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Assessment of Lung Functions in Obese Young Adolescent Medical Students

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Abstract:
Background: *Obesity is rapidly increasing in India in all age groups. College-based data indicates prevalence rate 24% in adolescents. Adolescent obesity is associated with a greater long-term risk of hypertension and type 2 diabetes mellitus in adulthood. However studies investigating lung functions in obese adolescents are few. The present study assesses lung functions in obese adolescent, first year medical students of KIMS medical students, Amalapuram, EG dist, Andhra Pradesh.* ***Aims:*** *Assessment of lung functions in obese adolescent medical students. Materials and Methods: Lung functions were measured in 67 overweight or obese adolescent medical students and an equal number of age-matched controls by using MEDI: SPIROWIN software (Maestros Medline Systems Ltd., Navi Mumbai, India). RESULTS: Forced expiratory volume in 1st second (FEV1) and forced vital capacity (FVC) were significantly decreased in the overweight and obese group (P < 0.001). Pulmonary functions in the study population negatively correlated with obesity, weight, body mass index (BMI), The strongest negative correlation was between BMI and FVC, FEV1 and FEV_1/FVC % (P < 0.001) .* ***Conclusion:*** *Lung function impairment particularly decreased FVC and FEV1 is associated with obesity in adolescents. In addition lung functions deteriorate with increasing obesity in adolescents. This study reveals another health hazard associated with obesity and highlights the need to reduce weight at a younger age.*

Keywords: *Adolescent obesity, body mass index, lung function tests (FVC, FEV1).*

I. Introduction:

Obesity is rapidly increasing universal problem in all age groups. In United States approximately 60% of adults and one in four adolescents are overweight or obese [1], [2]. More studies are necessary to ascertain the prevalence of overweight and obesity in India. College-based data indicate a prevalence of 24%of adolescents is obese [3], [4], [5].

The causes of adolescent obesity are lack of regular exercise, sedentary habits, overconsumption of high-calorie foods, and genetic factors [6]. 80% of adolescent obese become obese adults. Adolescent obesity is associated with a greater long-term risk of cardiovascular disease and type-2 diabetes mellitus in adulthood. In addition orthopedic issues such as slipped capital femoral epiphysis and gastrointestinal complications like cholelithiasis are more common in the obese adolescent [7]. Impairment of long functions is associated with adolescent obesity. Studies have revealed a significant reduction in forced vital capacity (FVC), forced expiratory volume in 1st second (FEV1), and FEV_1/FVC % [8]. Significant decrease in FVC, FEV1 has been found in obese adolescents [9],[10].

Hence the present study was aimed to investigate lung function variables in the adolescent obese in first year medical students of KIMS medical students, Amalapuram, EG dist., Andhra Pradesh.

II. Materials And Methods:

42 overweight 25 obese and 67 normal medical students are selected as subjects from KIMS medical college Amalapuram, EG dist., Andhra Pradesh. Medical students in the age group of 17-20 years were screened to identify the overweight obese and normal weight by recording their weight (in kilograms) and height (in

centimeters). These students came from different parts of the state. These students represents from urban, rural, tribal areas. All students are having different economic, social, cultural background.

The study protocol was ethically approved by the institutional ethical committee. All subjects were explained about the procedures to be undertaken. An informed consent of the subjects was taken on approved proforma. BMI was calculated from weight (kilograms) divided by height (square meters) by Quetelet index [10]. According to BMI all the students are classified as Normal weight (BMI-18.50 - 24.99), Overweight (BMI-25.0 - 29.99), Obese (BMI- more than 30.0), [13]. Students with symptoms of illness like fever, cough, and abdominal pain, anxious, apprehensive, and uncooperative were excluded from this study. A detailed personal history was taken about the habits like watching television, daily physical activity, diet, etc. A complete physical examination and Systemic examination was carried out by medical specialist. Pulse and blood pressure were recorded.

PULMONARY FUNCTION TESTING: The subjects were demonstrated the maneuvers of the lung function tests. Computerized spirometry was carried out using MEDI: SPIROWIN software (Maestros Medline Systems Ltd., Navi Mumbai, India). [13] with the subject sitting position. For the FVC maneuver subjects were asked to take deep inspiration and breathe out as rapidly as and as long as possible into the mouth of the spirometer. Flow volume curve was plotted. Best of three acceptable maneuvers being taken as the final reading. FVC, FEV1, FEV1 /FVC%, was taken as lung function tests for our study.

III. Results:

Table 1

Comparison between normal weight (n=42) & overweight (n=42).

Parameters	**Mean+ SD (n=42) (Normal Weight)**	**Mean + SD (n=42) (Over weight)**	**p value**
BMI	21.65 + 1.83	27.52 + 1.51	P < 0.001
Body fat %	20.50 + 8.20	31.08 + 8.81	P < 0.001
FVC	2.90 + 0.85	2.72 + 0.52	P < 0.001
FEV_1	4.14 + 11.90	2.56 + 0.44	P < 0.001
FEV_1/FVC %	93.27 + 13.52	94.74 + 6	P < 0.001

Table 1. BMI of Overweight group and Normal Weight group are 27.52 + 1.51 and 21.65 + 1.83 respectively. There is significant increase of BMI in over weight group than Normal Weight group. p value is P < 0.001.Body fat percentage of Overweight group and Normal Weight group is 31.08 + 8.81and 20.50 + 8.20 respectively. There is significant rise of Body fat percentage in over weight group than Normal Weight group. p value is P < 0.001. FVC of Overweight group and Normal Weight group are 2.72 + 0.52 and 2.90 + 0.85 respectively. Significant Decrease of FVC in over weight group than Normal Weight group. p value is P < 0.001. FEV1 of Overweight group and Normal Weight group are 2.56 + 0.44 and 4.14 + 11.90 respectively. Significant Decrease of FEV1 in over weight group than Normal Weight group. p value is P < 0.001. FEV1/FVC percentage of Overweight group and Normal Weight group are 94.74 + 6 and 93.27 + 13.52 respectively. No significant changes of FEV1/FVC percentage in over weight group than Normal Weight group. p value is P < 0.001.

Table 2.

Comparison between normal weight (n=25) & obese group (n=25).

Parameters	**Mean+ SD (n=25) (Normal Weight)**	**Mean + SD (n=25) (Obese)**	**p value**
BMI	21.65 + 1.83	32.70 + 3.78	P < 0.001
Body fat %	20.50 + 8.20	40.18 + 8.60	P < 0.001
FVC	2.90 + 0.85	2.61 + 0.50	P < 0.001
FEV1	4.14 + 11.90	2.52 + 0.44	P < 0.001
FEV1/FVC %	93.27 + 13.52	96.85 + 4.25	P < 0.001

Table 2. BMI of Obese group and Normal Weight group are 32.70 + 3.78 and 21.65 + 1.83 respectively. There is significant increase of BMI in Obese group than Normal Weight group. p value is P < 0.001. Body fat percentage of obese group and Normal Weight group are 40.18 + 8.60 and 20.50 + 8.20 respectively. There is significant rise of Body fat percentage in obese group than Normal Weight group. p value is P < 0.001. FVC of Obese group and Normal Weight group are 2.61 + 0.50 and 2.90 + 0.85 respectively. Significant Decrease of FVC in Obese group than Normal Weight group. p value is P < 0.001.

FEV1 of Obese group and Normal Weight group are 2.52 + 0.44and 4.14 + 11.90 respectively. Significant Decrease of FEV1 in Obese group than Normal Weight group. p value is P < 0.001. FEV1/FVC percentages of

obese group and Normal Weight group are96.85 + 4.25and 93.27 + 13.52 respectively. No significant changes of FEV1/FVC percentage in Obese group than Normal Weight group. p value is $P < 0.001$.

Table 3.
Actual & predicted values in **Over weight** and obese group.

Parameters	**Over weight**				**Obese subjects.**			
	Actual values	predicted values	P Value.	Significance	Actual values	predicted values	P Value.	Significance
FVC	2.72 + 0.52	3.08 + 0.56	0.02.	Significant	2.61 + 0.50	3.08 + 0.56	0.0031.	Significant
FEV1	2.56 + 0.44	2.70 + 0.45	0.07.	Significant	2.52 + 0.44	2.71 + 0.40	0.06.	Significant
FEV1/FVC %	94.74 + 6	84.82 + 0.84	<0.0001.	Significant	96.85 + 4.25	85.28 + 0.74	<0.0001.	Significant

Table 3.

Actual value of FVC in overweight subjects 2.72 + 0.52 and in obese subjects 2.61 + 0.50.Predicted value of FVC in overweight subjects 3.08 + 0.56and in obese subjects 3.08 + 0.56. Actual value of FVC is significantly less than predicted value of FVC in both overweight and obese groups. Actual value of FEV1 in overweight subjects 2.56 + 0.44 and in obese subjects 2.52 + 0.44.Predicted value of FEV1 in overweight subjects 2.70 + 0.45 and in obese subjects 2.71 + 0.40.Actual value of FEV1 is significantly less than predicted value of FEV1 in both overweight and obese groups. Actual value of FEV1/FVC % in overweight subjects 94.74 + 6and in obese subjects 96.85 + 4.25. Predicted value of FEV1/FVC % in overweight subjects 84.82 + 0.84 and in obese subjects 96.85 + 4.25. Actual value of FEV1/FVC % is significantly more than predicted value of FEV1/FVC % in both overweight and obese groups.

IV. Discussion:

In our study a predominant reduction in the FVC, FEV1, was observed in the obese and overweight subjects than the normal subjects. A decrease in the FVC, FEV1was also observed by Inselman et al [15] and Mallory et al [16]. However, no significant reduction was detected by Bossisio et al [17] and Chaussain et al [18].A reduction in the absolute value of FEV1 indicates airway narrowing [19].But no obstructive impairment was detected in any of the obese and overweight subjects and results are indicative of airflow limitation without significant obstruction.

In our study among normal weight, overweight and obese medical students, FVC and FEV1 were strongly negatively correlated with body weight and BMI. This suggests that lung function may be impaired though not sufficiently to cause clinical abnormality. The strongest negative correlation between BMI and pulmonary function was observed by Sri Nageswari et al [11].They hypothesized that obesity is characterized by decrease in chest wall compliance due to increased amount of adipose tissue around the chest and abdomen which decreases pulmonary functions in these medical students.

A number of hypotheses have been proposed to explain the negative correlation between lung function parameters and BMI. One possible mechanism is a mechanical limitation of chest expansion during the FVC maneuver. Increased abdominal mass may impede the descent of the diaphragm and increase the thoracic pressure. In addition visceral adipose tissue influences circulating concentrations of interleukin-6, tumor necrosis factor-alpha, leptin, and adiponectin, which are cytokines that may act via systemic inflammation to negatively affect pulmonary function [23], [24], [25], [26].Many authors reported an inverse association of serum leptin concentrations with FEV1. Higher levels of C-reactive protein, leukocytes, and fibrinogen, which are markers of systemic inflammation, may be the link between visceral obesity and pulmonary function [27].

V. Conclusion:

Lung functions are decreased in overweight and obese adolescent medical students as compared to normal weight subjects. However no clinical abnormality like obstructive or restrictive diseases has been detected in any of these overweight and obese medical students.

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