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Original Article

Spirometry Evaluation of Asymptomatic Non-Smoking Overweight and Obese Subjects

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Abstract

Introduction: Obesity has a significant impact on the respiratory function. In this study, we attempt to find a relation between the body mass index (BMI) and spirometry findings in healthy, non-smoking adults from North Kerala.

Materials and Methods: Totally, 100 healthy non-smoking adults with BMI more than 25 were evaluated over 1 year with a detailed history, clinical examination, and spirometry. Data were evaluated using statistical software service provisioning system software version 21 for correlation between BMI and spirometry.

Results: Out of 100 adults, 72 were males, and 28 were females. 63 adults were overweight, 31 had mild obesity, and 6 had moderate obesity. In the overweight group, 48 had restrictive anomaly, 2 had mixed anomaly, and 13 was normal. In the mild obesity group, 24 had restrictive anomaly, 2 had mixed anomaly, and 5 had normal spirometry. In the moderate obesity group, 3 had restrictive anomaly, 1 had mixed anomaly, and 2 had normal spirometry. There was a significant association between abnormal spirometry and BMI in both the overweight and obese groups. We could not find a significant association between the BMI and degree of restriction in any of the groups.

Conclusion: Overweight as well as obese adults had abnormal spirometry in our study. There was no correlation between the degree of obesity and spirometry values. Hence, we conclude that even a small reduction in weight can improve the pulmonary function.

Key words: Obesity, Pulmonary, Restriction, Spirometry

INTRODUCTION

Obesity is a chronic condition characterized by excessive accumulation of body fat that is harmful to individuals. Obesity increases the risk of cardiovascular disease, hypertension, metabolic disorders, and respiratory dysfunction. Obesity is often expressed in terms of body mass index (BMI) which is used to classify obesity. It is calculated as weight in kg divided by square of height of a person in meters (kg/m^2).

The WHO classified obesity as follows BMI of 18-24.9 kg/m^2 is considered as normal weight.

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BMI of 25.00-29.9 kg/m^2 is considered overweight, and BMI 30 or more is considered as obese.

Obesity can alter respiratory physiology leading to abnormalities in resistance, ventilation and perfusion relationships, workload of the respiratory muscles, upper airway caliber and tone, ventilator control and pulmonary, and chest wall compliance. Obesity affects various resting respiratory parameters such as compliance, neuromuscular strength, work of breathing, spirometry measurements, respiratory resistance, diffusing capacity, and gas exchange and reduces respiratory muscle strength and efficiency of respiratory muscles, especially the diaphragm.

The most common pulmonary function abnormality in obese adults is the reduction in the expiratory reserve volume.[1] In general, in mild obesity, spirometry is normal. As BMI increases, there is a decrease in forced expiratory volume 1 (FEV1) and forced vital capacity (FVC),

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rendering the FEV1 to FVC ratio normal. Lazarus *et al* found that FEV1/FVC ratio decreases with increase In BMI in overweight and obese individuals,[2] Biring *et al* found a reduction in the forced expiratory flow 25-75% (Mid-expiratory flows) and the FEV1/FVC ratio. Thus, spirometry abnormalities in mild to moderate obesities represent restrictive anomaly whereas with severe and morbid obesity, it may represent true airflow obstruction.[3]

Spirometry is a key test that is used to assess respiratory efficiency of an individual. The factors that affect spirometry are age, height, weight, gender, ethnicity, or race. Three key spirometry measurements are FVC, FEV1 s, and FEV1/FVC ratio. For each individual, values are compared to standard reference value American thoracic society guidelines. Many studies have shown restrictive ventilatory impairment in obesity with reductions in FEV1, FVC, total lung capacity, functional residual capacity (FRC), and expiratory reserve volume. In this study, we are assessing the spirometry values of healthy non-smoking overweight and obese individuals. We have excluded severe and morbid obese patients from our study.

MATERIALS AND METHODS

Setting

This study was conducted in the Department of Respiratory Medicine, Kannur Medical College.

Period of Study

The duration of the study was 12 months.

Study Design

This was an observational study.

Inclusion Criteria

Healthy adults with no respiratory symptoms between the age group of 20-60 years.

BMI more than 25 kg/m^2.

No history of smoking in the last 10 years.

Exclusion Criteria

Any adult with respiratory symptoms in the last 1 month.

Any adult with severe or morbid obesity.

100 patients were evaluated with spirometry using COSMED Omnia cardiopulmonary diagnostic suite. The FEV1, FVC, FEV1/FVC ratio, and peak expiratory flow rate were recorded. The relation between BMI and spirometry values was assessed. The suitable advice was given for weight reduction. Relation of spirometry to sex and degree of restriction was also assessed. Suitable advice for weight reduction and counseling was given to all patients.

RESULTS

The following are observations made in 100 adults over a period of 12 months.

Age

The mean age at presentation was 41.21 ± 9.37. The maximum no of subjects belong to age group 41-60 years.

Sex

The study group was formed by 72% males and 28% females (Figure 1).

BMI

Nearly, 63% of patients belong to overweight group BMI (25-29.9 kg/m^2), 31% belonged to mild obesity (Class I) (30-34.9 kg/m^2), 6% belonged to moderate obesity (Class II) (35-39.9 kg/m^2). The mean BMI was 29.26 ± 2.72 (Table 1).

Spirometry

Among 100 subjects, 20% had normal spirometry, and 80% had abnormal spirometry. In those with abnormal spirometry, the most common pattern was restrictive (75%) and (5%) mixed.

Table 1: Patients with normal and abnormal spirometry in different BMI groups

BMI	Normal spirometry	Abnormal spirometry	Total
25-29.9	13	50	63
≥30	7	30	37
Total	20	80	100

BMI: Body mass index

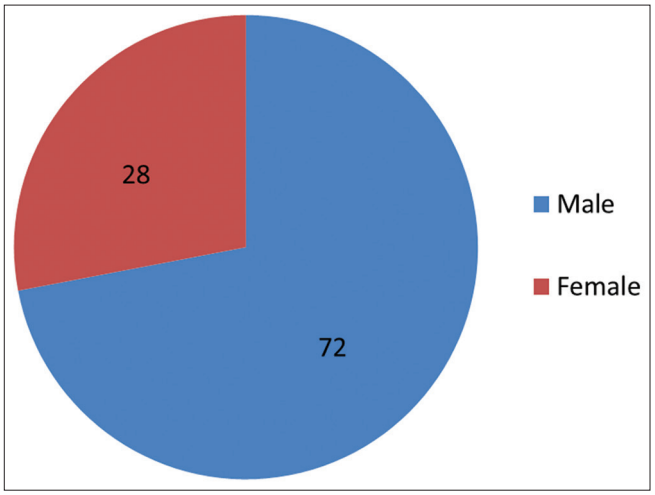

Figure 1: Pie diagram showing percentage of males and females in the study

Among 72 male subjects, 57 had abnormal spirometry (79.1%) and 15 adults had normal spirometry (20.8%). Among 28 female subjects, 23 had abnormal spirometry (82.14%), and 5 had normal spirometry (17.8%) (Table 2).

In overweight (63 subjects), 13 had normal spirometry (20.6%), 50 had abnormal spirometry (79.4%). 28 subjects had mild restriction (44.4%), 20 had moderate restriction (31.7%), 2 had mixed anomaly (3%).

In mild obesity (31 subjects), 5 had normal spirometry (16.1%), 26 had abnormal spirometry (83.9%). Among abnormal spirometry, 10 had mild restriction (32.3%), 14 had moderate restriction (45.2%), and 2 had mixed anomaly (6.5%).

In adults with moderate obesity (6 subjects), 2 had normal spirometry (33.3%), 3 had moderate restriction (50%), and 1 had mixed anomaly (16.7%).

Adults with BMI more than 25 had significantly abnormal spirometry values ($P < 0.05$). Overweight adults and obese adults when evaluated separately also had a significantly abnormal spirometry ($P = 0.0008$ for overweight subjects and $P = 0.001$ for obese patients) (Table 3).

There was no significant association between increase in BMI and the degree of restriction in each group ($P = 0.55$) implying that increased obesity did not show a greater degree of restriction.

There was no statistical association between the type of anomaly and BMI in each of the groups.

Table 2: Sex differentiation of different age, BMI and spirometry groups

Parameters	Male	Female
Age		
21-40	35	10
41-60	37	18
25-29.9	50	13
BMI		
30-34.9	18	13
≥35	4	2
Spirometry		
Normal	15	5
Restrictive	53	22
Mixed	4	1

BMI: Body mass index

Table 3: Relation between BMI and spirometry pattern

BMI	Restrictive		Normal	Mixed
	Mild restriction	Moderate restriction		
25-29.9	28	20	13	2
30-34.9	10	14	5	2
≥35	0	3	2	1

BMI: Body mass index

DISCUSSION

There have been many studies to assess the relation between pulmonary function test (PFT) and obesity. Most of the studies have targeted the obese adults with a BMI of more than 30 kg/m^2 in their studies. In our study, we have attempted to study the correlation between overweight adults and the impact of even a slight increase in BMI on the pulmonary function. In a study conducted by Prajapathi *et al.,* they concluded that more than half of the patients were having abnormal PFT, and increase in BMI was associated with increase in abnormal PFT pattern.[4] In this study, we have included both overweight and obese, and of the overweight, 79.3% had abnormal spirometry, and of the obese, 81.08% had abnormal spirometry.

Al-Gobain, on the effect of obesity on healthy non-smoking adults, concluded that obesity has no effects on spirometry tests and recommended alternative diagnosis in case of finding abnormal spirometry results among obese adults. We got contrasting results with predominantly restrictive anomaly in both overweight and obese subjects.[5]

Another study conducted by Devershetty *et al.* concluded that obesity has an impact on respiratory functions even in younger age group. This study was done exclusively on 60 healthy females, in this study, we have included 28 females and found abnormal results in 23(82.1%).[6]

Li *et al.* conducted a study which concluded that reduction in FRC and diffusion impairment was most common abnormality in obese patients. In our study, we have not included these parameters.[7]

Thyagarajan *et al.* conducted a longitudinal study on the effect of obesity with BMI and found that the age-related decline in vital capacity was significantly higher in overweight and obese patients compared to subjects with normal BMI. In this study, we could not make out significant decline in pulmonary function in the higher age groups even though ours was not a longitudinal study.[8]

Pakkala and Pakkala in a study conducted in South India found that FEV1, FVC, and FEV1/FVC were significantly lower in obese compared to non-obese adults. In our study, even though we could not find a specific correlation between BMI and spirometry parameters of FEV1, FVC, and FEV1/FVC; we could make out a significant correlation between increased BMI and abnormal spirometry. Most of the subjects had restrictive anomalies ranging from mild

to moderate, and a few had mixed anomalies. There was no correlation between the rise in BMI and the level of restriction.

Thus, from our observations, we conclude that even a mild increase in BMI (overweight) may contribute to a deterioration of pulmonary function. This may be overlooked in patients who have no obvious respiratory symptoms. From the other studies, this decreased respiratory pulmonary function may progress with age.[9] Hence, weight loss of even few kilograms may go a long way in improving pulmonary function and reducing respiratory comorbidities.

Hence, it becomes imperative that the pulmonary function should be monitored in overweight and obese subjects even if they are apparently healthy and have no respiratory symptoms.

CONCLUSION

In our study, overweight and obese subjects had abnormal spirometry, mostly restrictive, and mixed, despite having no respiratory symptoms. We could not make out any association between the increase in BMI and level of restriction. As even overweight subjects had significantly abnormal pulmonary function, we suggest that even mild weight reduction may help in improving pulmonary function. We also suggest regular spirometry analysis and counseling in overweight and obese adults even if they have no respiratory symptoms.

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