ABSTRACT

Aims & Objective: Obesity is a global health hazard and has been linked to numerous disorders including derangement in pulmonary functions and the negative association is still debated. This study is aimed at assessing the effects of obesity on slow vital capacity parameters.

Materials and methods: A case control study was used to measure pulmonary parameters and was performed with a computerized spirolser (with RS-232 connectivity). Slow vital capacity parameters measured between obese and non-obese groups were statistically analysed using student ‘t’ test.

Results: VC, ERV, IRV, IC and TV among obese were 2.78 ± 0.60, 0.59 ± 0.32, 1.70 ± 0.41, 2.27 ± 0.62 and 0.52 ± 0.23 in litre respectively. Same parameters among non-obese were 2.77 ± 0.61, 0.86 ± 0.37, 1.39 ± 0.53, 1.90 ± 0.47 and 0.53 ± 0.20 in litre respectively. Changes in ERV and IC was statistically highly significant (‘p’ <0.01), IRV was significant (<0.05) and VC, TV (>0.05) was insignificant (<0.05).

Conclusion: Apart from IC and IRV, reduction in ERV was considered as the most significant and sensitive PFT parameters to know the negative association with class I (Mild) obesity.

KEY WORDS: Body Mass Index; Obesity; Slow Vital Capacity; Vital Capacity
INTRODUCTION

Obesity is a chronic disease that is causally related to serious medical illness such as dyslipidemia, type II diabetes, cardio vascular diseases and derangement of pulmonary functions.[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, 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.

MATERIALS AND METHODS

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] in which 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. The study was conducted.

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.

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 no.1.

Table-1: Classification of overweight and obesity based on BMI in kg/m²

<table>
<thead>
<tr>
<th>Category</th>
<th>WHO Criteria</th>
<th>Recommendation for Indians</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>&lt;18.5 - &lt;25</td>
<td>&lt;23</td>
</tr>
<tr>
<td>Overweight</td>
<td>&gt;25 - &lt;30</td>
<td>&gt;23 - &lt;27.5</td>
</tr>
<tr>
<td>Obese (Mild – Class I)</td>
<td>&gt;30 - &lt;35</td>
<td>&gt;27.5 - &lt;32.5</td>
</tr>
<tr>
<td>Severe obesity (Class II)</td>
<td>&gt;35 - &lt;40</td>
<td>&gt;32.5 - &lt;37.5</td>
</tr>
<tr>
<td>Morbid obesity (Class III)</td>
<td>&gt;40</td>
<td>&gt; 37.5</td>
</tr>
</tbody>
</table>

After collecting the preliminary data and calculating BMI using anthropometric instruments and Quetelet’s index (Weight in kg divided by height in m²)[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 no. 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’ was >0.05 for age and blood pressure, <0.05 for pulse rate and <0.01 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 highly significant for rest of the parameters.

Table-2: Anthropometric and vital parameter data between cases and controls

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Obese (Value as Mean ± SD)</th>
<th>Controls (Value as Mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years</td>
<td>34.1 ± 7.30*</td>
<td>29.87 ± 7.36</td>
</tr>
<tr>
<td>Height in cm</td>
<td>165.77 ± 6.93***</td>
<td>157.00 ± 6.61</td>
</tr>
<tr>
<td>Weight in kg</td>
<td>86.40 ± 7.72***</td>
<td>60.87 ± 9.19</td>
</tr>
<tr>
<td>Body surface area in Sqm</td>
<td>1.97 ± 0.14***</td>
<td>1.68 ± 1.5</td>
</tr>
<tr>
<td>Body Mass Index</td>
<td>31.43 ± 1.84***</td>
<td>21.46 ± 2.64</td>
</tr>
<tr>
<td>Pulse in beats/min</td>
<td>82.3 ± 6.09**</td>
<td>77.93 ± 7.55</td>
</tr>
<tr>
<td>Blood pressure in mm Hg (Systolic/Diastolic)</td>
<td>126.9 ± 8.26*</td>
<td>127 ± 5.82</td>
</tr>
</tbody>
</table>

**NS (Not significant) ‘p’ = >0.05, **S (Significant) ‘p’ = <0.05, ***HS (Highly significant) ‘p’= <0.01.

Table-3: Slow Vital Capacity parameter data between Obese and controls

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Obese (L) (Value as Mean ± SD)</th>
<th>Control (L) (Value as Mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vital Capacity</td>
<td>2.78 ± 0.60*</td>
<td>2.77 ± 0.61</td>
</tr>
<tr>
<td>Expiratory Reserve Volume</td>
<td>0.59 ± 0.32***</td>
<td>0.86 ± 0.37</td>
</tr>
<tr>
<td>Inspiratory Reserve Volume</td>
<td>1.70 ± 0.41**</td>
<td>1.39 ± 0.53</td>
</tr>
<tr>
<td>Inspiratory capacity</td>
<td>2.27 ± 0.62***</td>
<td>1.90 ± 0.47</td>
</tr>
<tr>
<td>Tidal Volume</td>
<td>0.52 ± 0.23*</td>
<td>0.53 ± 0.20</td>
</tr>
<tr>
<td>FEV₁</td>
<td>2.22 ± 0.542*</td>
<td>2.42 ± 0.55</td>
</tr>
<tr>
<td>FEV₁/VC</td>
<td>0.08 ± 0.12*</td>
<td>0.85 ± 0.09</td>
</tr>
</tbody>
</table>

**NS (Not significant) ‘p’ = >0.05, **S (Significant) ‘p’ = <0.05, ***HS (Highly significant) ‘p’= <0.01.

Slow vital capacity parameters measured between obese and non-obese are tabulated in table no. 3. ‘p’ value for ERV and IC was <0.01 and is highly significant, for IRV was <0.05 and is significant and for VC, TV was >0.05 and is not significant. FEV1 in obese was 2.22 ± 0.54L and FEV1/ VC was 0.80 ± 0.12, in non-obese were 2.42 ± 0.55 and 0.85 ± 0.09 respectively and both were statistically insignificant.

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.

Reduction in ERV is one of the most consistent finding noted in obesity and is considered as the most significant and sensitive PFT parameters and the same type of highly significant values similar to those by Biring[5] is reported in this study and as compounding of ERV on recumbent posture as reported by Collins et. Al.[10] The reasons could be due to combination of Elevation of diaphragm due to accumulation of abdominal fat, reduction in chest wall compliance and decrease in respiratory muscle strength as described by Biring[5]. However the effect of the same with different classes of obesity as all the individuals in our study belonged to class I (Mild obesity).

Dudely[11], reported an increase in inspiratory capacity and inspiratory reserve volume and similar statistically significant (p <0.01 and <0.05) values were found in our study and this could be due to use of more energy for inspiration to overcome the chest wall recoil.

FEV₁ was not statistically significant between the cases and controls; however there was a small decrease in FEV₁ 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.

In our study significant change in VC was not seen, VC 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 31.43 kg/m$^2$, which falls into the class of mild obesity and a decrease in VC is expected only in higher grade of obesity and hence the VC might not have been altered here, apart from this decrease in VC requires not only reduced compliance but also there should be an increased work of breathing.

CONCLUSION

IC, IRV and ERV are considered as significant and sensitive PFT parameters to know the effects of obesity on pulmonary functions in class I (Mild) obesity. Hence, an early screening of obese might help recognize at risk individuals and minimize future morbidity produced by obesity.

ABBREVIATIONS USED

BMI: Body Mass Index;
ERV: Expiratory Reserve Volume;
FEV1: Forced Expiratory Volume in one second;
IC: Inspiratory Capacity;
IRV: Inspiratory Reserve Volume;
PFT: Pulmonary Function Tests;
TV: Tidal Volume;
VC: Vital Capacity

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