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Pulmonary function test in young obese individuals

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Abstract

Introduction: *The most obese persons exhibit anatomically intact pulmonary structure. However, indirect negative influences of obesity abound, principally regarding distortion of respiratory spaces and dynamics. Subjects with excessive body weight tend to be chronically hypo ventilated and have reduced aerobic capacity, probably because of sedentarism as well as heavy thoracic wall and abdominal mass and diminished compliance.*

The imbalance between the reduced strength of the inspiratory muscles and the increased mechanical load has been related to dyspnea sensation in obese subjects. In grossly obese persons mild degree of inspiratory muscle weakness, which is probably related to over stretching of diaphragm and an increased work of breathing causes reduced chest wall compliance and increased chest wall resistance. All these factors contribute to the decrease in lung volumes and capacities.

Materials and Methods: *This study was conducted on human subjects, age ranging from 20 – 40 years of both sexes. The subjects considered for the study are non alcoholic, non smokers and they do not have any cardiovascular diseases like Hypertension, metabolic diseases like Diabetes mellitus and respiratory diseases like Emphysema, Bronchitis, Asthma [obstructive], Pulmonary fibrosis and Pneumonia [restrictive] Thus all the subjects chosen for the study are obese but otherwise healthy. The obese subjects were chosen depending upon Body Mass Index BMI i.e. the subjects with BMI more than 30 kg/m² are considered as obese.*

The subjects in this study are divided into 4 groups, each group consisting of 25 subjects. Group I - 25 non obese males, Group II - 25 non obese females, Group III - 25 obese males, Group IV - 25 obese females. The general parameters like pulse, B.P, height, weight and respiratory rate of these subjects were recorded. The body mass index BMI was calculated as per the metric formula. The instrument used for this study is Computerized Spirometer SPIRO – 232 P.K Morgan Limited.

The parameters included in our study which are obtained from the spirometer are,

- *Forced Vital Capacity –* ***FVC***
- *Forced Expiratory Volume In 1 Sec –* ***FEV1***
- *Forced Expiratory Flow 25 – 75% -* ***FEF 25 – 75%***
- *Peak Expiratory Flow Rate –* ***PEFR***
- *Expiratory Reserve Volume –* ***ERV***

Results: *The Mean Forced Vital Capacity [FVC] in the obese male subjects is compared with non obese male subjects. This has shown a reduction of Forced Vital Capacity by 49.79% with a P value of less than 0.001, which is statistically significant.*

The mean Forced Expiratory Volume in First second i.e. FEV1 of obese male subjects is compared with non obese male subjects. This showed a decline in FEV1 by 44.29% with a P value of less than 0.001. The Mean Expiratory Flow 25 – 75% i.e. [FEV 25 – 75%] of obese male subjects is compared with non obese male subjects. These results showed a reduction of FEF 25 – 75% by 45.91% with a P value of less than 0.001. The Mean Peak Expiratory Flow Rate [PEFR] in the obese male subjects is compared with non obese male subjects. These showed a decrease in PEFR by 27.19% in male subjects, with a P value of less than 0.001.

The Mean Expiratory Reserve Volume [ERV] of obese male subjects is compared with non obese male subjects. This has shown a reduction in ERV by 54.17% with a P value of less than 0.001 which is statistically significant. The Mean FVC of Obese female subjects is compared with non obese female subject. This has a reduction of FVC by 27.44% with a P value of less than 0.001. The Mean Forced Expiratory Volume in first second [FEV1] of obese female subjects is compared with non obese female subjects. This showed a decline in FEV1 by 22.48% with a P value of less than 0.001, which is statistically significant. The Mean Forced Expiratory Flow 25 – 75% [FEF 25 – 75%] of obese female subjects is compared with non obese female subjects. These results showed a reduction of FEF 25 – 75% by 30.34% with a P value of less than 0.001. The Mean Expiratory Flow Rate PEFR in Obese female subjects is compared with non obese female subjects. These results showed a decrease in PEFR by 21.37% in obese female with a P value less than 0.001.

The Mean Expiratory Reserve Volume [ERV] of obese female subjects is compared with non obese female subjects. This has shown a reduction in Expiratory Reserve Volume by 37.38% with a P value less than 0.001.

Conclusion: *The present work is a comparative study of lung function in obese and normal human beings. The pulmonary function tests were conducted on 100 subjects out of which 50 are obese (25 male and 25 female) and 50 are non obese (25 male and 25 female) by using computerized spirometer – SPIRO – 232 MORGAN Medical limited.*

When the results were analyzed i found that in obese there is decrease in FVC by 40% FEV1 by 34.5%, FEF 25 – 75% by 38.69%, PEFR by 24.6%, and ERV by 46.29% when compared with normal subjects. When the Gender difference is taken into consideration, obese male showed more marked decrease in the spirometric values than obese female subjects. Males tend to deposit fat centrally [increasing the circumference of the abdomen] while in females the deposition appears more peripheral when compared to males. Thus a mechanical effect on the diaphragm in men impending expansion of lungs during inspiration could justify their higher impairment of ventilatory function.

Obesity causes derangement in pulmonary function by virtue of its effects on ventilatory mechanics, pulmonary volumes and on respiratory muscles. The Obese subjects with ventilatory impairment should be routinely encouraged to loose weight through balanced diet and dynamic exercise for improving their lung function, to promote fitness and to lead a good quality of life.

I. Introduction

Obesity is an increasing medical problem in the developing world and was also one of the oldest documented metabolic disturbances that persisted throughout the centuries. It is a misconception that obesity is primarily a problem in affluent countries, infact it is found in all countries in varying degrees. Further there has been an increased awareness of the problem in recent years.

Obesity is defined as an excess of adipose tissue deposition resulting from discrepancy between energy consumption and expenditure. Excess weight gain usually starts when individuals are aged between 20 and 40 years. In a few cases of obesity specific etiological factors can be identified however in most of the cases obesity arises from a complex interplay of behavioral and genetic factors. The major factor leading to obesity in the population appears to be an overall decreased in activity levels i.e. a sedentary life plus chronic ingestion of excess calories. There is evidence for strong genetic influences on the development of obesity, less than 1% of obese subjects have an identifiable secondary cause of obesity. Hypothyroidism and Cushing's syndrome are two important secondary causes of obesity.

Obesity is associated with significant increase in both mortality and morbidity. Obesity poses a greater risk to develop pulmonary functional impairment. Thus Obesity is one of the most common metabolic disorders

The most obese persons exhibit anatomically intact pulmonary structure. However, indirect negative influences of obesity abound, principally regarding distortion of respiratory spaces and dynamics. Subjects with excessive body weight tend to be chronically hypo ventilated and have reduced aerobic capacity, probably because of sedentarism as well as heavy thoracic wall and abdominal mass and diminished compliance. The imbalance between the reduced strength of the inspiratory muscles and the increased mechanical load has been related to dyspnea sensation in obese subjects. In grossly obese persons mild degree of inspiratory muscle weakness, which is probably related to over stretching of diaphragm and an increased work of breathing causes reduced chest wall compliance and increased chest wall resistance. All these factors contribute to the decrease in lung volumes and capacities.

Numerous studies have been conducted to characterize the consequences of obesity on pulmonary function, and most authors have found evidence of restriction.[Defined as > or = 20% reduction in total lung capacity].The respiratory insufficiency in obesity is mostly classified as restrictive.

The upper body obesity is a greater health hazard than the lower body obesity. Obese subjects with increased abdominal circumference have a greater risk of pulmonary impairment as seen in restrictive respiratory disorders. In our study an attempt has been made to examine the effects of obesity on ventilator function. This may be useful for the success of the treatment in obese patients and to motivate them for weight loss and regular physical activity.

II. Materials And Methods

This study was conducted on human subjects, age ranging from 20 – 40 years of both sexes. The subjects considered for the study are non alcoholic, non smokers and they do not have any cardiovascular diseases like Hypertension, metabolic diseases like Diabetes mellitus and respiratory diseases like Emphysema, Bronchitis, Asthma [obstructive], Pulmonary fibrosis and Pneumonia [restrictive] Thus all the subjects chosen for the study are obese but otherwise healthy.

The obese subjects were chosen depending upon Body Mass Index BMI i.e. the subjects with BMI more than 30 kg/m^2 are considered as obese.

The subjects in this study are divided into 4 groups, each group consisting of 25 subjects.
Group I - 25 non obese males.
Group II - 25 non obese females.
Group III - 25 obese males.
Group IV - 25 obese females.

All the subjects are informed of the experimental Protocol and are well educated to give maximum co-operation during experimental procedure and their consent was obtained. The general parameters like pulse, B.P, height, weight and respiratory rate of these subjects were recorded.

The body mass index BMI was calculated as per the metric formula:-

$$\text{Body Mass Index} = \frac{\text{Weight in kilograms}}{\text{Height in meters} \times \text{Height in meters}}$$

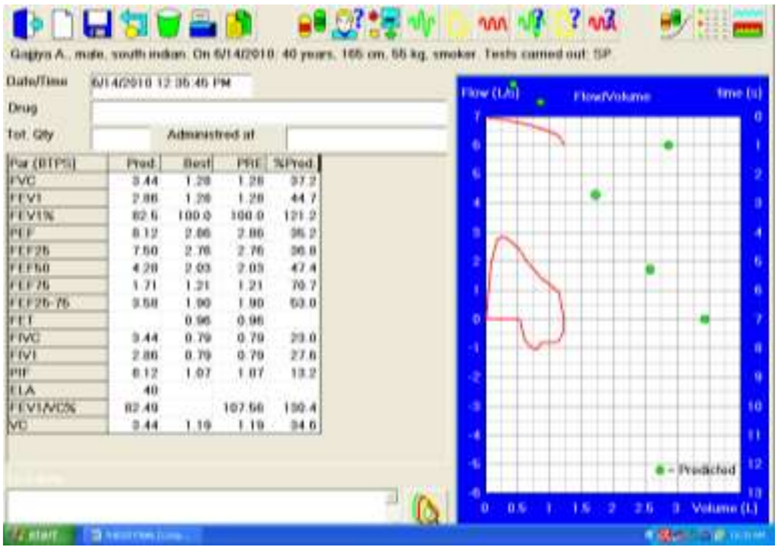
The subjects are advised to have small quantity of breakfast before coming for the study, and to evacuate the urinary bladder before start of the experimental procedure. Now the subjects are instructed to sit in front the spirometer and with the mouth piece held firmly between the lips they are asked to inhale and exhale into the spirometer with the nose clips applied.

Subjects are asked to take 2–3 normal breaths, after which deep inspiration followed by forceful expiration and again followed by deep inspiration, which will be recorded and tabulated.

The instrument used for this study is Computerized Spirometer SPIRO – 232 P.K MORGAN LIMITED.

The parameters included in our study which are obtained from the spirometer are,

- Forced Vital Capacity – **FVC**
- Forced Expiratory Volume In 1 Sec – **FEV1**
- Forced Expiratory Flow 25 – 75% - **FEF 25 – 75%**
- Peak Expiratory Flow Rate – **PEFR**
- Expiratory Reserve Volume – **ERV**



III. Statistical Analysis

Data reported as mean and standard deviation (± SD). Means are compared between 2 groups by (students unpaired) **t** test.

A **P** value of < 0.05 was considered statistically significant.

$$\sigma_{1,2} = \sqrt{\frac{\sigma^{12} n^1 + \sigma^{22} n^2}{n^1 + n^2}}$$

σ_1 = standard deviation of group 1
n_1 = number of samples in group 1
σ_2 = standard deviation of group 2
n_2 = number of samples in group 2

$$t = \frac{\overline{x_1} - \overline{x_2}}{\sigma_{12}} \times \sqrt{\frac{n_1 \times n_2}{n_1 + n_2}}$$

$\overline{x_1}$ = statistical mean of group 1 sample.
$\overline{x_2}$ = statistical mean of group 2 sample.

Table-1 Comparison of Mean Forced Vital Capacity-(FVC) in normal and obese subjects

Parameter	Normal Subjects		Obese Subjects		**t** value	**p** value	% of decrease
	Mean	S.D	Mean	S.D			
FVC Liters	2.9718	.6916	1.7832	0.3712	10.708	<0.001	40↓

Table-2 Comparison of Mean Forced Expiratory Volume In 1 Sec-(FEV1) in normal and obese subjects.

Parameter	Normal Subjects		Obese Subjects		**t** value	**p** value	% of decrease
	Mean	S.D	Mean	S.D			
FEV1 Liters	2.5342	.5879	1.66	.3618	8.9551	<0.001	34.5↓

Table-3 Comparison of Mean Forced Expiratory Flow 25-75% -(FEF 25-75%) in normal and obese subjects.

Parameter	Normal Subjects		Obese Subjects		**T** value	**p** value	% of Decrease
	Mean	S.D	Mean	S.D			
FEF 25-75%	2.839	0.597	1.741	0.372	11.032	<0.001	38.69↓

Table-4 Comparison of Mean Peak Expiratory Flow Rate-(PEFR) in normal and obese subjects.

Parameter	Normal Subjects		Obese Subjects		**t** value	**p** value	% of decrease
	Mean	S.D	Mean	S.D			
PEFR Liters	5.9318	1.1904	4.4728	0.8593	7.2072	<0.001	24.6↓

Table-5 comparison of mean expiratory reserve volume-(ERV) in normal and obese subjects.

Parameter	Normal Subjects		Obese Subjects		**t** value	**p** value	% of Decrease
	Mean	S.D	Mean	S.D			
ERV Liters	1.27	.257	.6822	.2070	20.088	<0.001	46.29↓

Table-6 Comparison of Mean Forced Vital Capacity-(FVC) in normal and obese Male subjects.

Parameter	Normal Subjects		Obese Subjects		**T** value	**p** value	% of Decrease
	Mean	S.D	Mean	S.D			
FVC Liters	3.34	0.6732	1.6772	0.3505	10.954	<0.001	49.79↓

Table-7 Comparison of Mean Forced Expiratory Volume In 1 Sec-(FEV1) in normal and obese Male subjects.

Parameter	Normal Subjects		Obese Subjects		**t** value	**P** value	% of Decrease
	Mean	S.D	Mean	S.D			
FEV1 Liters	2.7924	0.6195	1.5556	0.3566	8.834	<0.001	44.29↓

Table-8 Comparison of Mean Forced Expiratory Flow 25-75%(FEF 25-75%) in normal and obese Male subjects.

Parameter	Normal Subjects		Obese Subjects		**t** value	**p** value	% of Decrease
	Mean	S.D	Mean	S.D			
FEF 25-75%Lit	3.0436	0.6269	1.646	0.3566	9.68	<0.001	45.91↓

Table-9 Comparison of Mean Peak Expiratory Flow Rate-(PEFR) in normal and obese Male subjects.

Parameter	Normal Subjects		Obese Subjects		**t** value	**p** value	% of Decrease
	Mean	S.D	Mean	S.D			
PEFR Lit/sec	6.594	1.0296	4.8016	0.7532	7.02	<0.001	27.19↓

Table-10 Comparison of Mean Expiratory Reserve Volume-(ERV) in normal and obese Male subjects.

Parameter	Normal Subjects		Obese Subjects		**t** value	**p** value	% of Decrease
	Mean	S.D	Mean	S.D			
ERV Liters	1.347	0.225	0.617	0.192	11.5	<0.001	54.17↓

Table-11 Comparison of Mean Forced Vital Capacity-(FVC) in normal and obese female subjects.

Parameter	Normal Subjects		Obese Subjects		**t** value	**p** value	% of Decrease
	Mean	S.D	Mean	S.D			
FVC Liters	2.6036	.04908	1.8892	0.3675	13.44	<0.001	27.44↓

Table-12 Comparison of Mean Forced Expiratory Volume in 1 sec-(FEV1) in normal and obese female subjects.

Parameter	Normal Subjects		Obese Subjects		**t** value	**p** value	% of Decrease
	Mean	S.D	Mean	S.D			
FEV1 Liters	2.276	.4278	1.764	.369	11.31	<0.001	22.48↓

Table-13 Comparison of Mean Forced Expiratory Flow rate 25-75%-(FEF 25-75%) in normal and obese female subjects.

Parameter	Normal Subjects		Obese Subjects		**t** value	**P** value	% of Decrease
	Mean	S.D	Mean	S.D			
FEF 25-75%	2.6356	.4996	1.836	.3703	14.62	<0.001	30.34↓

Table-14 Comparison of Mean Peak Expiratory Flow rate-(PEFR) in normal and obese female subjects.

Parameter	Normal Subjects		Obese Subjects		**T** value	**p** value	% of Decrease
	Mean	S.D	Mean	S.D			
PEFR Liters	5.2696	.9589	4.144	.8455	5.9	<0.001	21.37↓

Table-15 Comparison of Mean Expiratory Reserve Volume-(ERV) in normal and obese female subjects.

Parameter	Normal Subjects		Obese Subjects		**t** value	**p** value	% of decrease
	Mean	S.D	Mean	S.D			
ERV Liters	1.1924	.2671	0.7468	0.2043	6.6277	<0.001	37.38↓

Chart-1 Comparison of Mean Forced Expiratory Volume in normal and obese subjects

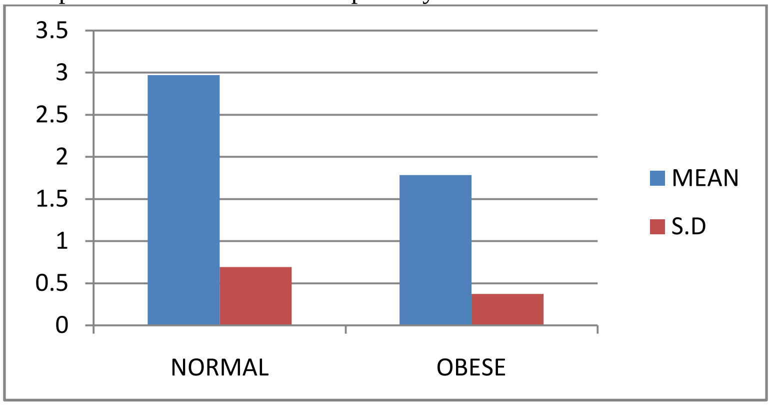


Chart – 2 Comparision of Mean Forced Expiratory Volume in 1 sec in normal & obese subjects

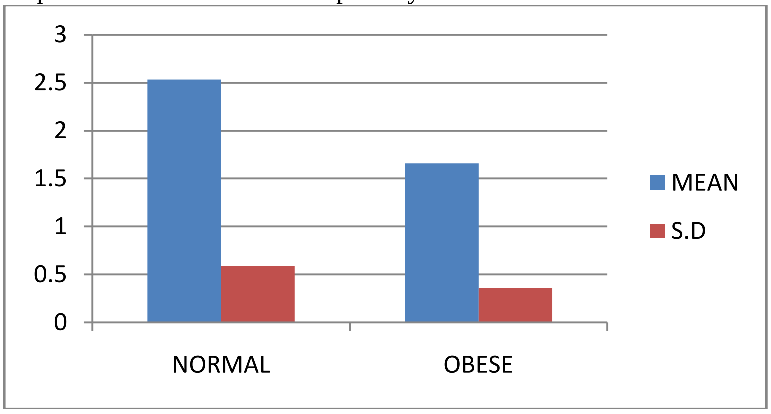


Chart – 3 Comparision of Mean Forced Expiratory Flow 25 – 75% in normal and obese subjects

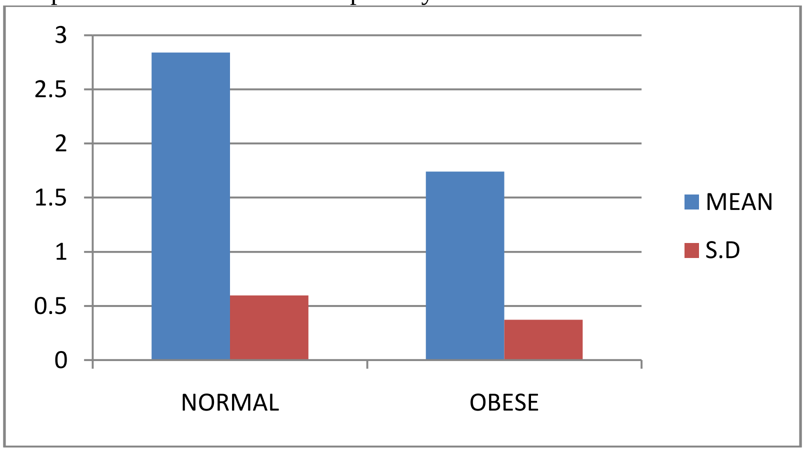


Chart – 4 Comparision of Mean Peak Expiratory Flow Rate in normal and obese subjects

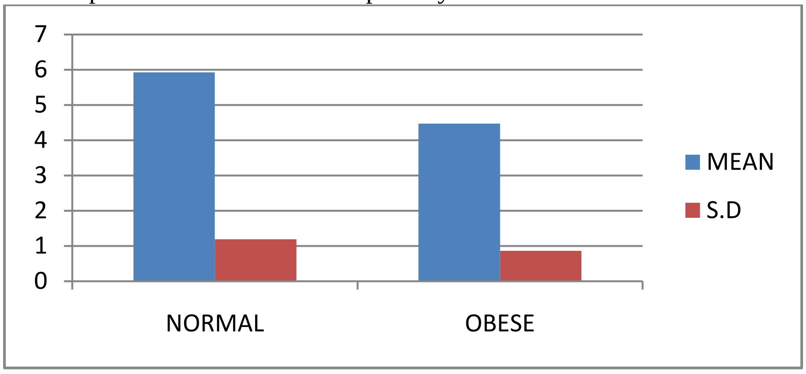


Chart – 5 Comparsion of Mean Expiratory Reserve Volume in normal and obese subjects

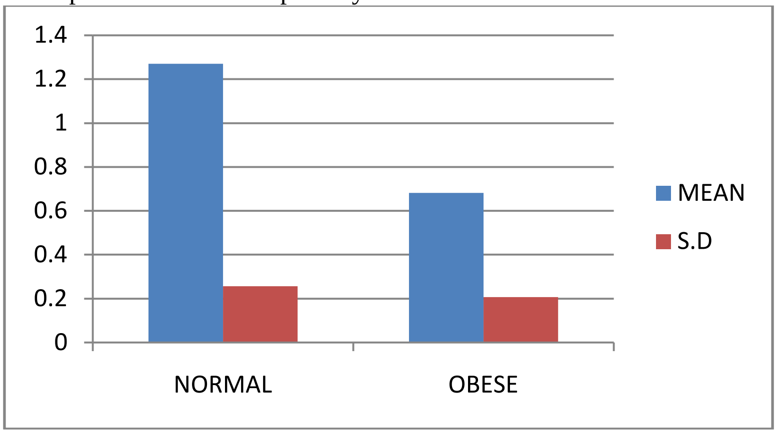


Chart – 6 Comparison of Mean Forced Vital Capacity in normal and obese male subjects

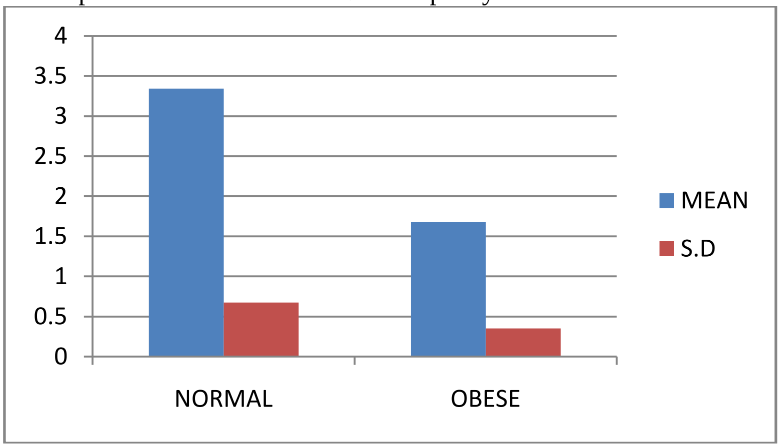


Chart – 7 Comparison of Mean Forced Expiratory Volume in 1 sec – in normal and obese male subjects

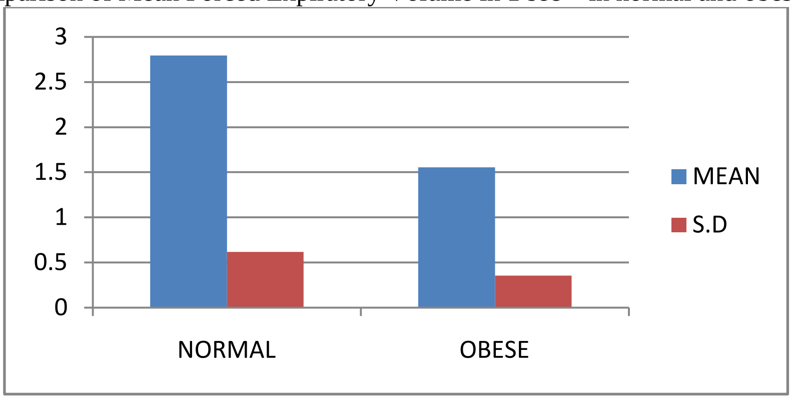


Chart – 8 Comparison of Mean Forced Expiratory Flow 25 – 75% in normal and obese male subjects

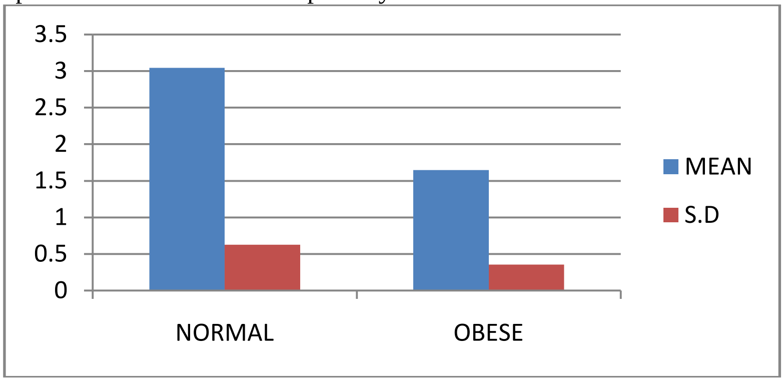


Chart – 9 Comparison of Mean Peak Expiratory Flow Rate in normal and obese male subjects

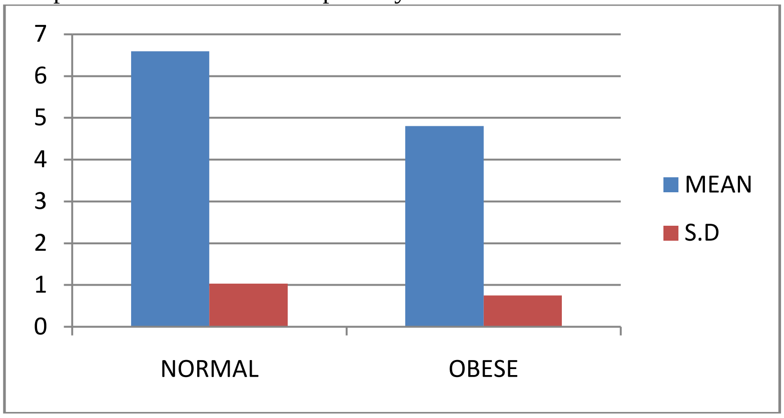


Chart – 10 Comparison of Mean Expiratory Reserve Volume in normal and obese male subjects

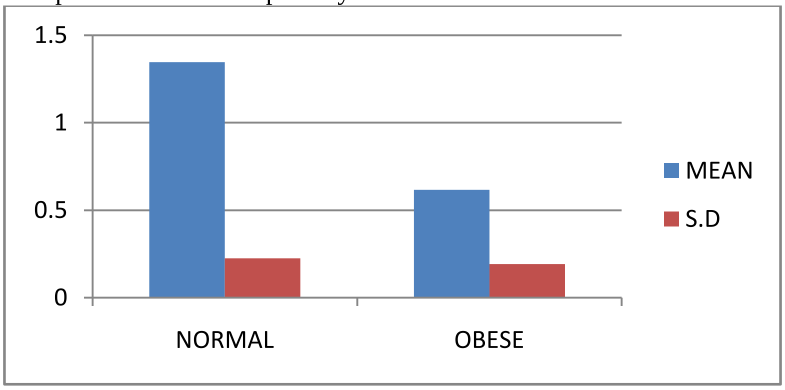


Chart – 11 Comparison of Mean Forced Vital Capacity in normal and obese female subjects

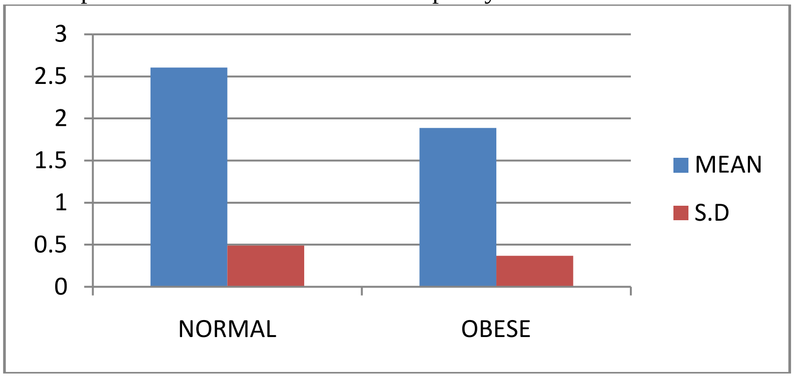


Chart – 12 Comparison of Mean Forced Expiratory Volume in 1 sec in normal and obese female subjects

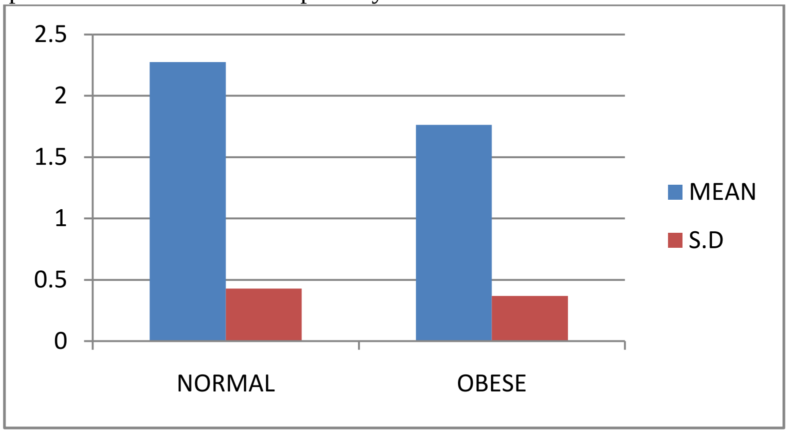


Chart – 13 Comparison of Mean Forced Expiratory Flow 25 – 75% in normal and obese female subjects

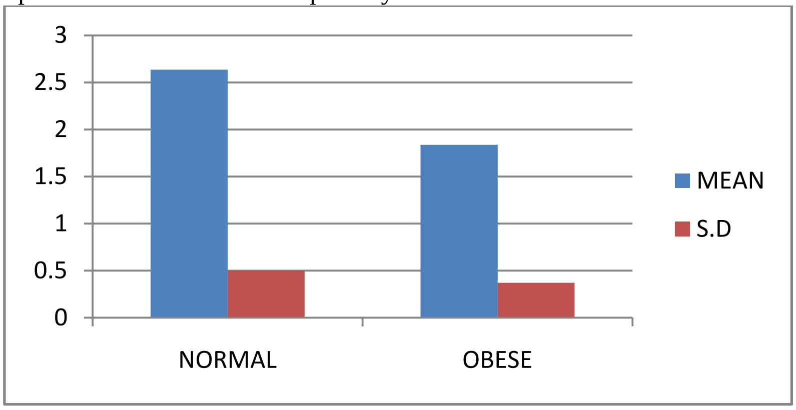


Chart – 14 Comparison of Mean Peak Expiratory Flow Rate in normal and obese female subjects

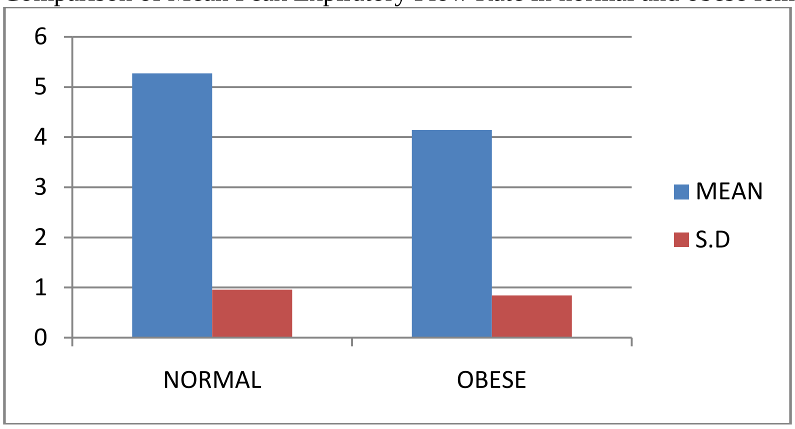
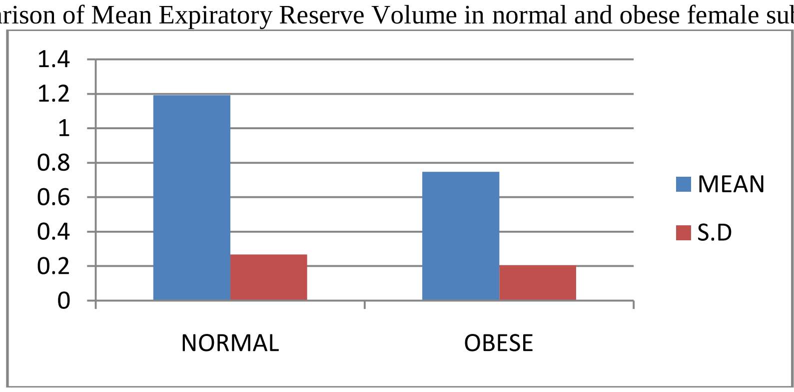


Chart – 15 Comparison of Mean Expiratory Reserve Volume in normal and obese female subjects



IV. Analysis Of Results

The mean Forced vital capacity [FVC] in the obese subjects [Group III and Group IV] is 1.7832, and it is compared with the mean FVC of normal or non obese subjects which is 2.9718 lit. This has shown a reduction of FVC of 40% with a P value of less than 0.001 which is significant statistically. The mean FEV1 of obese subjects is 1.66 lit, and it is compared with FEV1 of normal or non obese subjects which is 2.5342 lit. This showed a decline in Forced Expiratory Volume in first second about 34.5% with a P value of less than 0.001 which is significant statistically.

The mean FEF 25 – 75% of obese subjects is 1.741 lit is compared with FEF 25 – 75% of normal subjects which is 2.8396 lit. These results were significant because they showed reduction of FEF 25 – 75 by 38.68% with a P value less than 0.001.

The mean PEFR in the obese subjects is 4.4728 lit, and it is compared with the mean PEFR of normal subjects which is 5.9318 lit. These results showed a decreased in PEFR by 24.6% in obese subjects, with a P value of less than 0.001 which is statistically significant.

The mean Expiratory reserve volume – ERV of obese subjects is 0.6822 lit, and is compared with the mean ERV of normal subjects which is 1.27 lit. This has shown a reduction in expiratory reserve volume by 46.29% with a P value of less than 0.001 which is statistically significant.

The Mean Forced Vital Capacity [FVC] in the Obese male subjects [i.e. Group III] is 1.6772 lit, and it is compared with the Mean Forced Vital Capacity [FVC] of Normal or non obese male subjects [i.e. Group I] which is 3.34.This has shown a reduction of Forced Vital Capacity by 49.79% with a P value of less than 0.001, which is statistically significant.

The mean Forced Expiratory Volume in First second i.e. FEV1 of obese male subjects [i.e. Group III] is 1.5556 lit and is compared with the mean FEV1 of normal or non obese male subjects [i.e. Group I] which are 2.7924 lit. This showed a decline in FEV1 by 44.29% with a P value of less than 0.001.

The Mean Expiratory Flow 25 – 75% i.e. [FEV 25 – 75%] of obese male subjects [Group III] is 1.646 lit, and is compared with the FEF 25 – 75% of normal or non obese male subjects [i.e. Group I] which is 3.0436 lit. These results showed a reduction of FEF 25 – 75% by 45.91% with a P value of less than 0.001.

The Mean Peak Expiratory Flow Rate [PEFR] in the obese male subjects [i.e. Group III] is 4.8016 lit, and it is compared with the mean PEFR of normal non obese male subjects [i.e. Group I] which is 6.594 lit. These showed a decrease in PEFR by 27.19% in male subjects, with a P value of less than 0.001.

The Mean Expiratory Reserve Volume [ERV] of obese male subjects [i.e. Group III] is 0.6177 lit, and it is compared with the mean ERV of normal or non obese subjects [i.e. Group I] which is 1.3476 lit. This has shown a reduction in ERV by 54.17% with a P value of less than 0.001 which is statistically significant.

The Mean FVC of Obese female subjects [i.e. Group IV] is 1.8892 lit, and it is compared with the Mean FVC of normal or non Obese female subject [i.e. Group II] which is 2.6036 lit. This has a reduction of FVC by 27.44% with a P value of less than 0.001.

The Mean Forced Expiratory Volume in first second [FEV1] of obese female subjects [i.e. Group IV] is 1.7644 lit, and is compared with the mean FEV1 of normal or non obese female subjects [i.e. Group II] which is 2.276 lit. This showed a decline in FEV1 by 22.48% with a P value of less than 0.001, which is statistically significant. The Mean Forced Expiratory Flow 25 – 75% [FEF 25 – 75%] of obese female subjects [i.e. Group IV] is 1.836 lit, and is compared with the mean expiratory flow 25 – 75% of normal or non obese female subjects [i.e. Group II] which is 2.6356 lit. These results showed a reduction of FEF 25 – 75% by 30.34% with a P value of less than 0.001.

The Mean Expiratory Flow Rate PEFR in Obese female subjects [i.e. Group IV] is 4.144 lit, and it is compared with mean PEFR of normal or non obese female subjects [i.e. Group II] which is 5.2696 lit. These results showed a decrease in PEFR by 21.37% in obese female with a P value less than 0.001.

The Mean Expiratory Reserve Volume [ERV] of obese female subjects [i.e. Group IV] is 0.7468 lit, and it is compared with the mean ERV of normal or non obese female subjects [i.e. Group II] which is 1.1924 lit. This has shown a reduction in Expiratory Reserve Volume by 37.38% with a P value less than 0.001.

V. Discussion

Process respiration is divided into two steps, process inspiration & process expiration. The two main muscles of inspiration are Diaphragm & External intercostals muscles. Two muscles of expiration are Internal intercostals muscles & Anterior abdominal wall muscles. The diaphragm belongs to the category of skeletal muscle fibers. The attached portion is called crura. Diaphragm consists of two domes & a central part called the tendinous portion of the diaphragm. This is the shape in resting condition. During inspiration (**I**) neurons of respiratory center located in medulla fire motor current, this reaches the diaphragm through the spinal cord & phrenic nerve. Diaphragm now contracts, the domes are flattened & central tendon portion descends from thorax into the abdominal cavity. In resting condition the descent is 1-2 cm, in forced inspiration the diaphragm descends upto 8-10 cm. this increases ventral diameter of the chest wall.

Contraction of external intercostal muscles leads to bucket handle movement of the ribs which increases the transverse diameter of the chest wall. The above two movements result in pump handle movement of sternum which increases thickness of the chest wall namely anterio - posterior diameter. The pressure inside the lungs called intra pulmonary pressure falls down severely resulting in process inspiration.

Now second step process expiration commences passively using elastic recoil property of the lungs. Expiratory muscles do not contract & (**E**) neurons of expiratory centre will not fire motor current in resting respiration but during deep breathing in inspiratory centre the (**I**) neurons fire more number of impulses resulting in stronger contraction of the diaphragm, which descends upto 8-10 cm from thoracic region into the abdominal cavity.

Now (**E**) neurons of expiratory center start firing motor current which reaches the muscles resulting in contraction of main expiratory muscles (Internal intercostals muscles & anterior abdominal wall muscles).

The above mechanism is affected in obesity, the descent of the diaphragm is restricted by fat accumulation in anterior abdominal wall. So, limited amount of atmospheric air enters into the lungs. During forced expiration respiratory muscles contract powerfully but to some extent this is restricted by fat accumulation as only limited amount of air enters into the lungs during inspiration the FVC; FEV1; FEF 25-75%; PEFR; ERV; are significantly reduced in obese individuals. Many doctors studied the affect of pregnancy on PFT; their studies showed marked reduction in PEFR during the last trimester of pregnancy even though the mechanism is slightly different.

Results of my study revealed that the increased body mass index is significantly associated with decrease in Forced Vital Capacity [FVC]. Similar findings were seen in the previous work done by **Helena Santana and Elena Zoico**[21] .

The decrease in FVC and FEV1 values of my study on obese persons correlate with the results of **Canoy D, Luben R, Welch A and Bingham S**[6] .

Statistically significant decrease in ERV was seen in the study by **Rubin stein I, Zamel N D V Barry**[38] and the results of my study coincides with their findings.

Reduced ERV, FVC, FEV1, FEF 25 – 75% were found during the study conducted by **Biring M S, Lewis M I, Liv J T, Mohsenifar Z**[2] and my findings were in agreement with their study.

Prefaut C, Ramonatxom Monnier L[25] found that there is a decrease in ERV of obese people and my study is in agreement with their finding.

D. Canoy, R.Luben, A Welch, S Bingham[6] investigated the relation between obesity and respiratory function and found that the FEV1 and FVC were reduced and this finding is consistent with my study.

Ladosky , Bothelo M A, Aibuquerque J P Jr[28] conducted spirometry on 77 obese patients and found that their FEV1 is reduced in proportion to the FVC and their findings matched with findings of my present study.

Morganwk, Reger R B[33] work showed that FEV1 is decreased in over weight and obese subjects and this finding is consistent with my findings.

Thomas Ps, Cowen E R, Hulands G[42], stated that obesity is responsible for the decrease in lung volumes and more sensitive is ERV, and even in my study i found that ERV decreases in obese individuals.

Kolarzyk E, Kiec E, Galuszka Z and Wiater M[26], found that there is significant decrease in the VC and FEV1 in the obese person when compared with non obese counter parts and my present study is also in agreement with their study.

Harik – khan R I, Wise R.A, Fleg J L[20] opined that FVC and FEV1 decreases as the BMI increases. This is more marked in men than in women. My study correlates with their findings.

Valenca J, Caeiro F, Ontonio A[44] stated that obesity is associated with a reduction in FVC, FEV1 and ERV, and the results of my study are similar to their results.

Jenkins S C, Moxham J [23] – concluded that obesity even when mild significantly impaired lung function, and ERV is decreased in the obese persons. My study is in agreement with their study.

Wannamethee S G, Shaper A G and Whincup P H [47] after their study found that in obese individuals FEV1 is reduced and FVC tended to decrease with increasing BMI. These findings are correlating with my values obtained from the spirometry.

Boris I, Medarow M D, Paul strachan [3] concluded that increasing BMI has substantial decreasing effect on ERV and this finding is consistent with my study results.

Hamid Shebjami and Peter S Gartsides[19] **–** work on obese individuals revealed that there was significant reduction in the FVC, FEV1 and ERV and my findings are in accordance with their study.

M. Bottai, F. Pistelli, F. Dipede, L. Carrozzi [4] found that there is decrease in FVC, FEV1 and as BMI increases and these changes are more marked in males than in females, and results of my study is in agreement with their study.

Ross Lazarus, David Sparrow (27) found in their study that BMI was positively associated with decrease in FEV1 and FVC. This is in correlation with my study.

There is decreases values of FVC and FEV1 are seen in my study, and similar finding were previously observed by **Joel Faintuch, Shirley A.F, Souza, Antonic, Valezi** in their study on obese people.

VI. Summary & Conclusion

The present work is a comparative study of lung function in obese and normal human beings. The pulmonary function tests were conducted on 100 subjects out of which 50 are obese (25 male and 25 female) and 50 are non obese (25 male and 25 female) by using computerized spirometer – SPIRO – 232 MORGAN Medical limited.

When the results were analyzed i found that in obese there is decrease in FVC by 40% FEV1 by 34.5%, FEF 25 – 75% by 38.69%, PEFR by 24.6%, and ERV by 46.29% when compared with normal subjects. When the Gender difference is taken into consideration, obese male showed more marked decrease in the spirometric values than obese female subjects.

Males tend to deposit fat centrally [increasing the circumference of the abdomen] while in females the deposition appears more peripheral when compared to males. Thus a mechanical effect on the diaphragm in men impending expansion of lungs during inspiration could justify their higher impairment of ventilatory function. Obesity causes derangement in pulmonary function by virtue of its effects on ventilatory mechanics, pulmonary volumes and on respiratory muscles.

These obese individuals even though displaying nominally good health and being asymptomatic, they should be considered as appropriate candidates for specialized physical guidance to prevent diseases like Diabetes, Hypertension, Hyperlipidaemia, Heart diseases, cerebrovascular diseases etc.

The Obese subjects with ventilatory impairment should be routinely encouraged to loose weight through balanced diet and dynamic exercise for improving their lung function, to promote fitness and to lead a good quality of life.

As first step the patients can be advised breathing exercises. In second step the patient is advised slow reduction of body weight over a period of six to twelve months. Obesity treatment is considered as good success even if the patients loose 5 – 10% of existing body weight. The values of PFT will slowly return back to normal once the obesity is reduced.

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