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Research Paper

Medical Science

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Evaluation of Pulmonary Function Tests in obese individuals compared to non-obese individuals in age group of 35-55 years

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ABSTRACT

Background & objectives : Obesity has been found to be associated with altered PFTs. Obesity is known to induce respiratory mechanical impairments that may be combined with gaseous exchange abnormalities. The present study was planned to find out the relationship of obesity in terms of increased BMI & Pulmonary dysfunction.

Method : Patients were taken by organizing camps at QURESH MEDICAL TRUST, MIRZAPUR, AHEMDABAD and further divided according to their BMIs into two groups, N = 50 (control group) having BMI between 18.50-24.99 and N=50 (study group) having BMI >30. PFT parameters (FVC, FEV1, PEFR & MVV) were studied in both groups by using spirometer (computerised spirometer GMS-HELLIOS 702)

Results: The findings of PFTs showing that FVC, FEV1, PEFR & MVV were reduced in study groups compared to control group and difference was statistically significant (P<0.05)

Interpretation & conclusion: Similar to earlier studies done in India & abroad, we also found an impairment of the lung functions in obese having higher BMI than control subjects. There is inverse relationship between BMI & PFTs. Further reduction in weight helps to restore the normal pulmonary functions.

Introduction:

Obesity is one of the greatest threats to public health. Obesity invites disability, disease & premature death. Associated complications include DM, HTN, CHD, Sleep apnoea, gout, arthritis etc. Obesity is known to induce respiratory, mechanical impairment that may be combined with gaseous exchange abnormalities. Several studies have shown that excess weight & weight gain is related to pulmonary dysfunction. But this issue needs to be further clarified. So the present study was planned to find out the relationship of obesity in terms of increased BMI (>25) & pulmonary dysfunctions.

Aims & Objectives:

1. To compare the respiratory functions of obese individuals with control subjects
2. To find out if there is any change in inspiratory & expiratory vital capacities along with their related parameters like expiratory flow rate, peak expiratory flow, peak inspiratory flow and maximum voluntary ventilation
3. To find out the effect of obesity on CVS parameters like pulse rate and BP.
4. To analyse the results and conclude on the basis of statistical comparison of all collected data.

Material and Methods:

We had organised a camp at QURESH MEDICAL TRUST ,Mirzapur, Ahmedabad. We had taken 100 subjects, 50 subjects having BMI between 18.5-24.99 were taken as control group and another 50 subjects having BMI >30 were taken as study groups. The PFT parameters (FVC, FEV1, PEFR, MVV) were studied in both the groups by using **SPIROMETER GMS HELIOS 702**.

Result:

There was a significant decrease in the values of FVC & its components in obese compared to the control subjects. FIVC & FIV1 was not significantly different. The FEV1/FVC ratio of obese was significantly more but there was no significant difference for FIV1/FIVC ratio compared to control subjects. PEFR values in obese were significantly lower compared to control subjects. MVV values significantly lower in obese compared to control subjects. Flow volume loop shows restrictive pattern rather than obstructive pattern in obese individuals.

Table–1 Showing standard Anthropometrical Measurement of Control (n=50) and Obese subjects (n = 50)

Parameters	Control		Obese	
	Mean	SD	Mean	SD
Age (yrs.)	37.44	7.22	39.00	8.40
Height (cm)	168.00	5.28	166.28	5.01
Weight (kg)	61.16	7.64	94.56***	11.53
Waist (cm)	79.76	7.35	110.80***	1.16
Hip (cm)	87.12	6.88	117.00***	17.55
Hip/Waist	1.10	0.09	1.05	0.11
BSA (m^2)	1.70	0.12	2.05***	0.13
BMI (kg/m^2)	21.10	2.09	33.50***	3.48

*BSA = Body Surface Area, BMI = Body Mass Index, *** = P < 0.001*

Table – 2 Showing Pulse Rate (per min) and Systolic & Diastolic blood pressure in standing and supine postures in control (n=50) and Obese subjects (n = 50)

Parameters	Control		Obese	
	Mean	SD	Mean	SD
PR /min	80.16	5.77	85.84*	10.83
SBP in mmHg (St)	120.32	9.16	138.00***	11.90
DBP in mmHg (St)	76.64	5.99	85.36***	7.74
SBP in mmHg (Sup)	124.64	8.86	145.36***	14.61
DBP in mmHg (Sup)	78.16	5.65	89.68**	18.55

PR = Pulse Rate, SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, St. = Standing posture, Sup. = (Supine posture)

** = P < 0.05, ** P < 0.01 and *** = P < 0.001*

Table – 3 (A) Showing Forced Vital capacity and its expiratory and inspiratory volumes in control (n=50) and Obese subjects (n = 50)

Parameters	Control		Obese	
	Mean	SD	Mean	SD
FVC (l) O %	3.74 103.40	0.64 18.06	3.01*** 87.84 **	0.94 22.67
$FEV_{0.5}$ (l) O %	1.98 77.36	0.51 18.15	1.57* 66.04	0.80 28.88

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FEV_1 (l) O %	2.94 100.68	0.44 14.47	2.57* 97.00	0.81 21.00
FIVC (l) O	2.44	0.52	2.44	0.84
FIV_1 (l) O	1.93	0.76	1.55	0.90

L= Litres FVC (l) = Forced Vital Capacity (in liters), $FEV_{0.5}$ = Forced Expiratory Volume in 0.5 second (in liters), FEV_1 = Forced Expiratory Volume in one second (in liters), FIVC = Forced Inpsiratory Vital Capacity (in liters), FIV_1 = Forced Inspiratory Volume in one second (in liters)

O = Observed values

% = Percentage of Predicted values

** = P < 0.05, ** = P < 0.01 and *** = P < 0.001*

Table – 3 (B) Showing Ratio of FEV_1 to FVC and FIV1 to FIVC in control (n=50) and Obese subjects (n = 50)

Parameters	Control		Obese	
	Mean	SD	Mean	SD
FEV1 /FVC (%) O %	80.89 100.16	10.52 12.83	86.90** 112.40***	9.84 11.93
FIV1 / FIVC (%)O %	80.39 80.39	21.07 21.07	73.40 73.40	15.50 15.50

FEV_1/ FVC (%) = Ratio of Forced Expiratory Volume in one second to Forced Vital Capacity, FIV_1 / FIVC = Ratio of Forced Inspiratory Volume in one second to Forced Inspiratory Vital Capacity.

O = Observed values

% = Percentage of Predicted values

*** = P < 0.01 and *** = P < 0.001*

Table – 3 (C) Showing flow rates in control (n=50) and Obese subjects (n = 50)

Parameters	Control		obese	
	Mean	SD	Mean	SD
PEF (l/s) O %	6.78 88.72	1.43 19.36	5.72* 77.00	2.07 24.00
$FEF_{25-75\%}$(l/s) O %	3.29 98.52	0.84 23.04	3.54 123.00**	1.27 33.30
$FEF_{50\%}$ (l/s) O %	3.70 93.76	1.01 23.40	4.04 114.00**	1.56 35.50
$FEF_{75\%}$ (l/s) O %	1.69 105.40	0.71 41.31	1.98 150.00**	0.74 51.00
PEFT (l/s) O	3.09	1.36	2.29**	1.02
PIF (l/s) O	3.26	1.35	2.87	1.36

PEF = Peak Expiratory Flow (liters/second), $FEF_{25-75\%}$ = Forced Expiratory volume between 25% to 75% of FVC, $FEF_{50\%}$ = Forced Expiratory Flow at 50% of FVC (liters/second), $FEF_{75\%}$ = Forced Expiratory Flow at 75% of FVC (liters/second), PEFT = Peak Expiratory Flow Test (liters/second), PIF = Peak Inspiratory Flow (liters/second).

O = Observed values

% = Percentage of Predicted values

** = P < 0.05 and ** = P < 0.01*

Table – 3 (D) Showing Maximum voluntary ventilation in control (n=50) and Obese subjects (n = 50)

Parameters	Control		Obese	
	Mean	SD	Mean	SD
MVV (l/min) O %	181.7 100.16	42.4 12.83	139.57* 82.40	24.15 11.93

MVV = Maximum Voluntary Ventilation in litres.

O = Observed values

% = Percentage of Predicted values

** = P < 0.05*

Expiratory flow volume loops *showing restrictive as well as obstructive pattern in the subjects analyzed and restrictive pattern was found in obese individuals compared to control subjects and values were found to be significant.*

Normal

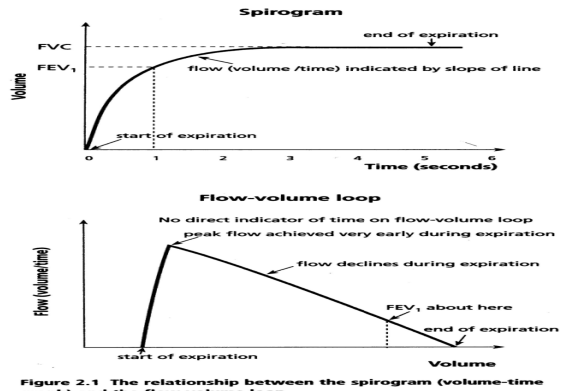

Figure 2.1 The relationship between the spirogram (volume–time graph) and the flow–volume loop

Restrictive Pattern

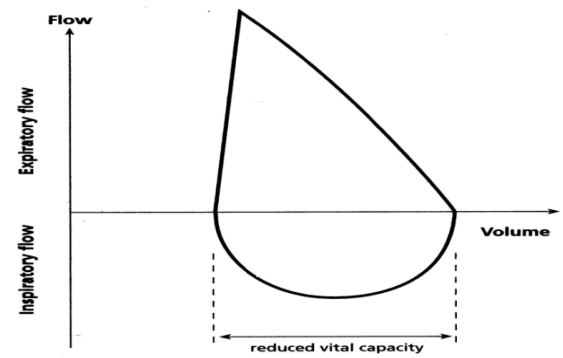

Figure 2.5 Restrictive flow-volume loop
The loop is narrow because the vital capacity is reduced, and peaked because the stiffness of the lungs increases elastic recoil and increases peak expiratory flow.

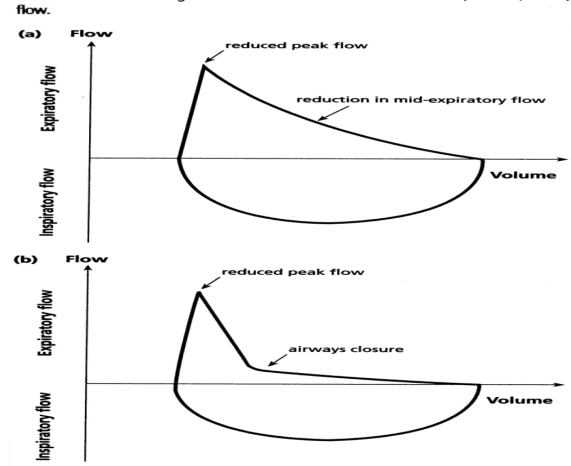

Figure 2.4 Obstructive flow-volume loops
(a) Concave loop caused by airways narrowing (for example, asthma).
(b) Airway collapse/closure, typical of emphysema.

Obstructive Pattern Discussion:

The table-1 shows the anthropometrical measurements of control subjects (n=50) and obese individuals (n=50). The mean age of control subjects was 37.44±7.22 years while that of obese individuals was 39.40 ± 8.42 years. The mean heights were 168.00 ± 5.28 and 162.8 ± 5.01 cm of control and obese individual respectively.

There was significant difference in weight of obese individuals (94.56 ± 11.53kg) compared to the weight of control individuals (61.16 ± 7.64 kg).

Table 2 shows that the cardiovascular parameters of both the groups. The values for pulse rate were significantly higher ($P < 0.05$) in obese individuals (85.84 ± 10.83 per minute) Compared to those of control subjects (80.16 ± 5.77 per minute).

The values of systolic blood pressure were found to be significantly higher ($P < 0.001$) in obese individuals irrespective of posture (138.00 ± 11.90 mm Hg in standing and 145.36 ± 14.61 mm Hg in supine posture) when compared with control subjects (120.32 ± 9.16 mm Hg in standing posture and 124.64 ± 8.86 min Hg in supine posture).

Similarly, the diastolic blood pressure-values were also found to -be significantly higher ($P < 0.001$ for standing posture and $P <0.01$ for supine posture) in obese individuals when compared with the values of control subjects irrespective of posture. The diastolic blood pressure of obese was 85.36 ± 7.74 mm Hg in standing posture and 89.68 ± 18.55 mm Hg in supine posture, while that of control subjects was 76.64 ± 5.99 mm Hg in standing posture and 78.16 ± 5.65 mm Hg in supine posture.

Table 3 (A), 3 (B), 3 (C) and 3 (D) show the comparison of various respiratory parameters of obese and control individuals.

Table 3 (A) shows the Forced Vital Capacity (FVC), Forced Expiratory Volume in 0.5 second (FEV O.5), Forced Expiratory Volume in one second, Forced Inspiratory Vital Capacity (FIVC) and Forced Inspiratory Volume in one second (FIV1) of control as well as obese individuals. FVC in obese (3.01 ± 0.94 litres) was significantly lower than that of control subjects (3.74 ± 0.64, $P < 0.01$). The $FEV_{0.5}$ of obese (1.57 ± 0.80 litres) was also found significantly lower than that of control subjects (1.98 ± 0.51 litres, $P < 0.05$). Similarly FEV_1 value of obese (2.57± 0.31 litres) was found to be significantly lower ($P < 0.05$) when compared that with of control subjects (2.94 ± 0.4 litres). There was no significant difference between the values of FIVC and FIV_1 of obese and control subjects, though the FIV_1 was found to be low in obese subjects.

Table 3 (B) shows ratio of FEV_1 to FVC (FEV_1 /FVC) and FIV_1 to FIVC (FIV_1/FIVC). The FEV_1/FVC ratio shows significantly higher ($P < 0.05$) values in obese individuals (86.90 ± 9.81) compared to control subjects (80.89 ± 10.52). The value for FIV_1/ FIVC of obese individuals (73.40 ± 15.50) was lower than that of control subjects (80.39 ± 21.07) but the difference was found to be non-significant.

In table 3 (C) respiratory flow rates of obese and control subjects have been shown. Peak Expiratory Flow of obese (5.72 ± 2.07 litres/second) was significantly lower ($P < 0.05$) than that of control subjects (6.78 ± 1.43 litres/second). Similarly Peak Expiratory Flow Test was also found to be significantly lower ($P < 0.05$) in obese than control subjects. Though the Peak Inspiratory Flow of obese individuals (2.78 ± 1.36 litres/second) was lower than that of control subjects (3.26 ± 1.35 litres/second), the difference was not significant. Values for Forced Expiratory Flow at 50% of FVC ($FEF_{50\%}$), at 75% of FVC ($FEF_{75\%}$) and FEF between 25 to 75% of FVC ($FEF_{25-75\%}$) of obese individuals were higher than those of control subjects, the differences were found to be non-significant.

Table 3 (D) shows Maximum Voluntary Ventilation (MVV) in litres/minute during voluntary ventilation. The MVV of obese individuals (139.57 ± 24.15 litres/ minute) was significantly lower ($P < 0.05$) when compared with the MVV of control subjects (181.7 ± 42.4 litres/minute).

Conclusion:

Here with we conclude that obesity or overweight burdens the respiratory system leading to impairment in pulmonary functions. The work of breathing is definitely getting increased. The reduction in body weight may help in reversal of these parameters towards the normal.

Lung functions are more compromised with upper body obesity. There is inverse relationship between obesity and spirometry values. As problem of obesity is increasing day by day and also the associated complications, further study should be carried out in this field.

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