EARLY DETECTION OF COPD IN ASYMPTOMATIC SMOKERS USING SPIROMETRY

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ABSTRACT

BACKGROUND

COPD (Chronic Obstructive Pulmonary Disease) is now ranked sixth among the leading cause of death worldwide according to 1990 world burden of disease study. Among various causes of COPD tobacco smoking is leading cause. Smokers seek physician's attention only when they develop mild to moderate exertional dyspnoea by the time 50% of their ventilatory reserves lost. This loss is also irreversible. Therefore, it is necessary to diagnose COPD incidence earlier in smokers, so that measures such as smoking cessation can be initiated at appropriate time and save the ventilatory capacity in smokers. This study is done to detect COPD earlier in south Indian smokers and to analyse the association of age of onset, duration, pack years and severity of disease according to GOLD criteria.

MATERIALS AND METHODS

It was a prospective descriptive cross sectional study done in 174 male smokers. They were subjected to spirometry. The predicted and measured values of FEV1, FVC, FEV1/FVC, PEFR, FEF 25-75 were recorded. The data were analysed as per GOLD criteria and the subjects classified as mild, moderate, severe and very severe air flow obstruction using statistical test.

RESULTS

FVC has got significant negative correlation coefficient (p 0.001) with FEV1/FVC ratio. FEV1 has got significant positive correlation coefficient (p 0.001) with FEV1/FVC. 19/174 had mild and 12/174 had moderate obstruction pattern. All the participants with obstructive spirometry are asymptomatic during study. Airflow limitation with FEV1/FVC ratio <70 was noted in 17.816% (n=31). FEV1/FVC has significant positive correlation with FEV1 and significant negative correlation with Smoking Index and FVC.

CONCLUSION

61.29% of asymptomatic smokers had mild COPD and 38.7% had moderate COPD as per GOLD guidelines. The FEV1/FVC ratio as a screening tool to detect the presence of COPD in asymptomatic smokers is established.

KEYWORDS

Smoking Index, COPD, Spirometry, GOLD Criteria, FEV1, FVC.

HOW TO CITE THIS ARTICLE: Senthilnathan NK, Mohanasundaram T, Muthuman L, et al. Early detection of COPD in asymptomatic smokers using spirometry. J. Evolution Med. Dent. Sci. 2016;5(37):2178-2182, DOI: 10.14260/jemds/2016/508

INTRODUCTION

Among non-communicable diseases COPD is emerging as one of the leading cause of mortality in INDIA. The incidence and prevalence of COPD is increasing throughout the world with more population is reaching the age group above 60 years at which the disease normally develops. It is projected to become third leading cause of mortality by 2020.[1] Prevalence of COPD in people aged more than 30 years in India is 2.7% in females and 5% in males according to meta-analysis of population based study by Jindal SK et al.[2] Smoking not only causes health hazard to individual, it also produces environmental tobacco smoking (ETS) to non-smokers as it contaminates the atmosphere. Among various causes of COPD tobacco smoking is the leading cause. Smokers often ignore the early symptoms of COPD such as cough and sputum production. Even treating physician often ignores it as normal in smokers.

Financial or Other, Competing Interest: None.
Submission 22-03-2016, Peer Review 17-04-2016,
Acceptance 22-04-2016, Published 06-05-2016.
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DOI: 10.14260/jemds/2016/508

Smokers seek physician attention only when they develop mild to moderate exertional dyspnoea, by that time 50% of their ventilatory reserve is lost, which is irreversible.[3] Therefore it is necessary to diagnose COPD early in smokers, so that smoking cessation can be emphasized and educated at appropriate time to preserve the ventilatory capacity in smokers.[4] Post bronchodilator Spirometry remains the gold standard for diagnosis and follow up of COPD patients. Spirometry is best standardized and according to GOLD criteria it can categorize the severity of disease.[5] this study is done to detect COPD earlier in South Indian smokers and to correlate with age of onset, duration, pack years, smoking index and severity of disease according to GOLD criteria. In our study after identifying the patients with COPD the severity is assessed according to above guidelines.

AIMS AND OBJECTIVE

1. Early detection of COPD in asymptomatic smokers by using spirometer.
2. To correlate Smoking index and age of onset of first smoke with FEVI/FVC Ratio.
3. To Study the relationship between Smoking index and FEV1/FVC ratio with severity of COPD.

MATERIALS AND METHODS

Place of Study

Mahatma Gandhi Memorial Government Hospital Attached to K.A.P. Viswanatham Government Medical College, Tiruchirappalli in Southern Region of India.

Period of Study

From January 2014 to August 2014.

Study Design

A prospective descriptive cross sectional study.

Institutional Ethical committee approval obtained. The study population was well explained about the study and its purpose in local language. Informed and written consent obtained from study population.

Inclusion Criteria

1. Subjects with history of smoking and age above 25 years.
2. No significant respiratory symptoms.
3. Regular smokers.
4. Willing to undergo spirometry.
5. Willing to give consent to participate in the study.

Exclusion Criteria

1. Subjects with smoking cessation.
2. History of respiratory disease like Tuberculosis, Bronchial asthma or Occupational lung disease.
3. On inhaled bronchodilators or corticosteroids.
4. Diabetes mellitus, Hypertension and Coronary artery heart disease.
5. Chest wall and vertebral deformities like pectus, kyphosis, scoliosis etc.
6. Inadequate spirometry like air escape, failure to reach plateau are excluded.

Study Group

Patients attending the outpatient Department of tertiary care hospital, Mahatma Gandhi Memorial Government Hospital attached to KAP Viswanatham Government Medical College, Tiruchirappalli in southern region of India.

Sample Size

Calculated from prevalence in North Indian and Madras study. Total number of subjects included was 174. All are men with history of smoking

METHODOLOGY

After getting consent from subjects they were given short lecture using printed modules in Tamil language and demonstration of spirometry is done by the technician who does the procedure. Quantum of smoking was calculated using smoking index. Height, weight and BMI were recorded. They were subjected to spirometry 15 mins after 400 mcg of salbutamol nebulisation as per GOLD criteria. The predicted and measured values of FEV1, FVC, FEV1/FVC, PEFR, FEF 25-75 for all the patients were recorded. Minimum of three trials and maximum of eight trials done for each subject based on guidelines from American Thoracic Society.[6] The data were analysed as per GOLD criteria and the subjects classified as mild, moderate, severe and very severe air flow obstruction using statistical test.

RESULTS & ANALYSIS

PARAMETERS (N=174)	MEAN (SD)	MINIMUM	MAXIMUM
AGE	44.9943 (8.794)	28	65
ONSET	20.65 (2.634)	16	26
BMI	22.6925 (3.101)	16.5	32
SI	226.821 (77.315)	80	450
FVCp	87.31 (58.383)	58	822
FEV1p	79.97 (16.248)	51	152
FEV1/FVCp	98.55 (17.961)	60	139
MEF 25-75	64.4 (31.458)	11	191
MEF 75	68.68 (23.448)	18	137
MEF 50	66.66 (24.668)	22	133
MEF 25	59.90 (32.588)	7	247
PEF	69.74 (22.198)	24	128
FVC m	3.2059 (.78459)	1.33	5.46
FEV1m	2.7059 (.68959)	1	4.53
FEV1/FVC m	.7755 (.07193)	0.18	0.85

Table 1: Descriptive Statistics

Onset- Age of First Smoke.
BMI-Body Mass Index.
SI-Smoking Index.
FVCp- Forced Vital Capacity (Predicted).
FEV1p – Forced Expiratory Volume in 1 second (Predicted).
MEF 25-75 – Mid Expiratory Flow.
PEF- Peak Expiratory Flow.
FVCm- Forced Vital Capacity (Measured).
FEV1m – Forced Expiratory Volume in 1 Second (Measured).

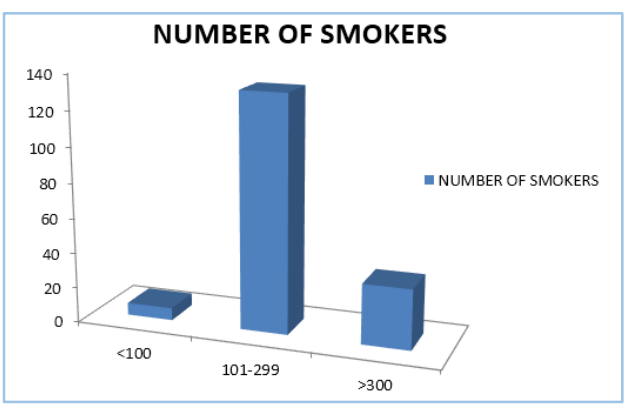


Fig. 1: Smoking Index Distribution in Smokers

Sl. No.	Number of Smokers	Percentage
<100	7	4.02%
101-299	133	76.43%
>300	34	19.43%

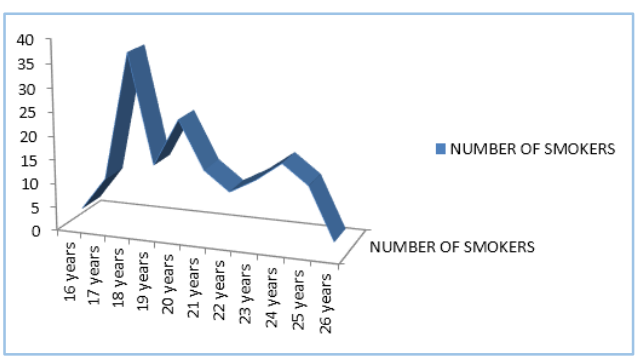


Fig. 2: Age of First Smoke among Smokers

1. Youngest age is 16 years.
2. Maximum number observed is at 18 years.

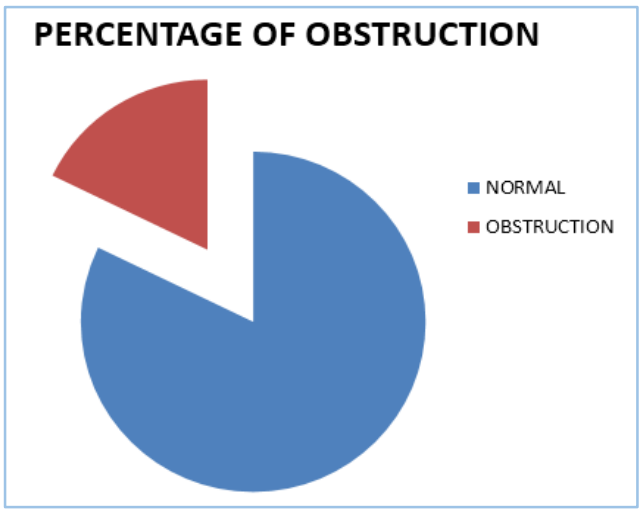


Fig. 3: Distribution of Obstructive Lung Disease in Spirometry

Normal spirometry – 82.18% (n=143).
Obstruction- 17.81% (n=31).
Among Obstructive Pattern.
Mild Obstruction- 61.29% (n=19).
Moderate Obstruction- 38.7% (n=12).

ONE SAMPLE T TEST		
PARAMETERS (N=174)	**MEAN (SD)**	**p VALUE**
AGE	44.9943 (8.794)	0.075
ONSET	20.65 (2.634)	0.001***
BMI	22.6925 (3.101)	0.101
SI	226.821 (77.315)	0.001***
FVCp	87.31 (58.383)	0.001***
FEV1p	79.97 (16.248)	0.002**
FEV1/FVCp	98.55 (17.961)	0.018*
MEF 25-75	64.4 (31.458)	0.065
MEF 75	68.68 (23.448)	0.651
MEF 50	66.66 (24.668)	0.062
MEF 25	59.90 (32.588)	0.035*
PEF	69.74 (22.198)	0.564
FVC m	3.2059 (.78459)	0.054
FEV1m	2.7059 (.68959)	0.322
FEV1/FVC m	.7755 (.07193)	0.001***

Table 2: T Test for Significance

*is p value <0.05.
**is p value <0.01.
***is p value < 0.001.

	ONSET	**FVCm**	**FVCp**	**FEV1m**	**FEV1p**	**FEV1FVCm**	**FEV1FVCp**
CHI SQUARE	64.613a	107.609b	77.59c	87.33b	180.39d	108.46e	79.36d
df	10	97	52	97	46	21	46
p VALUE	0.001***	0.217	0.012*	0.749	0.001***	0.001***	0.002**

Table 3A: Spirometric values Correlation

	PEF	**MEF 25-75**	**MEF 75**	**MEF 50**	**MEF 25**	**BMI**	**SI**	**AGE**
CHI SQUARE	69.86f	61.55g	71.07h	85.03i	98.41j	108.89k	240.25l	57.72m
df	67	80	68	71	78	83	39	35
p VALUE	0.382	0.938	0.376	0.122	0.059	0.03*	.001***	.009**

Table 3B: Correlation with SI

*is p value <0.05.
**is p value <0.01.
***is p value < 0.001.

SI has significant negative correlation with FEV1m _0.225 (p 0.003), FEV1p _0.158 (p 0.03), FEV1/FVCm _0.476 (p0.001), FEV1/FVCp _0.406 (p 0.001), PEF_0.256 (p 0.001), MEF 25-75_0.216 (P 0.004). FEV1/FVCm has significant positive correlation with FEV1p 0.257 (p 0.001). FEV1/FVCp has significant negative correlation with FVCp_0.229 (p 0.002) and significant positive correlation with FEV1 p 0.254 (p 0.001), FEV1FVCm 0.460 (p 0.001).

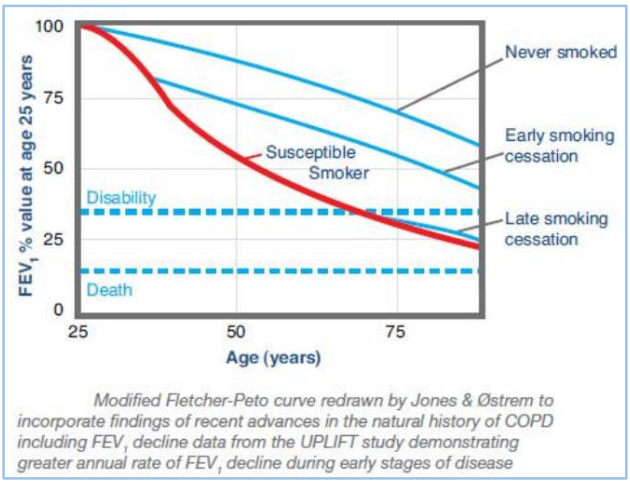
DISCUSSION

Smoking Index.[7] (SI)

In countries like India smoking of tobacco varies from person to person. It may be either cigarette or bidi. Cigarettes are 10 per pack and bidis 15-24 per pack.

So quantum of smoking by pack years is not applicable to our country. Thus evolved smoking index, which is expressed as number of cigarettes/bidis smoked per day multiplied by years of smoking.

Meanwhile as we compare pack year and smoking index for example 1 bidi per day for 10 years is same as 10 bidis/day for 1 year. It clearly indicates the amount of exposure. SI is also categorized as mild 100, moderate 100-300 and severe 300 as per Lung India, smoking index- a measure to quantify cumulative smoking exposure, 1988.[6] With all this literature review, the original curve of Fletcher and Peto has been modified and published as follows in natural history of obstructive lung disease.[8] The earlier curve predicted that lung damage occurs at old age but it was proved wrong. The newer concept is damage to lung volumes in smokers occur at much earlier as predicted by spirometry.



Modified Fletcher-Peto curve redrawn by Jones & Østrem to incorporate findings of recent advances in the natural history of COPD including FEV1 decline data from the UPLIFT study demonstrating greater annual rate of FEV1 decline during early stages of disease

This modified curve of Fletcher and Peto clearly shows that smoking cessation started at earlier age is more beneficial than at later age in regard to obstructive lung pathology. The curve also gives clear evidence that smoking cessation started before forty years is more beneficial than later. So we included persons from the age of 25 years in this study. Any intervention that is done after loss of half of lung volume is not useful for improving the quality of life in COPD patients.

GOLD

Global Initiative for Obstructive Lung Disease requires FEV1FVC ratio less than 0.7 post bronchodilator.

Criteria for COPD Severity

1.	Mild COPD	- FEV1/FVC <0.7 and FEV1p> 80%
2.	Moderate COPD- FEV1/FVC <0.7 and FEV1p 50%- 80%	
3.	Severe COPD	- FEV1/FVC <0.7 and FEV1p 30%- 50%
4.	Very severe COPD- FEV1/FVC <0.7 and FEV1p< 30%	

Or

FEV1p <50% and chronic respiratory failure.

The population in the study group is representative of patients attending the Outpatient department in the tertiary care hospital Tiruchirappalli, South India. The prevalence of COPD in this population is 10.2%. The prevalence of smoking has increased and 50% of males smoke either cigarette or bidi. All the participants were male. It was ensured that all the participants continue to smoke and does not have respiratory symptoms and signs during the study. Most of them were sales representatives, vendors and auto/taxi drivers by occupation. The parameters collected were age of first cigarette, BMI, SI, FEV1, FEV1/FVC both measured and percent, MEF25-75, MEF75, MEF50 and MEF 25. The results were statically analysed.

Age: The mean age was 44.994 (8.794). Most of them were between 39-49 years (n=67) 38.5%. Youngest age in this study is 28 years. Age group 61-71 years is only 2.87% (n=5). Significant negative correlation with FVCm _0.387 (p 0.003), FEV1m _0.478 (p 0.001), FEV1FVCm _0.300 (p 0.001). This correlates well with Natural history pattern of COPD in which as the age advances the severity of disease progresses as explained by Fletcher and Peto curve.

Less number of patients in >60 years is probably due to occurrence of symptoms as age advances and Our study included only asymptomatic patients.

BMI

The mean BMI was 22.6925 (3.1010). About 76.43(n=133) were in 18.5-24.9 BMI range. Underweight noted only in 5.172% (n=9) probably our study included only asymptomatic population of smokers. Since most of the participants are middle aged working group they were in BMI range of normal to overweight 89.64% (n=140). There is no correlation of BMI with severity of obstructive pattern in our study

Smoking Index

About 78.735% (n=137) participants had moderate SI i.e. 100-300. Severe SI observed in 21.26% (n=37). SI and age has significant positive correlation coefficient 0.616(p 0.001) which is consistent with previous studies. SI and FEV1/FVC ratio both m and p has significant negative correlation coefficient (p 0.001) i.e. SI increases FEV1/FVC ratio decreases. Moderate obstruction had SI of 400 (88.25) and mild obstruction had SI of 310(66.50). SI also has significant negative correlation coefficient (p 0.001) with MEF 25-75 which is again consistent with presence of small airway disease in smokers with COPD. FEV1m_ 0.225(p 0.003), FVCm _0.187 (0.01) alone had correlation with SI. When percentage is considered they does not correlate. Thus FEV1/FVC ratio is gold standard for screening the presence of airflow limitation in smokers as indicated in study Stralelis G, et al[9] and Zielinski et al[10] which is consistent with our study.

Age of First Smoke

Majority started smoking around 20 years. About 1/5th (n=37) 19.54 % started to smoke at 18 years. Age of first smoke does not have any correlation with obstructive lung disease in our study (p=.839). It is the quantity of smoke and not the duration of smoke correlates with severity of airflow limitation.

FVC

It has also got significant negative correlation coefficient (p0.001) with FEV1/FVC ratio. These are well established in various studies and reproduced in our study also.

FEV1

Significant positive correlation (p 0.001) with, FEV1/FVC, MEF 25-75 which is consistent from previous studies. According to GOLD criteria 19/174 had mild and 12/174 had moderate obstruction pattern. All the participants with obstructive spirometry are asymptomatic during study. But when only FEV1 value is considered 57.47% (n=100) had FEV1 >80. 42.52% (n=74) had FEV1 50-80%. So in determining the obstructive pathology we need FEV1/FVC or FEV1/FEV6. FEV1 alone is not useful as screening criteria for diagnosis of COPD in asymptomatic smokers.

FEV1/FVC

Airflow limitation with FEV1/FVC ratio <70 was noted in 17.816% (n=31). Out of which when applied to GOLD guidelines mild obstruction noted in 61.2903% (n=19). Moderate obstruction seen in 38.7096% (n=12). None of

them had severe or very severe obstruction. FEV1/FVC has significant positive correlation coefficient (p 0.001) with FEV1 and MEF 25-75. It has also got significant negative correlation coefficient (p 0.001) with SI and FVC.

CONCLUSION

1. The most common age of first smoking is 18 years and all participants had started smoking by 26 years.
2. The youngest age of first smoking is at 16 years.
3. The age of first smoking does not have significance with airflow limitation.
4. The most common age group found is 39-49 years.
5. The most prevalent BMI is 18.5-24.9 and does not have significance in respect to airflow obstruction.
6. SI has significant negative correlation with FEV1/FVC and Significant positive correlation coefficient with age.
7. The quantum of smoking correlates with severity of airflow obstruction as indicated by SI.
8. There is 17.8% of asymptomatic smokers have airflow limitation in the form of obstructive lung disease.
9. There is 61.29% of asymptomatic smokers had mild COPD and.
10. 38.7% had moderate COPD as per GOLD guidelines.
11. The FEV1/FVC ratio as a screening tool to detect the presence of COPD in asymptomatic smokers is established.
12. Handheld office spirometry is useful for screening the smokers for presence of airflow obstruction before significant symptoms.

Limitations and Recommendations

1. The period of study is low, large data would have been collected if done for long time.
2. Serial spirometry not done on same participant since it is cross sectional study.
3. Study group is just adequate.
4. History regarding occupational exposure is not probed in depth.
5. Non-smokers as control group not done.
6. Environmental tobacco smoking and genetic predisposition to COPD are not ruled out.
7. Economic burden of individual due to smoking is not calculated.

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