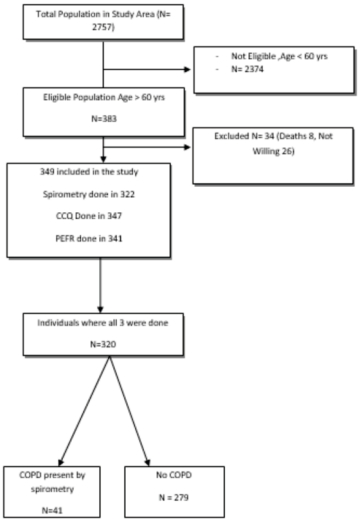
All statistical analysis was done by using STATA 10 software.

We studied various combination of screening strategies to identify the optimal strategy and finally studied the diagnostic yield of the strategy when used in a community based setting along with the percentage of COPD correctly identified or missed. We used this information to identify optimal screening strategy.

RESULTS

The total population of three villages is 2757.Of a total 2757 people ,383 individuals were 60 years or more .Out of this group there were 8 deaths and 26 did not give consent to participate hence they were excluded. Remaining 349 people were included in the study.Spirometry was done in 322 participants , Clinical COPD questionnaire (CCQ) was administered for 347 and Peak expiratory flow rate using peak flow meter was performed in 341 of them. A total of 320 participants received all the three tests, CCQ , Spirometry and PEFR .The history of smoking and tobacco consumption was also collected. Individuals were spirometrically confirmed to have COPD based on post bronchodilator FEV1/FVC <70%, hence fulfilling the GOLD criteria for the diagnosis of obstructive airway disease. Spirometrically confirmed COPD was present in 41 individuals, thus providing objectivity to the criteria. See study flow (Fig 1).

Fig 1.Study Flow Chart



A) Baseline Characteristics and Demographic Features

Table 1 Baseline characteristics of study population

Table 1 shows the baseline characteristics of study population. The mean age was 67 years and median age was 65 years with a range of 60 to 92 years. Thus the population represents young elderly. Also, two third of the individuals did not receive formal education. Very few continued education beyond primary school.

	All	Men	Women	P Value
Number	349	165	184	
Mean Age in yrs (SD)	67.13(6.06)	67.99(6.27)	66.35(5.76)	0.01
Education				
No Formal Education	229	80	149	
1-5 yrs	76	52	24	0.01
6-10yrs	37	28	9	
10 yrs +	7	7	0	

It also shows that females outnumbered males. Illiteracy was higher in females.

Table 2 COPD risk factors (Smoking)

There were 61 smokers (17 %) in the study population. On average individuals smoked for 40 years and as quantity of cigarettes or beedis smoked per day was 16.42.Thus average pack years of smoking exposure were 27.

	All	Men (165)	Women (184)	P Value
Smokers	**61**	**59**	**2**	**< 0.001**
Smoking Yrs		42.52(13.19)	10.3(17.0)	
Smoking Quantity		16.0(12.1)	15.5(20.5)	
Pack Years		34.1(26.2)	4(2.82)	
Tobacco Users	167	94[56.6%]	73[39.8%]	0.002
Tobacco Yrs		41.7(10.3)	43.4(15.3)	
Tobacco Quantity		2.9(4.8)	1.7(1.22)	

Of all smokers 59 (96.72 %) were men. The mean duration of smoking and pack years were higher in males. The mean exposure was 34 pack years in men and 4 pack years in women. While smoking was largely confined to men, tobacco use was equally distributed in men and women. They consumed tobacco for more than 40 years and the average quantity was 3 gm per day in men and nearly half of it in women.

Table 3 Distribution of CCQ scores in study population

We analyzed the distribution of Clinical COPD Questionnaire (CCQ) Score in study population. In this questionnaire the minimum score was zero and maximum of 60 .The maximum possible symptom score is 24 , functional score is 24 and mental score is 12 .The Mean (SD)of total and symptom, functional and Mental score are presented in Table 5.Of the total score of 60 the highest score in our population was 34.

	All (347)	Men (165)	Women(182)	P Value
CCQ S	4.36(2.16)	4.42(2.55)	4.31(1.74)	0.66
CCQ F	3.19(2.09)	3.28(2.25)	3.12(1.94)	0.46
CCQ M	0.59(0.82)	0.58(0.85)	0.60(0.49)	0.70
CCQ T	8.16(4.69)	8.29(5.31)	8.04(4.06)	0.63

Mean CCQ scores were similar in men and women. Mean CCQ S was 4.42 in males and 4.31 in female. Mean CCQ F was 3.28 in males and 3.12 in females. Mean CCQ M was 0.58 in males and 40.49 females. Mean CCQ T was 8.29 in males and 8.04 in females

Spirometric Variables

The median FEV1, FVC, FEV1/FVC were within normal range. The Mean FEV1 was 1.52 ,and FEV1 percentage predicted was 88.53 %, mean FVC was 1.81 and % predicted 86.71, mean FEV1/FVC was 84.01 %.Mean PEFR was 187.52.

Table 4 Distribution of Spirometric Variables by Gender

	All(322)	Men (153)	Women (169)	P Value
FEV1	1.52(0.56)]	1.80(0.56)]	1.26(0.42)]	0.001
FEV1 pp	88.51(32.21)]	96.50(34.74)]	81.30(27.92)]	0.001
FVC	1.81(0.68)]	2.18(0.67)]	1.47(0.48)]	0.001
FVC PP	96.76(30.86)]	33.80)]	79.11(25.72)]	0.001
FEV1/FVC	83.99(12.00)]	82.51(12.35)]	85.34(11.54)]	0.034
PEFR	339[187.33(84.35)]	162[221.52(96.54]	177[156.24(55.76]	0.001

As expected from normal physiological measures, women had significantly lower FEV1, FEV1 PP FVC, and PEFR as compared to men. However all these mean values were within normal range. This is because most of the population is normal individuals in community.

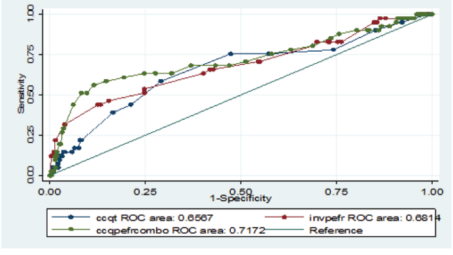


Fig 2 Comparing combination of CCQ T and PEFR with either alone

Fig 2 compares, PEFR, CCQ T with the combination of CCQT and PEFR. The AUC for CCQT is 0.65 and that for inv PEFR is o.68.The combination of CCQ T and PEFR has AUC of 0.71 and the combination has increased specificity than either parameter assessed alone. So for screening either strategy is equally good. Addition of PEFR to CCQ only marginally improves accuracy.

Table 5: Comparison of CCQ Total and PEFR in subgroup of individuals

	Category	No	Cut off	Best Sensitivity	Best Specificity	Area Under Curve	95 % CI
CCQT							

For COPD	Men	152	>8	72.7	53.8	0.66	0.51-0.80
	Women	167	>8	78.9	52.03	0.64	0.51-0.78
	Smoker	60	>10	80.0	78.0	0.78	0.60-0.96
	Non Smoker	249	>8	75.8	50	0.63	0.51-0.74
PEFR							
for No COPD	Men	152	>180	70.7	50.0	0.65	0.53-0.78
	Women	167	>120	79.7	68.4	0.77	0.64-0.91
	Smoker	60	>180	66.0	60.0	0.67	0.47-0.87
	Non Smoker	249	>130	81.8	55.1	0.71	0.59-0.83

Table 5 compares the role of PEFR and total symptom score for detecting COPD in various subgroups. Non smokers with CCQT cut off of 8 had 78 % sensitivity and Smokers with cut off of 10 had 80 % sensitivity. The AUC is 0.78 for smokers with CCQT more than 10, and 0.66 in men with CCQ total more than 8.Thus male smokers have higher COPD. Women with PEFR less than 120 had AUC of 0.77 followed by non smokers with PEFR less than 130had AUC of 0.71.

Table 6: Various Screening Strategies—A Comparison

Strategy Used	Screened	COPD Identified	% Yield	COPD Missed	% Missed
All	349	41	11.74	0	
CCQ > 8	162	32	19.75	9	21.95
CCQ >10	69	19	27.53	22	53.65
Smoking +	60	11	18.33	30	73.17
CCQ 8 & Smoking +	30	10	33.33	31	75.60
CCQ 10 & Smoking +	19	9	47.36	32	78.04
PEFR					
PEFR < 180	181	30	16.57	11	26.82
PEFR < 150	138	27	19.56	14	34.14
PEFR < 130	90	22	24.44	19	46.34
PEFR < 120	62	20	32.25	21	51.21

Table 6 compares various screening strategies for identification of COPD.To identify all 41 individuals with COPD we screened 349 individuals (yield 11.74 %)

If our aim is to detect maximum individuals with COPD with minimum number to screen, screening those with CCQ 8 or more is optimal. We can still identify 32 out of 41 (78 %),all COPD by screening only half of the population.(Yield 20%).Although percentage yield is higher in groups with combination of CCQ and smoking status, 75 % of COPD are missed hence from community screening point of view it may not be the optimal screening strategy.

Similarly by using PEFR less than 180, 30 of 41(73 %) can be identified by screening around half of the population and 26 % of COPD are missed.

Thus lower PEFR and high symptom score group helps to identify larger number of COPD in a community based setting.

Summary and conclusion

We screened 383 individuals. Out of these finally there were 320 participants who consented for all 3 investigations, Spirometry, PEFR and CCQ. Spirometry was performed as per ATS /ERS guidelines. Post bronchodilator FEV1/FVC <70 was used to confirm COPD.

We studied 349 individuals of whom 165 (47%) were men. The mean age of study patients was 67 years (range 60-92 years).We analyzed the CCQ scores, PEFR values and the information about smoking exposure in spirometricaly confirmed COPD cases.

Patients with severe COPD were found to have more CCQ scores as compare to normal. Total scores differed significantly between the severe COPD (stage III and IV) and mild COPD (stage I).Similarly PEFR values are significantly lower in severe COPD.

The various CCQ scores had an inverse correlation with spirometry values. Patients with higher score were found to have lower FEV1.
Thus we concluded that:

- Undetected airflow obstruction is common in geriatric age group.
- Patient with more severe disease (GOLD stage III and IV) have poor health related quality of life as compared to mild disease and have higher scores on symptom scale.
- Screening of symptomatic population can diagnose more cases of COPD compared to screening asymptomatic population.
- Smokers have higher prevalence of COPD.
- Rising prevalence of COPD in rural women may be due to exposure to biomass fuel and indoor air pollution.
- For screening in community, smokers with higher symptom score subgroup yields maximum for detection of COPD.
- Low PEFR is common is severe COPD.
- CCQ and Modified Wright Peak Flow Meter can be used as easy and low cost alternative to field based spirometry.
- Individuals with higher scores and low PEFR may be subjected to office spirometry for ascertaining diagnosis of COPD.

Our final model shows that the chance of detecting COPD in a geriatric population is highest in the symptomatic population. Those with Symptom score more than 8 were more likely to have COPD. Similarly those with reduced PEFR (less than 130) had higher chance of having COPD.

Similarly, when symptomatic participants with CCQ score >10 and smoking status were analyzed together, this strategy had maximum percentage yield (42.10%)

Our study has several strengths. It is a population based study exclusively studying COPD in geriatric population. We applied American Thoracic criteria to judge the quality and appropriateness of the spirogram. We collected data on both cigarette smoking and tobacco use. We defined COPD by GOLD criteria and then analyzed various screening strategies individually and in combination and tried to find out optimal screening strategy as discussed above.

Finally, our enrollment in study was excellent and only a few people refused participations.

Our study has several inherent limitations. Firstly, we could get only 41 patients with COPD: thus our sample size was small. The relatively small numbers do limit the interpretation of differences in questionnaire scores between various categories. Secondly, because smoking is a taboo in our culture and patients often hide their smoking history from their physicians whom they trust, it is possible that we might have underestimated the prevalence of smoking in our study population. Thirdly, it is difficult to obtain an accurate and reproducible spirogram from geriatric participants.

Since the entire CCQ score was self reported there is a chance for recall bias.

We did not consider the COPD exacerbations while assessing severity by symptom scores. Exacerbations requiring a physician visit or a hospitalization would be less subject to recall bias.

GOLD definition of COPD which we used was based on a post bronchodilator FEV1/FVC ratio < 70 at a single examination. The use of the fixed 0.70 Cutoff to diagnose airflow limitation may overestimate the prevalence of the disease in elderly persons, and hence lower limit of normal is now considered superior to spirometric values .However for practical reasons it is the most widely accepted definition which is simplified case definition for epidemiologic purposes rather than a definitive clinical diagnosis In conclusion, for screening COPD in geriatric population presence of symptoms and low PEFR are simple and inexpensive tools. Further confirmation can be done by spirometry. Smoking is an important risk factor but other factors like indoor air pollution may be contributory. The CCQ offers a means to assess the severity of symptoms and their impact on various aspects of life and health related quality of life. Although symptoms are subjective measures and CCQ reflect symptom or severity from a patient's perspective, they do correlate well with the airflow limitation. Hence questionnaire can serve as a first level screening tool for identification of subjects at risk of COPD .It can also prompt individuals at risk to undergo spirometric testing. Since even severe airflow limitation is undiagnosed or detected, actively probing for respiratory symptoms might help to bring more undiagnosed COPDs n the forefront, thereby increasing the detection of COPD. Symptoms scores can be supplemented by technology to judge severity of disease. It will be more economically efficient than broad population level screening for COPD. Further work with larger population size is needed to determine the performance of these tools for early diagnosis and therapeutic interventions in COPD.

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