ORIGINAL RESEARCH PAPER

Physiology

EFFECT OF BODY MASS INDEX ON PULMONARY FUNCTION OF ELDERLY PEOPLE OF NORTH INDIA

KEY WORDS: obesity, body mass index, lung function, pulmonary function

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ABSTRACT

Background: Obesity significantly affects lung function which has been reported among children, adolescents and adult age groups. However, there is limited research on effect of obesity on pulmonary function among elderly age group.**Methods:** In this study 600 elderly people aged 65 years and above were selected from rural areas of Haryana in whom lung function parameters including force expiratory volume in first second (FEV1), force vital capacity (FVC) and FEV1/FVC were measured. Body mass index (BMI) was estimated and categorised into underweight, normal, overweight and obese categories as per BMI classification of Asian Indians. Mean and standard deviations were calculated and association between lung function parameters and body mass index was determined by one way ANOVA test. **Results:** Mean age of subjects was 68 ± 5.2 years. Among all the three parameters, highest mean values were observed among subjects with normal body mass index, whereas lowest mean FVC and FEV1/FVC values were observed in underweight category and lowest mean FEV1 values in obese individuals. A statistically significant difference in the mean FEV1 and FEV1/FVC values were observed between various body mass index categories. **Conclusion:** Body mass index has significant impact on lung function of elderly people depicted by reduction in FEV1 and FEV1/FVC values in obese individuals.

Introduction

Obesity like other non-communicable diseases is currently in the epidemic form and is associated with high mortality and morbidity. Obesity significantly affects respiratory function as shown by increasing prevalence of asthma with obesity. (1-3) Although few studies reported no association between asthma and obesity, (4-6) obesity has been reported to affect lung function including lung volumes significantly. (7,8)

Obesity affects lung function through multiple mechanisms including reduction in lung compliance, small airway dysfunction, respiratory muscle weakness, reduction in pulmonary gas exchange, etc.. (9) Jones and Nzekwu reported significant detrimental effects of high body mass index on all of the lung volumes among North American people. (10) Respiratory mechanics and gas exchange is affected with reduction in lung volumes, compliance and resistance with increasing body mass index (BMI). (11,12)

Many studies have been conducted to determine effect of body mass index on lung function, among young and adult people, but similar studies carried out among elderly age group are limited. Hence this study was designed to determine the effect of obesity on lung function of elderly people.

Methods

This is a cross-sectional study, which was conducted in rural area of Haryana among 600 elderly people aged 65 years and above. Subjects were selected through purposive sampling technique.

Smokers and subjects with pulmonary or cardiac disorders were excluded from the study. After obtaining informed consent, age of the subjects was recorded and anthropometric data (height and weight) were measured for body mass index estimation.

Body mass index was calculated and on the basis of body mass index classification for Asian Indians, subjects were categorized into 4 categories – underweight (BMI<18.0 kg/m2), normal (BMI=18.0-22.9 kg/m2), overweight (BMI=23.0-24.9 kg/m2) and obese (BMI≥25 kg/m2).

Portable spirometer was used for measuring lung function parameters including force expiratory volume in first second (FEV1), force vital capacity (FVC) and FEV1/FVC of the selected elderly subjects.

The data collected was entered into Microsoft Excel and analysed in SPSS version 20. Mean and standard deviations were calculated for the lung function parameters. The association between lung function parameters and body mass index was determined by one way ANOVA test. P value <0.05 was considered to be significant for the study.

Results

Out of total 600 subjects 332 were males and 268 were females. Mean age of subjects was estimated to be 68 ± 5.2 years. Majority of the subjects (55.5%) were aged below 70 years whereas only 2.8% of the elderly selected for the study were of the age 90 years and above. (Table 1)

Table 1. Distribution of subjects according to age

AGE GROUP (in years)	Total	
	No.	%
<70	333	55.5%
70-79	158	26.3%
80-89	92	15.3%
90 and above	17	2.8%

Table 2 shows mean ± SD of force expiratory volume in first second (FEV1), force vital capacity (FVC) and FEV1/FVC of study subjects according to body mass index categories. Among all the three parameters, highest mean values were observed among subjects with normal body mass index, whereas lowest mean FVC and FEV1/FVC values were observed in underweight category and lowest mean FEV1 values in obese individuals. A statistically significant difference in the mean FEV1 and FEV1/FVC values were observed between various body mass index categories.

Table 2. Lung function parameters according to body mass index

Lung function parameter		Underweight	Normal	Overweight	Obese	p value
		n=91	n=231	n=153	n=125	
FVC	Mean	2.21	2.42	2.39	2.27	0.126
	SD	0.79	0.81	0.89	0.82	
FEV1	Mean	2.14	2.23	2.19	1.97	0.035
	SD	0.76	0.89	0.81	0.72	
FEV1/ FVC	Mean	82.14	85.05	84.14	83.86	0.044
	SD	8.85	8.09	9.16	7.19	

Discussion

Obesity is a well-known risk factor for many non-communicable diseases like diabetes, stroke, cardiovascular diseases, osteoarthritis, etc. However, its effect on respiratory system is not considered seriously. Various factors affect lung function of which age, sex, smoking, dust exposure and many more have been documented as major determinants. (13-16) In our study we observed highest mean FVC, FEV1 and FEV1/FVC among subjects with normal body mass index, however lower mean FVC, FEV1 and FEV1/FVC values were observed among obese subjects. Among the three parameters, mean FEV1 and FEV1/FVC were found to be significantly different across various body mass index categories whereas FVC showed no significant association with body mass index.

Reduction of lung function test parameters with increasing body mass index as found in our study is consistent with many studies. (17-21) Findings similar to our study i.e., no significant association of body mass index with FVC and significant decline in mean FEV1 and FEV1/FVC with increasing body mass index have been reported in some studies. (17,18) Although many studies have reported significant effect of obesity on lung function, (19-21) but some studies showed no association of body mass index with lung function. (22-24) This may be attributed to differences in age composition of study subjects, ethnicity, different equipment used or differences in the techniques of measuring lung function.

Reduction in lung compliance among obese subjects is due to many factors. Important one among these is the effect of elevated position of diaphragm among obese subjects. (10) Another factor being fat accumulation in chest wall with abnormal function of intercostal muscles which impedes the movement of chest wall. Thirdly inflammatory markers released due to obesity in the lung directly affects lung tissue and also reduces airway diameter. (25)

Although increasing body mass index was associated with significant reduction in lung function, high body mass index gives no indication of body fat distribution. People with high body mass index may have higher fat distribution around abdomen in abdominal obesity than chest wall. Hence chest circumference, abdomen circumference and hip circumference or the ratio between them may show better association with lung function.

Conclusion: Body mass index has significant impact on lung function of elderly people depicted by reduction in FEV1 and FEV1/FVC values in obese individuals.

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