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EXPIRATORY TIME AN INDICATOR OF PULMONARY EFFICIENCY IN OBESE – A CASE CONTROL STUDY

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ABSTRACT

Obesity is a global health hazard and has been linked to numerous disorders such as dyslipidemia, type II diabetes, cardio vascular diseases and derangement of pulmonary functions. The mechanism for negative association of obesity with pulmonary functions is still debated. We assessed the association of Forced vital capacity and maximal voluntary ventilation parameters and body mass index by using a case control study. These parameters measured between obese and non obese groups were statistically analysed using student 't' test. Changes in expiratory time was statistically extremely significant ('p' <0.001) whereas forced vital capacity and maximal voluntary ventilation parameters were not statistically significant (>0.05).

Keywords: *Body Mass Index; Obesity; Forced vital capacity; Expiratory time.*

Abbreviations used

PFT: Pulmonary Function Tests. FVC: Forced Vital Capacity, FEV_1: Forced Expiratory Volume in one second, T_E: Expiratory time, MEF_{75}: Mid Expiratory Flow Rate75, MEF_{50}: Mid Expiratory Flow Rate50, MEF_{25}: Mid Expiratory Flow Rate25, MMEF: Maximal Mid Expiratory Flow rate, MVV: Maximum Voluntary Ventilation, BMI: Body Mass Index.

INTRODUCTION

Obesity is a chronic disease that is causally related to serious medical illness[1]. It is a far reaching problem worldwide today, is more prevalent than ever and millions of people are at increased risk of a number of diseases due to obesity. Obese people are also prone for social discrimination and possibly adverse psychological consequences. Much needs to be understood in all areas of obesity to provide best palliation, treatment, care and hope to the obese[2]. Obesity and overweight are so common that they are replacing the more traditional public health concerns such as under nutrition and infective diseases as significant contributors to ill health and it in fact they are threatening to overwhelm health services[3]. Health consequences of obesity have been studied for hundreds of years; Egyptians have portrayed statues showing obese along with other illnesses. Prevalence of obesity has increased besides to genetic predisposition, from adoption of sedentary life styles, disproportionate intake of calories, ease of availability of junk foods and use of automated working profiles[4]. Apart from calculations of Body mass index, alterations in some of the parameters of pulmonary function tests have been considered as an early and a significant marker of problem obesity[5]. Their significance in milder forms of obesity, the more prevalent class in our country has not been extensively studied and hence this study was taken up.

EXPERIMENTAL

Methodology

This case control study was carried out after obtaining institutional ethical committee clearance and written informed consent and the study was in adherence to Indian Council of Medical Research guidelines 2006[6]. 150 individuals were screened and of them, individuals who fulfilled the inclusion criteria were considered as case subjects and an equal number of representative control subjects were selected.

Inclusion criteria:

- Individuals aged between 18-45 years and whose body mass index was above 27.5 (Obese) were included as case subjects.
- Individuals aged between 18-45 years and whose body mass index ranging from 18.5 to 23 were included as control subjects.

Exclusion criteria:

- Individuals <18yrs and > 45 years.
- Individuals with history of chronic diseases like hypertension, cardiac diseases and tuberculosis or any disease known to affect respiration were excluded.

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Sample size:
32 individuals fulfilled the criteria's under the heading of case subjects and hence an equal number of controls of 32 were included in the study.

Classification of obesity proposed by World health organization and National Institute of Health recommended for Indians was used while grouping individuals into different classes of obesity based on BMI [1, 7 & 8] and the same is depicted in Table 1.

Table 1: *classification of overweight and obesity based on BMI in kg/m²*

Category	WHO Criteria	Recommendation for Indians
Normal	<18.5 - <25	< 23
Overweight	>25 - < 30	>23 - <27.5
Obese (Mild – Class I)	>30 - < 35	>27.5 - <32.5
Severe obesity (Class II)	>35 - < 40	>32.5 - <37.5
Morbid obesity (Class III)	>40	> 37.5

After collecting the preliminary data and calculating BMI using anthropometric instruments and Quetelet's index (Weight in kg divided by height in m^2)[9], Computerised spirolyser (with RS-232 connectivity), was used to measure pulmonary parameters. Statistical analysis was done and its significance was determined by using student't' test.

RESULTS

Anthropometric measurements and vital parameters between the obese and non obese group is represented in Table 2. 't' values for age, height, weight, body surface area, body mass index, pulse rate and systolic/ diastolic blood pressure between the obese and control groups were 1.93, 5.18, 12.03, 7.99, 17.53, 2.55 and 0.054/ 0.68 respectively and 'p' value was >0.05 for age and blood pressure, <0.05 for pulse rate and <0.001 for the rest of the parameters and it was considered as statistically non significant for age and blood pressure, as significant for pulse rate and very significant for rest of the parameters.

Table 2: *anthropometric and vital parameter data between cases and controls.*

Parameter	Obese (Value as Mean ±SD)	Controls (Value as Mean ±SD)
Age in years	34.1 ± 7.30	29.87 ± 7.36
Height in cm	165.77 ± 6.93	157.00 ± 6.61
Weight in kg	86.40 ± 7.72	60.87 ± 9.19
Body surface area in m^2	1.97 ± 0.14	1.68 ± 1.5
Body Mass Index	31.43 ± 1.84	21.46 ± 2.64
Pulse in beats/min	82.3 ± 6.09	77.93 ± 7.55
Blood pressure in mm Hg (Systolic/ Diastolic)	126.9 ± 8.26 82.07 ± 4.94	127 ± 5.82 81.33 ± 3.29

Forced vital capacity parameters were measured between obese and non obese is tabulated in Table 3. 'p' value for Expiratory time was <0.001 and was very highly significant, for FVC, FEV_1, FEV_1/VC, FEV_1/FVC and MMEF was >0.05 and are statistically not significant.

Table 3: *Forced Vital Capacity parameters between Obese and controls.*

Parameter	Obese (Value as Mean ± SD)	Controls (Value as Mean ± SD)	'p' value
Vital Capacity(L)	2.78 ± 0.60	2.77 ± 0.61	> 0.05
Forced Vital Capacity (L)	2.55 ± 0.66	2.64 ± 0.55	> 0.05
FEV (L)	2.22 ± 0.54	2.42 ± 0.55	> 0.05
Expiratorytime (sec)	2.65 ± 1.07	1.80 ± 0.85	< 0.001
FEV /VC	0.80 ± 0.12	0.80 ± 0.12	> 0.05
FEV / FVC	0.88 ± 0.11	0.85 ± 0.09	> 0.05
MMEF (L/sec)	3.02 ± 1.03	2.95 ± 1.05	> 0.05

Similarly Maximal voluntary ventilation parameters were measured between obese and non obese is tabulated in Table 4. 'p' value of all the parameters was >0.05 and are statistically insignificant.

Table 4: *Forced Vital Capacity and Maximal Voluntary ventilation parameters between Obese and controls.*

Parameter	Obese (Value as Mean ± SD)	Controls (Value as Mean ± SD)	'p' value
PEFR (L/sec)	4.41 ± 1.56	4.83 ± 1.89	> 0.05
MEF_{75} (L/sec)	4.27 ± 1.78	4.58 ± 1.78	> 0.05
MEF_{50} (L/sec)	3.48 ± 1.24	3.35 ± 1.07	> 0.05
$MEF2_5$ (L/sec)	1.83 ± 0.79	1.94 ± 0.75	> 0.05
MEF/ FVC	1.28 ± 0.73	1.12 ± 0.41	> 0.05
MVV (L/min)	89.71 ± 23.57	91.28 ± 18.11	> 0.05

DISCUSSION

General consensus is that, obesity has definite implications on all the respiratory functions but this is not true and it is difficult to brand the nature of defect in obesity as restrictive or obstructive or as mixed. Further obesity is graded in terms of severity and type of respiratory insufficiency is bound to change.

Statistical significance was noted between BMI of cases and controls it suggests absence of sampling bias/ errors and were well representative in terms of age of the subjects.

Mean FVC at rest in obese was 2.55±0.66L and non obese was 2.64±0.55, though it was insignificant there

was a definite small reduction in FVC in obese indicating some amount of airway collapse in them.

Increase in Expiratory time is one of the most consistent finding noted in obesity and is considered as the most significant and sensitive PFT parameters. Prolongation of ET during forced maneuver may indicate some form of expiratory flow limitation. Similar expiratory flow limitation was reported by Pankow[10] and in contrast no such significant change in T_E was reported by Chlif et al.[11]

FEV_1 was not statistically significant between the cases and controls; however there was a small decrease in FEV_1 in obese probably indicating mild form of expiratory flow limitation. FEV_1/VC at rest in obese was also statistically insignificant and this in contrast to Porhomayon[12] who reports a statistically significant increase in its ratio with increase in BMI.

Obesity is usually considered to produce a predominant restrictive pattern of respiratory defect, characterized by decreased Total lung capacity, FVC/VC, and MVV. In our study we did not find significant changes with VC or MVV. MVV is considered as an index of respiratory muscle strength and hence is usually reduced in morbidly obese subjects with Obesity Hypoventilation syndrome[5]. Mean BMI of cases in our study was 31.43kg/m2, which falls into the class of mild obesity and hence a decrease in MVV is not observed. Similarly it has been proposed that each kg of weight gain causes a steady reduction in VC (-26cc/kg) [5], a decrease in VC is expected only in higher grades of obesity as decrease in VC requires not only reduction in compliance but also an increase work of breathing.

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