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Spirometric Analysis of Clinically Diagnosed Asthma by Primary Physician and Correlation with BMI

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Abstract:
Background: *Chronic dyspnea, defined as shortness of breath lasting longer than one month is a common clinical presentation. Spirometry provides good functional assessment of lung and helps in diagnosis for the cause and is of great help especially in overweight/obese individuals to rule out an over-diagnosis of common respiratory disease like asthma. The aim of the present study was to evaluate patients of chronic dyspnea using spirometry to first classify them into obstructive/restrictive/mixed patterns. To further analyze the study population categorized by sex and BMI based on various spirometric variables, make a specific diagnosis and then study the effect of BMI.*
Methods: *186 patients, who visited the T.B. and Chest OPD of Rajendra Institute of Medical Sciences(RIMS), Ranchi with features of chronic dyspnea, were included in the study. A detailed clinical history, clinical examination and spirometry were done in all patients included. A repeat Post-bronchodilator spirometry was performed in those showing an abnormal pattern. Study population was categorized on sex and BMI. Obstructive/restrictive/mixed patterns were identified and specific diagnosis was made using additional investigations where required. Response to bronchodilator was recorded. Overall pattern, distribution and disease association with BMI was studied.*
Results: *Most symptomatic patients including both sexes were in the overweight (63 males & 27 females), followed by normal BMI (46 males & 26 females). 66.5% Subjects whose spirometric findings were abnormal were subjected to a post-bronchodilator spirometry. There was a statistically significant difference ($p<0.05$) in the lung volumes (FEV_1%, FEV_3%),and vital capacity (FVC %) among diseased and non-diseased. Majority of patients presenting with chronic dyspnea were overweight and normal. Overall an obstructive pattern was the most common in all BMI groups (67/186 cases), followed by restrictive (31) and mixed(25) patterns. Obstructive pattern was most common in overweight(31/90 cases). Restrictive pattern was most frequent in the obese group (5/24 cases). Asthma was the most common diagnosis overall (42 cases), closely followed by COPD (39 cases). Lung parenchymal damage was seen in 19 cases and Pleural & chest wall deformity in 13 cases. COPD was most frequently diagnosed in the normal and overweight BMI group whereas asthma was more frequent in the obese group.*
Conclusion: *Spirometry is a reliable tool in assessing the physiological lung function of patients presenting with chronic dyspnea and can be helpful in differentiating the etiology. The use of Spirometry must be encouraged in the Indian population to prevent over-diagnosis of Asthma which has clinical symptoms similar to several other respiratory disorders. Both Obstructive and Restrictive lung disorders are associated with higher BMI. Not all symptomatic cases show spirometric abnormalities. In cases where spirometry is contraindicated or PFT findings are inconclusive, additional investigations should help in diagnosis.*
Key words: *Spirometry, Asthma,COPD(Chronic Obstructive Pulmonary Disease), BMI(Body Mass Index)*

I. Introduction:

Respiratory diseases are responsible for about a fifth of all deaths worldwide and its prevalence reaches 15% of the world population. Primary health care (PHC) is the gateway to the health system, and is expected to resolve up to 85% of health problems in general. Moreover, little is known about the diagnostic ability of general practitioners (GPs) in relation to respiratory diseases in PHC. This study aims to evaluate the diagnostic ability of GPs working in PHC in relation to more prevalent respiratory diseases, such as asthma , chronic obstructive pulmonary disease (COPD),lung parenchymal dis,pleural and chest wall defect leading to chronic dyspnea. José BP et. al. demonstrated the lack of consistent evidence on the accuracy of diagnoses of respiratory diseases by general practitioners. In relation to asthma and COPD, studies have shown diagnostic errors leading to overdiagnosis or underdiagnosis depending on the methodology used. The lack of precision for the diagnosis of asthma varied from 54% underdiagnosis to 34% overdiagnosis, whereas for COPD this ranged from 81% for underdiagnosis to 86.1% for overdiagnosis. Studies show a low level of knowledge about tuberculosis on the part of general practitioners. According to his review, PHC represented by the GP needs to improve its ability for the diagnosis and management of this group of patients constituting one of its main demands[1]. If the basis of

patient's diagnosis of asthma has not previously been documented confirmation with objective testing should be sought .Many patients (25 – 35%) with a diagnosis of asthma in primary care can not be confirmed as having asthma.[2]

Asthma is one of the major noncommunicable diseases. It is a chronic disease of the the air passages of the lungs which inflames and narrows them. Some 235 million people currently suffer from asthma. Most asthma-related deaths occur in low- and lower-middle income countries. According to the latest WHO estimates, released in December 2016, there were 383 000 deaths due to asthma in 2015.The strongest risk factors for developing asthma are inhaled substances and particles that may provoke allergic reactions or irritate the airways. Medication can control asthma; avoiding asthma triggers can also reduce the severity of asthma. Appropriate management of asthma can enable people to enjoy a good quality of life.[3]About 15 million disability-adjusted life years are lost annually due to asthma; asthma, therefore, represents 1 per cent of the total global disease burden.[4] A recent Indian Study on Epidemiology of Asthma, Respiratory Symptoms and Chronic Bronchitis (INSEARCH) done with 85,105 men and 84,470 women from 12 urban and 11 rural sites in India estimated the prevalence of asthma in India to be 2.05% among those aged >15 years, with an estimated national burden of 18 million asthmatics. [5]

In 2014, more than 1.9 billion adults aged 18 years and older were overweight. Of these over 600 million adults were obese. Overall, about 13% of the world's adult population (11% of men and 15% of women) were obese .In 2014, 39% of adults aged 18 years and over (38% of men and 40% of women) were overweight. The worldwide prevalence of obesity more than doubled between 1980 and 2014.[6]

NCHS data of US on effect of obesity on asthma shows that In 2011-2014, current asthma prevalence was 8.8% among all adults. During this time period, asthma was more common among adults with obesity (11.1%) compared with adults in normal weight (7.1%) and overweight (7.8%) categories. Women with obesity were more likely to have asthma than those in lower weight categories. Overall, women with obesity had higher current asthma prevalence (14.6%) compared with women in the normal weight (7.9%) and overweight (9.1%) categories. Among adults aged 60 and over, there was a significant trend of increasing asthma prevalence with weight status: 7.0% among normal weight adults; 9.1% among overweight adults; 11.6% among adults with obesity. Among weight status subgroups, current asthma prevalence increased from 5.6% in 2001-2012 to 8.4% in 2013-2014 among adults in the overweight category.7

The aim of our study is spirometric confirmation of patients presenting to our OPD with previous diagnosis of Asthma by general physicians and assessing the correlation with BMI(Normal ,overweight and Obese). We also further assessed the patients who were not asthmatic with additional investigations to search other respiratory causes of breathlessness.

II. Materials And Method

A total of 186 patients who clinically diagnosed Bronchial asthma attended to Outdoor of Department of TB and Chest, Rajendra Institute of Medical Sciences (RIMS), Ranchi for the treatment of Bronchial asthma during the period of June 2014 to May2016 having age more than 18 Yrs were included in study.

All patients included in study were diagnosed as patient of asthma on clinical ground by General physicians without help of spirometry. Patients who were contraindicated for spirometry and those who were infected and those who can't perform the test properly were excluded from study. Patients were further classified in three BMI group, calculated as weight in Kilogram and height in meter (up to 100^{th} fraction) and defined as a. Normal (≥18.5 to <25), b. Over weight (≥25 to <30) and c. Obese (≥ 30) .[8] A detailed clinical history and clinical examination was done before performing spirometry by WinspiroPRO™. Pre and post bronchodilator spirometry was done after 4 puffs of Salbutamol (pMDI) with spacer device after 15 minutes of drug administration. Those patients who were normal in pre bronchodilator test post bronchodilator test were not done.

Patients were declared normal only when they had normal spirometry at the time of screening and there was no evidence of worsening of symptoms or reversible airflow obstruction next two month despite being weaned of asthma medications.

Obstruction was defined as FEV_1/FVC < 70%. Restriction was defined as FVC and FEV_1 < 80% of the predicted with maintained FEV_1/FVC ratio >70%.Post bronchodilator reversibility was defined as post bronchodilator improvement of FEV_1 >200 ml and >12% [9]

Diagnostic subgroups identified as –

Asthma – a history of episodic wheeze, shortness of breath, chest tightness and cough that vary over time and in intensity together with variable expiratory airflow limitation with post bronchodilator improvement in FEV_1 of 12% and 200 ml [10]

Chronic obstructive pulmonary disease (COPD) – a diagnosis of COPD was done to patients who has dyspnoea, chronic cough or sputum production, and/or a history of exposure to risk factors for disease with spirometry confirmation by the presence of post-bronchodilator FEV_1/FVC < 0.7 [11]

Lung parenchyma damage- diagnosis was done by clinical feature and radiographic appearance (Xray chest and HRCT). The chest wall and pleural pathology were clumped together and were diagnosed on clinical and radiographic (CXR and CECT-Thorax) features. After collecting all the relevant information and reports the final diagnosis of all the patients were made by discussion with all the authors of this publication.

Data Analysis: Proper template was generated in Ms Excel. Data were fed into template. SPSS software version 12 was used for data analysis. 5% level of significance was considered for this study. Paired t test was used to see the significance difference in spirometric parameters before and after of the drug therapy.

III. Result:

186 patients were enrolled in our study with 62 females and 124 males. Figure 1 shows the BMI and sex wise distribution of the subjects in the study population. It was observed that the majority of subjects including both sexes were in the overweight group of 90 patients (63males & 27 females), closely followed by normal group of72, which included(46 males & 26 females). 24 patients were in the obese group (15 males & 9 females)

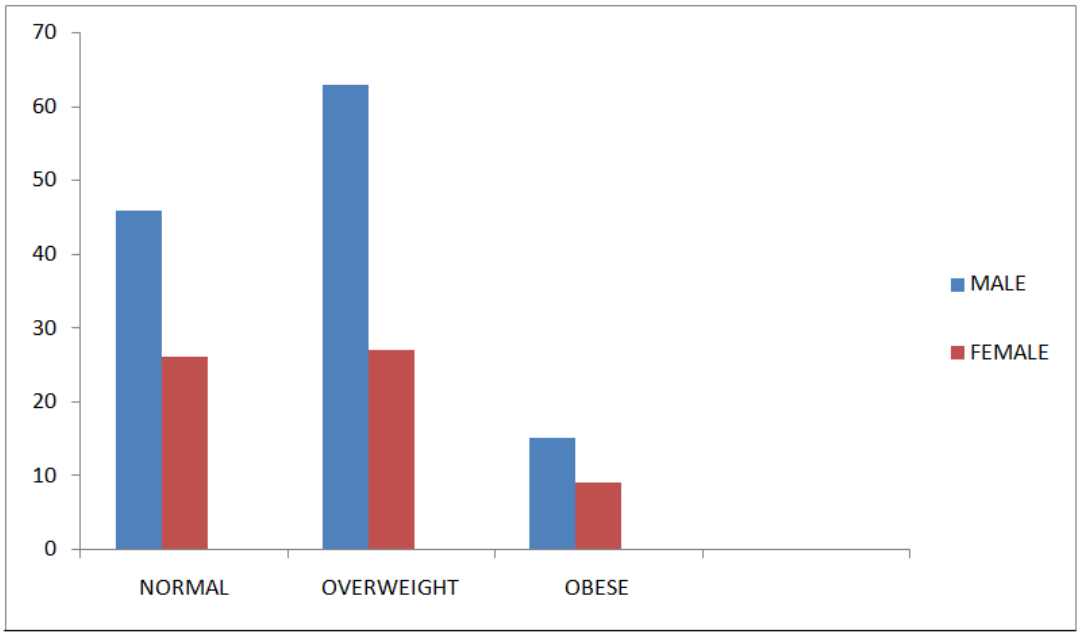

Fig 1: shows the BMI and sex wise distribution of the subjects in the study population.

Table1: Baseline characteristic of all patients on BMI category who has received diagnosis of asthma on clinical basis

Variables	NORMAL (18.5 to <25) [n=72]	OVERWEIGHT (≥ 25 to < 30) [n=90]	OBESE (≥ 30) [n= 24]	P value
Age, yrs, mean(SD)	56.35 (17.28)	57.98 (14.28)	51.0 (12.01)	0.141
Sex, female no.(%)	26(36.1%)	27(30%)	09(37.5%)	0.642
Height,cm, mean(SD)	162.39 (8.87)	163.04 (9.04)	161.40 (9.00)	0.612
Weight,Kg Mean(SD)	59.65 (8.61)	71.38 (11.03)	84.79 (10.36)	0.000
Pre FVC% Mean(SD)	75.97 (20.87)	75.90 (24.37)	73.25 (20.91)	0.864
Pre FEV_1% Mean (SD)	69.11 (23.18)	67.18 (25.64)	68.33 (21.26)	0.879
Pre FEV_1/FVC% Mean (SD)	73.08 (13.31)	71.88 (14.08)	77.17 (12.69)	0.243

FVC%: forced vital capacity%=percentage of predicted total volume of air a patient is able to exhale for the total duration of the test during maximal effort
FEV 1% : forced expiratory volume in one second%=percentage of predicted total volume of air a patient is able to exhale in the first second during maximal effort
FEV 1 /FVC %: the percentage of the FVC expired in one second

In table 1 we analyzed various variables used in this study for all patients of chronic dyspnea enrolled in this study segregating them on different BMI group. It was observed that there was a no statistically significant difference ($p<0.05$) in majority of variables except weight ($P=0.00$) in all three groups. A Description of spirometric variables is also discussed in Table 1.

We found that there were 63 (33.87%) non diseased as compared to 123(66.13%) after spirometry . However when we analysed the similar variables in all non diseased and diseased groups(Table 2),we observed statically very significant difference (<.01) in spirometric findings (i.e. Pre FVC%, Pre FEV_1% and Pre FEV1/FVC%) and significant difference(<.05) were seen in age, sex and height . However there were no significant difference were found in weight and BMI.

Table2: Baseline characteristic of patients under study who were confirmed diseased and non diseased after spirometry.

Variables	Non diseased (n=63)	Diseased (n=123)	P value
Age, yrs, mean(SD)	52.83 (16.23)	68.30 (14.63)	0.021
Sex, female no.(%)	14 (22.2%)	48 (39%)	0.021
Height, cm, mean(SD)	163.27 (9.33)	162.15 (8.58)	0.04
Weight,Kg ,mean(SD)	69.78 (13.29)	67.95 (12.88)	0.37
BMI, mean(SD)	2.78 (0.66)	2.72 (0.68)	0.60
Pre FVC%, mean, (SD)	94.51 (12.16)	65.89 (20.38)	0.00
Pre FEV_1% mean, (SD)	93.00 (11.80)	55.31 (17.96)	0.00
Pre FEV1/FVC% mean,(SD)	80.87 (6.05)	69.02 (14.69)	0.00

Table-3 shows the distribution of various spirometric patterns in different BMI groups. 63(33.87%) out of 186 subjects showed a normal pattern on spirometry. Majority of patients presenting with chronic dyspnea were overweight (90 cases) or normal (72 cases). Overall an obstructive pattern was the most common observation in all BMI groups36% (67/186 cases), followed by restrictive 16.67% (31) and mixed patterns 13.44%
(25). Obstructive pattern was most common in all groups. Restrictive pattern was most frequent in the obese group (20.83%). Mixed pattern was less frequent.

Table3: Distribution of different spirometry pattern in BMI groups

GROUP (BMI)	SRIROMETRY PATTERN				GROUP TOTAL
	OBSTRUCTIVE	RESTRICTIVE	MIXED	NORMAL	
NORMAL (% in group)	30 (41.66%)	12 (16.66%)	8 (11.12%)	22 (30.56%)	72
OVERWEIGHT (% in group)	31 (34.44%)	14 (15.56%)	12 (13.33%)	33 (36.67%)	90
OBESE (% in group)	6 (25.00%)	5 (20.83%)	5 (20.83%)	8 (33.33%)	24
PATTERN TOTAL (%)	67 (36.02%)	31 (16.67%)	25 (13.44%)	63 (33.87%)	186

Specific diagnosis of respiratory disease was made using spirometric findings and additional investigations where required. Table-4 shows the distribution of various diseases in different BMI groups. Asthma was the most common diagnosis overall (42 cases), closely followed by COPD (44 cases). Lung parenchyma damage was seen in 19 cases and Pleural & chest wall deformity in 13 cases. One case was diagnosed as Asthma COPD overlap syndrome whereas in 9 cases no specific diagnosis could be made. COPD was most frequently diagnosed in the normal and overweight BMI group whereas Asthma was more frequent in the obese group. No case of ACOS was seen in the normal and obese BMI group.

Table 4: Different diseases diagnosed in different BMI group (% in group)

Disease, no, (% in group)	BMI			Total,no,(% of total) =186(100%)
	Normal= 72	Overweight= 90	Obese= 24	
No disease, no (% in group)	22 (30.6%)	33 (36.7%)	8 (33.3%)	63 (33.9%)
Asthma, no (% in group)	18 (25.0%)	17 (18.9%)	7 (29.2%)	42 (22.6%)

COPD, no, (% in group)	19 (25.0%)	19 (21.1%)	1 (4.2%)	39 (21.0%)
ACOS, no (% in group)	0 (0.0%)	1 (1.1%)	0 (0.0%)	1 (0.5%)
Lung parenchymal disese, no, (% in group)	5 (6.9%)	8 (8.9%)	6 (25%)	19 (10.2%)
Pleura and chest wall deformity, no (% in group)	2 (2.8%)	9 (10%)	2 (8.3%)	13 (7.0%)
Nonspecific diagnosis, no, (% in group)	6 (8,3%)	3 (3.3%)	0 (0.0%)	9 (4.8%)

IV. Discussion

Chronic dyspnea, defined as shortness of breath lasting longer than one month is a common clinical presentation in medical OPDs. Descriptions of sensations from patients generally do not help in a specific diagnosis. In majority patients the underlying cause is cardiopulmonary disease. [12,13] It is recommended that In patients with chronic dyspnea, spirometry should be performed to diagnose airflow obstruction.[13] All patients presenting with chronic dyspnea may not show abnormal spirometric changes. In such cases additional investigations may be required.

Out of the 186 subjects we studied in Ranchi, The study population divided into3 groups on the basis of BMI (Fig-1) showed that the majority of subjects presenting with chronic dyspnea were overweight (94) or normal(72) as compared to obese(24). This apparently suggests that there is an association between chronic dyspnea and high BMI. However it remains debatable whether a higher BMI directly affects the respiratory function. Salome et al (2010) concluded that obesity has effects on lung function that can reduce respiratory well-being, even in the absence of specific respiratory disease and may also exaggerate the effects of existing airway disease.[14] Some other studies were also in agreement with this conclusion.[15,16] But a worldwide population study by Vanfleteren et al(2016) has suggested that chronic airflow limitation (CAL) was associated with lower BMI.[17] Other studies suggested that abnormal spirometric findings are not due to obesity but intrinsic lung disease except in those with extreme obesity.[18] Similar result were seen in our study (Table-1)as there is no significant differences were seen in BMI groups. Difficulty in breathing and decrease exercise tolerance is a common observation in overweight individuals but apparent spirometric abnormalities need not always be present.

In our study population only 66.13% subjects showed abnormal PFT. (Table-2) A statistically very significant difference was seen in FVC %, FEV_1 % and FEV_1/FVC %. In case of an obstructive defect, an Increase in FEV 1 or FVC of > 12% and > 200 mL suggests a reversible pathology. Obstructive defects in persons with asthma are usually fully reversible, whereas defects in persons with COPD typically are not.[19] In 33.5 % subjects where PFT appeared normal despite clear symptoms of chronic dyspnea, additional investigations in correlation with clinical findings may be required.

Aaron SD et al showed about one-third of obese and nonobese individuals with physician-diagnosed asthma did not have asthma when objectively assessed. This finding suggests that, in developed countries such as Canada, asthma is overdiagnosed.[20]

Similar observations were seen in our study (Table-3) we too got normal lung function in our study groups (30.56% to 36.67%).the incidence of clinical over diagnosis was more in overweight and obese patient as compared to normal BMI individuals.

A correlation of Spirometric patterns with the BMI groups (Table-3) showed that obstructive pattern was the most common observation in all BMI groups. Obstructive pattern which mostly comprises of Asthma & COPD (Table-4), was highly prevalent in the overweight group. But the overall prevalence of Asthma was only 22.6% among all symptomatic subjects. High BMI did not appear to be well associated with obstructive pattern. This was observed in several other studies but whether the obstructive pattern and related symptoms can be relieved by weight loss remains debatable.[21,22]

Restrictive and mixed pattern showed more frequent association with group 3 BMI (obese subjects). Common diseases showing a restrictive pattern are interstitial lung disease (Lung parenchymal damage) and Pleural and chest wall deformity. Bronchodilator administration usually is of little or no use in restrictive pattern but in some restrictive cases that respond to bronchodilator therapy there is a possibility of underlying obstructive diseases.[23]

Spirometry along with other tests showed that COPD & Asthma were the most common specific diagnosis (Table-4). Whereas restrictive lung disease due to Lung parenchymal damage and Pleural and chest wall deformity was not uncommon in patients presenting with chronic dyspnea in our study population. Though Asthma COPD overlap syndrome (ACOS) is a infrequent finding but there should be increasing awareness among pulmonologists and primary care physicians that the diagnosis is not missed.[24] Spirometry is a reliable tool in assessing the physiological lung function of patients presenting with chronic dyspnea and can be helpful

in differentiating the etiology of the patient's symptoms. The use of Spirometry must be encouraged in the Indian population to prevent over-diagnosis of Asthma which has clinical symptoms similar to several other respiratory disorders.

V. Conclusion-

Chronic dyspnea is a common clinical presentation. Spirometry must be performed in all possible cases to make a specific diagnosis and to prevent overdiagnosis of common clinical conditions like Asthma as well as helps to workup for other causes of asthma. Not all symptomatic cases show spirometric abnormalities. Both Obstructive and Restrictive lung disorders are not associated with higher BMI. In cases where spirometry is contraindicated or PFT findings are inconclusive, additional investigations should help in diagnosis

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