ORIGINAL ARTICLE

A STUDY OF SPIROMETRY IN OBESE AND NON OBESE ASTHMATICS

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ABSTRACT: Total of 104 patients were studied with an average age of 47.952 + 16.9112, with 77% of the patients being male. The maximum no of patient were of the middle aged adult males age group 31 – 40.The study comprised of 104 individuals of which 79 patients were males and 25 were females. The average weight of the 104 patients was 68.615 kg .

The body mass index of our patients had a mean of 26.146 with a minimum BMI of 14.382 a maximum BMI of 48.828.

Forced expiratory volume in 1st second in our OBESE asthmatics was 1.78 ± 0.8150.& Forced vital capacity in the obese group was 2.102 ± 0.8638 .FEV1% was > 70 % in all the patients of the study population demonstrating no fixed airflow limitation in patients of our study population . ERV in the obese groups was .441 ± 0.2190 liters. The inspiratory capacity in the obese group was 1.771 ± 0.6628 liters . No significant statistical correlation was demonstrated in between the obese and no obese group . Significant correlation was demonstrated between BMI & Waist Circumference.

BMI correlated with FEV1, FVC, FEV1% in the study population and a negative correlation was demonstrable.

A statistically significant co relation could not be established between BMI & the dynamic spirometric variables.

BMI correlated with ERV & VC in the study population and a negative correlation was demonstrable.

A statistically significant co relation could not be established between BMI & the static spirometric variables.

Waist circumference correlated with the FEV1, FVC, FEV1% in the study population and a negative correlation was demonstrable. A statistically significant co relation could not be established between waist circumference & the dynamic spirometric variables. Waist circumference correlated with ERV & VC in the study population and a negative correlation was demonstrable. A statistically significant co relation could not be established between waist circumference & the static spirometric variables.

KEYWORDS: Spirometry , obesity , asthma

INTRODUCTION: Obesity with excessive white adipose tissue produces a myriad of complications through its endocrine function. More than one billion people around the world are overweight or obese with a body mass index (BMI) of 25 kg/m2 or more. [1]

Asthma and obesity are two chronic medical conditions in children, adolescents and adults that share common threads. The prevalence of both conditions continues to increase resulting in significant morbidity, mortality, economic loss, and escalating health care expenditures.

The relationships, interactions and association between obesity and asthma are complex and are active sources of hypotheses and research. Though the direct relationships between asthma and obesity remain controversial there is growing and significant evidence that the two conditions have multiple areas of interplay particularly in the inflammatory microenvironment.

Obesity is an increasingly important health problem worldwide including the developing countries. In India obesity is emerging as an important health problem particularly in urban areas paradoxically co-existing with under nutrition. Almost 30-65% of adult urban Indians is either overweight or obese or has abdominal obesity. The rising prevalence overweight and obesity in India has a direct correlation with the increasing prevalence of obesity-related co-morbidities like hypertension, the metabolic syndrome, dyslipidemia, type 2 diabetes mellitus (T2DM) and cardiovascular disease (CVD)[2].

Asian Indians exhibit unique features of obesity like excess body fat, abdominal adiposity, increased subcutaneous, intra-abdominal fat and deposition of fat in ectopic sites (liver, muscle, etc.). Obesity is a major driver for the widely prevalent metabolic syndrome and type 2 diabetes mellitus (T2DM) in Asian Indians [3, 4, 5, 6, 7]

Obesity is not immediate lethal disease itself but it is a significant risk factor associated with a range of serious non-communicable diseases (Tanaka K. and Nakanishi T.1996). Cohort and cross-sectional studies have indicated that obesity may be linked with an increased risk of coronary heart disease, hypertension, diabetes mellitus and gallstone (Saw and Rajan 1997). One of the first attempts to document systematically the relationship between Obesity and menstrual dysfunction was presented by Rogers and Mitchell in 1952.

The NFHS-2 shows that 9 percent women in Delhi are obese and another 25 percent are overweight which is highest among all the states in country. Punjab comes after Delhi with 21.1 percent overweight and 9.1 percent obese women. Haryana comes third rank in north India with 12.3 percent overweight and 3.9 percent obese women. All together these three north Indian states comprise 18.5 percent overweight and 7.2 percent obese women. Increasing rates of obesity have paralleled increasing rates in asthma prevalence but the interrelation is uncertain (8).

MATERIAL & METHODS: The present study entitled “A STUDY OF SPIROMETRY IN OBESE AND NON OBESE ASTHMATICS” was undertaken at Mediciti Hospitals, Hyderabad, a tertiary care referral centre.

METHODOLOGY:

Study Design: An Institutional based cross-sectional study.

Study Setting: Department of Pulmonary Medicine
Mediciti Hospitals, Hyderabad.

Study Period: One year extending from Dec 2007 to Dec 2008

Inclusion Criteria: Symptomatic ASTHMATIC diagnosed using 2007 GINA Guidelines

Exclusion Criteria:

1. Patients with history of Ischemic heart disease, Valvular heart diseases, coronary Artery disease, chronic liver diseases
2. Patients with pre-existing structural lung diseases, lung cancer & critically ill.
3. Smokers

DATA COLLECTION: The study group consists of 104 subjects presenting to Mediciti Hospital OPD and Emergency room. All the subjects were interviewed and complete history was taken along with thorough clinical examination was done according to proforma that was predesigned. Spirometry (pre and post bronchodilator) was done as a pre requisite to enter the study. Informed consent was secured from the patients for participation in the study.

METHODS: Detailed history was taken in all 100 Subjects, particularly with focus on duration of respiratory symptoms and progression of symptoms with reference to daily symptoms. Smoking history taken and expressed as Pack years. In physical examination Height, Weight was recorded and Body Mass Index (weight in kilograms divided by height in meter squares) was calculated. Arterial blood gas analysis, Haemogram and other routine investigations done and ruled out subjects with exclusion criteria.

Participants were weighed without shoes and with minimal clothing .height were measured with the aid of an anthropometer coupled to the scale .the weight / height2 formula was used to calculate BMI.

SPIROMETRY: It was done by MORGAN HYPAIRCOMPACT MODEL, which is standardized according to American Thoracic Society recommendations [114]. Spirometry was performed with the subject in a sitting position .The forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV1) was measured using standard guidelines using reproducibility and acceptability criterion (FVC and FEV1 were measured within 5% standard deviation).the best of the 3 acceptable curves was selected. The same pulmonologist evaluated the results of all pulmonary function tests. The data was expressed as the percentage of predicted value, which was calculated from regression equations according to age, height and sex. FEV1/FVC values less than 70% was taken as airway obstruction .The test was repeated 15-20 minutes following inhalation of 200mcg of Salbutamol to check for reversibility. Greater than 12%reversibility over baseline FEV1 or greater than 200 ml absolute volume was considered as significant reversibility and these subjects were excluded from the study. Diagnosis of bronchial asthma and staging was done on basis of GINA 2009 guidelines which on basis of FEV1 & PEFR variability classified patients into intermittent [80%,<20%],mild persistent[80%,20 -30%] ,moderate persistent[60-80%,30%] & severe persistent [60%,> 30 %].

Individuals were instructed to rest for 5 to 10 minutes prior to the test. the procedures to be carried out were carefully explained to the participants, with an emphasis on maximum inhalation followed by maximum exhalation [sustained until asked to inhale again] and on not allowing air to leak from around the mouthpiece [technician demonstrated the procedure using a small tube] .the area in which the tests were carried out was quiet & private ,temperature and humidity were maintained t constant levels between 8:00 am and 12:00 pm to avoid circadian influences .participants were asked to remain seated during the tests and to wear a nose clip

STATISTICAL ANALYSIS: Statistical data analysis was done using Microsoft excel 2000,SPSS (statistical package for social science) version 15.Mean, standard deviation are calculated for age, height, weight, Body Mass Index (BMI), FEV1,FVC , FEV1%, PEFR ,MEFR ,IC ,EC ,VC . The mean differences were compared by independent t tests /correlation of linear variables whichever is feasible. Correlation co-efficient were used for studying the relationship of BMI with other variables in study. Regression models were also fitted for prediction of Asthma severity with various measured variables. Level of significance was considered as <0.05

LIMITATIONS: Our study is a point observational study, and trends of the spirometric variables would have been more representative. The study population should have been larger to correlate with the south Indian population cohort. Interventional results in the form of effect of weight reduction advice or medical interventions would have been a better study criterion for evaluation of effects of weight on pulmonary functions. Poor reversibility was seen in many asthmatics contributing to strong suspicion of coexisting COPD. Diffusion capacities of the patients could not be studied due to financial constraints.

RESULTS: The present study entitled "Study of spirometry in obese and non obese asthmatic patients" was conducted in the Department of Pulmonology, MediCiti Hospitals, and Hyderabad.
Total number of patients studied (n): 104
The following are our observations on analyzing the results of the study:-
A] **AGE :-**

The average age of the 104 patients which took part in bur study was 47.952 + 16.9112, with 77% of the patients being male .The maximum no of patient were of the middle aged adult males age group 31 – 40

DISCUSSION: In a study period of 2 year from 2007 to 2009 a point observation study of spirometry comprising both static and dynamic variables was conducted in the Dept of Pulmonology in MediCiti Superspeciality Pvt Ltd on stable asthmatics presenting to the OPD for routine follow up.

In our study the study group comprised predominantly of the middle aged group individuals who were mostly follow up cases of bronchial asthma, with our oldest patient of 75 yrs.

The present study comprised of 104 patients of which predominantly were male patients. In similar studies conducted by Lazarus et al [126] obese men had higher derangement of spirometric variables then females. Asthma is more common in women than in men, which is reflected in various frequency measures including prevalence, incidence & hospitalization. [138,139,140] Chen et al [130] found that spirometric derangements were more in female adults as compared to males.

C] HEIGHT: The average height of the study subjects included in this study is 161 ± 0.09 cm which is comparable to the average height of 162.02 ± 9.23 cm & 165 ± 8.2 cm in studies conducted by RAZI et al [115] & Knudson et al respectively [120].Relatively higher height were reported from studies conducted by Lazarus et al[126] & Zied et al[118] which were 175.7 ±7.04 cm & 178 ± 0.07 cm respectively . Saxena et al [131] conducted a study with an average height of 1.7 ± 6.97 cm.

D] WEIGHT: The present study revealed an average weight of 68.615 ± 17.8 kg which was comparable to the average weight of subjects in the study conducted by LAZARUS et al [126] of 78.6 ± 11.28 kg .RAZI et al[115] conducted a similar study in obese asthmatics in which the average weight is 94.10 ± 11.2 kg .In a study conducted by Zied et al[118] the average weight of the subjects included in the study is 106.5 ± 9.29 kg , since he included subjects of class 3 & 4 BMI groups respectively where as DIXON et al[116] found an average weight of 110.6 ± 11.28 kg in a study conducted on BMI group 2,3,4 asthmatics.

E] BMI: In the present study conducted of 104 asthmatic patients the average BMI is 26.14 ± 6.519 which included 32.6% patients in the BMI group 4 & 34% in the BMI Group 2. In the present study, we observed that increased BMI did not impair pulmonary function in males or females with class I or II obesity but had shown statistically insignificant changes in the BMI Group III & IV respectively.

In studies conducted by Zied et al [118] the average BMI of the patients is 33.7 ± 2.55 KG/M2, while the BMI in the study conducted by Lazarus et al [126] was 25.5 ± 3.25 KG/M2. The average BMI in a study conducted by Dixon et al [2] is 42 ± 14 kg/m2 while in the study conducted by Bedell et al[123] is 51 ± 9 kg/m2 .& 33.28± 3.39 in a study conducted by Saxena et al[131]. Various studies have shown altered pulmonary function in individuals with class III obesity like studies conducted by Schoenberg et al. (127), Rubeinsten et al. (125), Mohd et al [129] and Chen et al. (130) which reported that increased BMI may result in decreased pulmonary function.

Razi et al [115] observed a FVC in obese asthmatic patients of 3.04±0.93 lit and in control group: 3.68±1.12 lit p=0.39, respectively. The mean FEV1 in obese asthmatic patients were: 2.38± 0.75 lit and in control subjects: 3.17± 0.92 lit p=0.07 respectively. DIXON et al [116] included 488 pt [186 females 302 males] in their study demonstrated a FEV1 of 77 ± 16 % in obese asthmatic patients with 82 ± 16 % in the control group p = 0.01 . An FVC of 84 ± 15 % in obese asthmatic patients as compared to 92 ± 14 in non obese asthmatic individuals p <0.001 .The FEV1/FVC was 74 ± 10 in obese as compared to 74 ± 15 in non obese individuals p = 0.71 . There were no significant differences between non-obese and class I and II Obese when we compared FVC, FEV1 and FEF25-75% values. Obese females presented significantly lower FVC and FEV1 values than did non- obese females. Among the individuals suffering from class I or II obesity, no significant alterations were seen in males, although females presented significant decreases in FVC and FEV1 .Sahebjami et al (122) studied pulmonary function in 8 healthy obese males and reported spirometric values similar to those found in the present study, although those authors studied subjects who were in a higher age group and presented slightly lower BMIs. We detected a directly proportional relationship between FVC and BMI in non obese males and females (control group) in our study, which confirms the data reported by Lazarus et al.(126)

ERV: ERV values were significantly lower in obese males and females when compared to those values obtained from non-obese males and females .

In a study conducted by Bedell et al [125], it was also reported that, in pulmonary function tests of obese individuals, ERV (decrease) was the most sensitive parameter and that altered (decreased) ERV becomes more pronounced in parallel with increased obesity (from class I to class II and from class II to class III).In the present study, we also observed a significant decrease in ERV in both genders, and our data were compatible with those reported in the literature.

IC: In obese males and females, IC values were higher, although the difference was only significant for males . Sahebjami et al(126) reported higher percentage of predicted ERV values and lower percentage of predicted IC values than those found in our study. In their study, patients were younger and had lower BMI, which may explain this difference. Their data are similar to those reported in the literature, that is, although class I and II obesity may alter spirometric values, only class III obesity promotes significant impairment of pulmonary function. Ray et al.[124] reported that, due to a compensatory increase in IC, vital capacity and total lung capacity were unaltered in class I and II obesity. Increased IC indicates normal pulmonary compliance and the ability of the inspiratory muscles to compensate, at least temporarily, for the fat deposition in the chest and abdominal walls .

In our study, we observed significantly higher IC values in males and females with class I or II obesity than in non-obese individuals.

In obese males, negative correlations were found between BMI and ERV and between waist circumference and FEV1. These correlations were less than significant in obese females. The correlation between waist circumference and the other spirometric variables were not statistically significant in males or females with class I or II obesity.

Lean et al. reported a negative correlation between waist circumference and FEV1 /FVC ratio(120). We observed the same negative correlation in our study, although it was less than significant in obese males. There was positive, although also less than significant, correlation between waist circumference and FEV1 /FVC ratio in females with class me or II obesity. Lazarus et al.(121)reported that the correlation between FVC and waist circumference was negative in males and positive in females. In the present study, no significant correlations were found between BMI and the following spirometric values in either gender: FVC, FEV1 ,FEV1/FVC, and FEF25-75%. The correlation between BMI and ERV, as well as between BMI and percentage of predicted ERV values was negative.

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N	Mean[yrs]	95 % CI	SD	MINIMUM	MAXIMUM
104	47.952	44.6 – 51.2	16.9112	10	75

The subgroup distribution of the cases reveals,

Age [yrs]	Male	Female
< 10		
11 - 20	6	1
21 - 30	7	5
31-40	10	8
41 - 50	11	4
51 - 60	21	3
61 - 70	16	2
71 - 80	8	2
>80		
TOTAL	79	25

B] GENDER:-

GENDER	MALE	FEMALE
	79	25
TOTAL	104	

The study comprised of 104 individuals of which 79 patients were males and 25 were females

C] HEIGHT:-

	N	Mean	SD	Minimum	Maximum
HEIGHT [metres]	104	1.620	0.09226	1.320	1.860

Range	FEMALES	MALES
1.3-1.40	0	1
1.41 - 1.49	5	5
1.50-1.59	15	15
1.60-1.69	1	4
1.70-1.79	2	31
1.80-1.89	2	21
1.90 -2.0	0	2
>2.0	0	0

D] WAIST:-

	N	**Mean**	**SD**	**Minimum**	**Maximum**
WAIST [inches]	104	34.091	5.2689	24.000	53.000

Waist [inches]	**Males**	**Females**
20 to 24		1
25 to 29		15
30 to 34	36	9
35 to 39	28	
40 to 44	13	
45 to 49	2	

E] WEIGHT :-

	N	Mean	95% CI	SD	Normal Distr.
WEIGHT [kg]	104	68.615	65.154 - 72.077	17.7984	0.340

WEIGHT [kg]	**Females**	males
< 30	0	
31 – 40	2	3
41 -50	3	8
51 -60	8	17
61 – 70	2	12
71 – 80	6	18
81 – 90	1	13
91 – 100	3	6
> 100	0	2

F] BODY MASS INDEX :-

	N	Mean	SD	Minimum	Maximum
BMI[kg/m2]	104	26.146	6.5159	14.382	48.828

The body mass index of our patients had a mean of 26.146 with a minimum BMI of 14.382 a maximum BMI of 48.828.

BMI [kg/m2]	SEX		
	FEMALE	MALE	
1	3	13	(15.4%)
2	10	26	(34.6%)
3	3	10	(12.5%)
4	7	27	(32.7%)
5	0	2	(1.9%)
6	2	1	(2.9%)
	(24.0%)	(76.0%)	

G] DYNAMIC AND STATIC VARIABLES :-

The following results were observed in our study-

VARIABLES	OBESE	Non OBESE	SIGNIFICANCE
FEV1 [L/SEC]	1.78 ± 0.8150	1.91 ± 0.8417	0.4057
FVC [LITRES]	2.102 ± 0.8638	2.257 ± 0.7805	0.3164
FEV1%	70.287 ± 17.783	74.631 ± 20	0.2260
ERV [LITRES]	0.441 ± 0.2190	0.444 ± 0.22	0.9421
IC [LITRES]	1.771 ± 0.6628	1.795 ± 0.7311	0.855

H] CORRELATIN BETWEEN STUDY VARIABLES :-

The correlation of study variables is as follows-

	PRESENT STUDY	
Variable pair	**Correlation**	**P**
BMI vs. WC	Positive	S
BMI vs.FEV1	Negative	NS
BMI vs. FVC	Negative	NS
BMI vs. FEV1%	Negative	NS
BMI vs. ERV	Negative	NS
BMI vs. VC	Negative	NS
vs. FVC	Negative	NS
WC vs. FEV1%	Negative	NS
WC vs. ERV	Negative	NS
WC vs. VC	Negative	NS
	Negative	NS

A] AGE : -

The age of the 104 study population was predominantly in the middle age adult group.

AUTHOR	AGE [yrs]
RAZI et al [115]	42.63 ± 11.76
LAZARUS et al [126]	45.5 ± 15.01
Sahebjani et al [122]	44 ± 11
Zied et al[118]	33.3 ± 10.5
Dixon et al [116]	42.1 ± 14

Saxena et al [131]	29.4± 6.50
Present study	47.952 ± 16.912

B] SEX DISTRIBUTION :-

AUTHOR	N	MALES	FEMALES
PRESENT STUDY	104	89	25
ZIED ET AL [118]	96	48	48
RAZI ET AL [115]	101	53	48
DIXON ET AL[116]	488	302	186
SAXENA ET AL [131]	88	54	34

F] DYNAMIC FLOW VARIABLES :-

Variables	Present study Obese	Non obese	SI	Zied et al[118] Obese	Non obese	SI	Saxena et al[131] Obese	Non obese	SI
FEV1	1.78 ± 0.8150	1.91 ± 0.8417	NS	2.89 ± 0.48	3.20 ± 0.39	< 0.05	3.75±0.28	3.55± 0.36	NS
FVC	2.102 ± 0.8638	2.257 ± 0.7805	NS	3.36 ± 0.56	3.70 ± 0.52	< 0.05	3.37±0.25	3.80± 0.35	**NS**
FEV1%	70.287 ± 17.783	74.631 ± 20	NS	100 ± 4.80	101 ± 6.11	NS	89.63±2.68	89.50± 2.47	**NS**

G] THE STATIC VARIABLES:-

Jones et al [117]			**Zied et al[118]**			**Present study**			
	OBESE	NON OBESE	SI	OBESE	NON OBESE	SI	OBESE	NON OBESE	SI
ERV	32.1 ± 19.1	83.95 ± 29.8	< 0.05	0.71 ± 0.38 2.68 ± 0.51	1.29 ± 0.36 2.44 ± 0.38	< 0.05 NS	0.441 ± 0.2190	0.444 ± 0.22	0.9421
IC	87 ± 5.2	97 ± 10.0	<0.10				1.771 ± 0.6628	1.795 ± 0.7311	0.855

CORRELATION:-

	PRESENT STUDY		**ZIED ET AL [4]**	
Variable pair	**Correlation**	**P**	**Correlation**	**P**
BMI vs. WC	Positive	S	positive	NS
BMI vs.FEV1	Negative	NS	Negative	NS
BMI vs. FVC	Negative	NS	Negative	NS

BMI vs. FEV1%	Negative	NS	Negative	NS
BMI vs. ERV	Negative	NS	Negative	<0.05
BMI vs. VC	Negative	NS	Negative	NS
WC vs.FEV1	Negative	NS	negative	NS
WC vs. FVC	Negative	NS	Negative	NS
WC vs. FEV1%	Negative	NS	Negative	NS
WC vs. ERV	Negative	NS	Negative	NS
WC vs. VC	Negative	NS	Negative	NS

NS – NOT SIGNIFICANT
S – SIGNIFICANT
P - Significant correlation