PULMONARY FUNCTION TEST IN OBESE AND NON-OBESE INDIVIDUALS.

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ABSTRACT

Background and Objective : To find out the relationship of obesity and pulmonary function test.

Methods: Cross sectional study was done on 30 males with age25 -50 years and Body Mass Index (BMI) ≥25 and 30 males age 25-50 years and BMI <25 in the Department of Physiology Medical College, Baroda. After thorough clinical examination of all the selected patients, they were subjected to pulmonary function test by spirometry. Statistical analysis was done by applying student-t test.

Results: There was significant decrease in the values of FVC, FIV1, PEF, PIF in obese compared to control subjects.FIVC was not significantly different in obese.The ratio of FEV1/FVC of obese was significantly more than control subjects but there was no significant difference for FIV1/FIVC. Mid expiratory flow rates were found to be higher in obese than that of control subjects.The difference of MVV of control and obese individuals was significant but for the RR value the differences was non-significant.

Interpretation and Conclusion: Obesity was associated with increase in abnormal PFT pattern.

Key-words: Pulmonary function test, Obesity, Body mass index, Males

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INTRODUCTION

Even as India battles malnutrition, the country has developed another nutritional problem-obesity. In past 10 years, the number of obese people has doubled in the country.[1] As per the survey conducted by Ministry of Health and Family Welfare (MoHFW), people having Body Mass Index (BMI) more than 25 kilogram per meter square have been considered as obese.[2] Experts believe that obesity is the major reason for developing different types of diabetes mellitus. Several researchers have highlighted that obesity accounts for 80-85 per cent of the risk of developing Type-2 diabetes. The survey highlights that urban population is more prone to obesity as compared to their rural counterparts.[1] It was observed that the BMI values were similar in men and women; however, there were more overweight/obese (BMI≥25 kg/m ^{2})

women (6.6%) than men (3.5%). In certain regions, obesity and consequent diseases are posing an enormous public health problem. Prevalence of obesity (overweight or obese, BMI ≥ 25) in men are 26.3% in urban, 14.3% in rural and 18.6% total in India. In Gujarat 25.9% in urban, 14.3% in rural and 19.7% total in India.[1] Most of the states have experienced sharp rise in the number of obese people.

Obesity is known to induce respiratory mechanical impairments that may be combined with gas exchange abnormalities. The mass loading of the ventilator system induced by obesity, particularly on the abdominal component of the chest wall, modifies the static balance within the respiratory system. The association between severe obesity, arterial hypoxemia, decreased functional capacity (FRC) and decreased expiratory reserve volume (ERV) has long been recognized.[34567] Studies have shown that excess weight and weight gain is related to pulmonary dysfunction, but this issue needs to be further clarified. The present study was conducted to find out the relationship of obesity in terms of increased BMI and pulmonary dysfunction.

MATERIALS AND METHODS

This study was conducted in the Department of Physiology, Medical College, Baroda. All the subjects of study were males between the age group of 25-50 years.

Sample selection criteria: Participants in our study were of two different categories: Control subjects who were having body mass index less than 25.

Obese and overweight individuals (N=30) who were having the body mass index more than 25. Subjects were selected after applying the inclusion and exclusion criteria and taking written informed consent for all participants. Subjects were categorized into the two groups based on the BMI. The study was approved by scientific review committee and institutional ethical committee of Baroda Medical College.

Inclusion criteria: Subjects aged 25-50 years males.

At the time of participation all the subjects were asymptomatic and were not under any sort of medical treatment related to major cardiovascular or pulmonary diseases in the past and specially so on the day of test.All the subjects had daily physical exercise like walking & cycling for 20-30 minutes.

Exclusion criteria: Subjects with known cardiovascular, respiratory, thyroid dysfunction, diabetes mellitus, history of tobaccosmoking/chewing and alcohol consumption, thoracic skeletal deformities.

Parameters recorded: Following the selection of subjects, a generalphysical examination was performed and the followinganthropometric measurements and pulmonary functiontests were performed on them. Anthropometric measurements: Height (in meters) – Measurement were plotted on the wall using a non-elastic measuring tape for recording the height of elderly. Erect heights were obtained with the subjects standing barefoot on the flat surface, against the vertical wall with occiput, buttocks and heal touching the wall and arms hanging freely on the sides. A non-elastic plastic ruler was used to localize the upper limit of height measurements. Height measurements were recorded to the nearest of 0.5 cm. Weight (in kilograms) – all study subject were weighed in the clothes they had worn. The weighing machine was regularly standardized with a known weight. The adults were instructed about the procedure. The scale was readjusted to zero after weighing each adult. They were made to stand erect with the both feet together without any support, looking straight with vision fixed on point on opposite wall such that the plain of vision was perpendicular to their body and parallel to the ground. The measurements were recorded to nearest of 0.5 kg using a digital weighing scale. Body massindex (BMI) was calculated using the formula BMI = Wt.(kilograms)/Ht.^{2} (meters).

Pulmonary function tests: (PFTs): these test were carried out by using the instrument MEDI:SPIRO (medical equipment & computer system (I) Ltd. Mumbai India Maestros connected to computer employed pulmonary function, Medi : Spiro Software. Age, Height, Weight of the subject was filled in, this information was used for obtaining age and height corrected predicted value (INDIAN). Spirometry was done in erect sitting posture. Subjects were demonstrated the methods were allowed rehearsal after enough practice, subject were performed spirometry in three different ways to record,

(a)Forced vital capacity – Expiratory and Inspiratory (FVC and FIVC)

(b) Maximum voluntary ventilation and

(c) Expiratory and Inspiratory flow-volume LOOP.

For FVC MANEUVER; subjects after breathing quietly for two tidal breaths, one instructed to take a deep maximum inspiration and then breath out as forcefully , as fast as, as completed as possible. Graphic records and values of FVC and its component were obtained.

For MVV manoeuvre the subject performed as fast as and as deep as, inspiration and expiration for 10 seconds computed value for MVV/ minute were obtained.

To obtained flow- Volume curve subjects was allowed to take two quite breath and instructed to breath all the way in, hold the breath and breath all the way out as fast as complete as possible for expiratory flow volume loop. The data was obtained through computer printer all the Spirometric value is there automatically corrected to BTPS.

Computerized spirometry record shows the following reason

Force Vital Capacity (FVC), Force Expiratory Volume in 0.5 and 1second ($FEV_{0.5}$ and $FEV_{1\ sec}$), FEV_1 / FVC%, Peak Expiratory and Inspiratory Flow rate (PEFR,PIFR), Forced expiratory flow (FEF at 25%,50% and 75% of expired volume), FEF 25%, 75% i.e. Flow rate at expired value termed as maximum and mid expiratory flow rate –MMFER.

MVV and Flow–Volume curve predicted value were obtained, remarks whether, flow volume and flow rates were normal or suggestive of restrictive and obstructive defect.

Statistical Analysis: Data entry and statistical analysis were performed using MS-Excel and Epi-Info software respectively. Difference and statistical significance of mean values and standard deviations of physical characteristics and PFT parameters between the two groups was analysed using an Un-paired t-test. P-value < 0.05 was considered statistically significant.

RESULTS:

The mean age of control subjects was 31.44 ± 7.22 years while that of obese individuals was 32.40 ± 8.42 years. There was significant difference between weight of obese individuals and weight of control individuals. Table 1 shows the comparison of respiratory parameters of Forced Vital Capacity (FVC), Forced Expiratory Volume in 0.5 second (in litres) , Forced Expiratory Volume in 1 second (in litres), FIVC =Forced Inspiratory Vital Capacity (in litres), FIV1 =Forced Inspiratory Volume in 1 second (in litres) of controls and as well as obese individuals. Forced Vital Capacity in Obese was 3.01 ± 0.94 while in control subjects it was 3.74 ± 0.64. The difference was statistical significant. Forced Vital Capacity in Obese was significantly lower than that of control group. The FEV0.5 of obese (1.57+-0.80) was also found significantly lower than that of control subjects (1.98+-0.5 litres, P<0.05). Similarly FEV1 value of obese (2.57+-0.81 litres) was found to 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 F1VC and F1V1 of obese and control subjects.

Table-2 shows ratio of FEV1 to FVC (FEV1/FVC) and FIV1 to FIVC (FIV1/FIVC). The FEV1/FVC ratio shows significantly higher (P < 0.05) values in obese individuals (86.90 ± 9.84) compared to control subjects (80.89 ±10.52). The value for FIV1/FIVC of obese individuals (73.40 ± 15.50) was lower than that of control subjects (80.39 ± 21.07), but difference was found to be non–significant.

In Table-3 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). 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 (FEV50), at 75% of FVC (FEV75) 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-4 shows Maximum Voluntary Ventilation (MVV) in litres/minute and Respiratory Rate (RR) per minute during voluntary ventilation. The MVV of obese individuals (86.90±9.84 litres/minute) was significantly lower (P<0.05) when compared with the MVV of control subjects (80.89 ± 10.52 litres/minute). While there was no significant difference found for the values of RR in obese and control subjects.

Tables

Table-1 Pulmonary function tests (Forced Vital capacity and its expiratory and inspiratory volumes in control and obese subjects

	Control		Obese		
Parameters	**Mean**	**SD**	**Mean**	**SD**	
FVC (1) O	3.74 (103.40%)	0.64 (18.06%)	3.01 (87.84%)	0.94 (22.67%)	P<0.001
FEV0.5 (1) O	1.98 (77.36%)	0.51 (18.15%)	1.57(66.04%)	0.80 (28.88%)	P<0.05
FEV1 (1) O	2.94 (100.68%)	044 (14.47%)	2.57 (97%)	0.81 (21%)	P<0.05
FIVC (1) O	2.44	0.52	2.44	0.84	
FIV1 (1) O	1.93	0.76	1.55	0.9	
FVC = Forced Vital Capacity (in litres), FEV 0.5 = Forced Expiratory Volume in 0.5 second (in litres) ,					
FEV1 =Forced Expiratory Volume in 1 second (in litres),					
FIVC =Forced Inspiratory Vital Capacity (in litres),					
FIV1 =Forced Inspiratory Volume in 1 second (in litres),					
O = Observed values % = Percentage of predicted values.					

Table-2 Pulmonary function tests (Ratio of FEV1 and F1V1 to FVC and FEV 25-75) in control and obese subjects

	Control		Obese		
Parameters	**Mean**	**SD**	**Mean**	**SD**	
FEV1/FVC (%) O	80.89 (100.16%)	10.52 (12.83%)	86.90 (112.40%)	9.84 (11.93%)	P<0.001
FIV1/FIVC (%)	80.39 (80.39%)	21.07 (21.07%)	73.40 (73.40%)	15.50 (15.50%)	
FEV1/FEV (%) = Ratio of Forced Expiratory Volume in one second to Forced Vital Capacity					
FIV1/FIVC= Ratio of Forced Inspiratory Volume in one second to Forced Inspiratory Vital Capacity					
O = Observed values % = Percentage of predicted values.					

Table-3 Pulmonary function tests ((flow rates) in control and obese subjects

	Control		Obese		
Parameters	**Mean**	**SD**	**Mean**	**SD**	
PEF (l/s)	6.78 (88.72%)	1.43 (19.36%)	5.72 (77.00%)	2.07 (24.00%)	P<0.05
FEV25-75(%)	3.29 (98.52%)	0.84 (23.05%)	3.54 (123.00%)	1.27 (33.30%)	
FEF50 (l/s)	3.70 (93.76%)	1.01 (23.40%)	4.04 (114.00%)	1.56 (35.50%)	
FEF75 (l/s)	1.69 (105.40%)	0.71 (41.31%)	1.98 (150%)	0.74 (51.00)	
PEFT (l/s)	3.09	1.36	2.29	1.02	
PIF (l/s)	3.26	1.35	2.87	1.36	
PEF= Peak Expiratory Flow (l/s), FEV25-75(%) Forced Expiratory volume between 25% to 75% OF FVC					
FEV50 (%) Forced Expiratory volume at 50% OF FVC, FEV 75 (%) Forced Expiratory volume at 75% OF FVC					
PEFT= Peak Expiratory Flow Test (l/s), PIF = Peak Inspiratory Flow (l/s).					
O = Observed values % = Percentage of predicted values.					

Table-4 Pulmonary function tests (maximum voluntary ventilation and Respiratory rate in control subjects and obese subjects)

	Control		Obese		
Parameters	**Mean**	**SD**	**Mean**	**SD**	
MVV (l)	80.89 (100.16%)	10.52 (12.83%)	86.90 (112.40%)	9.84 (112.40%)	P<0.05
RR(/min)	32.9 (98.52%)	8.4 (23.05%)	35.4 (123.00%)	12.7 (33.30%)	
MVV(L) = Maximum Voluntary Ventilation in litres, RR(/min) = Respiratory rate per minute					
O = Observed values % = Percentage of predicted values.					

DISCUSSION

The age was similar in both obese and control individual so we can see the effect of obesity on pulmonary function test accurately because here age is matched. Table 1,2,3,4 show the comparison of various respiratory parameters of obese and control individuals. Table 1 shows the Forced Vital Capacity (FVC), Forced Expiratory Volume in 0.5 second ($FEV_{0.5}$),Forced Expiratory Volume in 1 second were found significantly lower in obese individual as compared to controls. The reduction in FVC may be due to reduction in the compliance of the total respiratory system. There was no significant difference between the values of FIVC and FIV1 of obese and control subjects. The FEV1/FVC ratio shows significantly higher in obese individuals compared to control subjects. The value for FIV1/FIVC of obese individuals was lower than that of control subjects, but the difference was found to be non-significant.

Peak Expiratory Flow of obese was significantly lower than that of control subjects. Similarly Peak Expiratory Flow test was also found to be significantly lower in obese than control subjects. Though the peak Inspiratory Flow of obese individuals was lower than that of control subject, the difference was not significant. Values for Forced Expiratory Flow at 50% of FVC (FEV50), at 75% of FVC (FEV75) and FEF between 25 to 75% of FVC (FEF25-75) of obese individual where higher than those of control subjects, the differences were found to be non-significant. The MVV of obese individuals was significantly lower when compared with the MVV of control subjects. While there was no significant difference found for the values of RR in obese and control subjects. A study conducted A M Li in children observed that reduction in FRC and diffusion impairment were more common in obese patients.[8] A prospective study of pulmonary function test in obese patients carried out by Pradeep Prajapati concluded that increase in BMI was associated with increase in abnormal PFT pattern. The most common abnormal function was decreased mean FVC, FEV1 and increased FEV1/FVC ratio.[9] Contrasting finding observed by G. K. Sudhir that increase in FVC with increasing BMI.[10]

CONCLUSION

Herewith one can conclude that obesity burdens the respiratory system. So reduction in the body weight may help in reversal of the parameters towards normality.

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