Effect of Obesity on Pulmonary Function among Egyptian Women

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ABSTRACT

Study objective: *was to assess the correlation between the ventilatory function impairment and the different classes of obesity.* ***Subjects and methods:*** *Three hundred obese women, their mean age 30.77±5.22 years, their body mass index (BMI) between 30 and ≥40 Kg/ m^2, waist circumference (WC) ≥ 90 cm, were selected from the social clubs at Cairo City. They were assigned into three equal classes I, II and III according to their BMI. Each of them consisted of 100 participants. Class I (30 – 34.9 Kg/ m^2), while Class II (35 -39.9 Kg/ m^2) and Class III (≥40 Kg/ m^2). Clinical assessment was done to exclude any other pathological conditions. Evaluation of obesity included body mass index, percentage of body fat, waist circumference and neck circumference was done. Assessment of ventilatory function was done for evaluating FVC, FEV_1, FEV_1/ FVC, MVV, PEF and $FEF_{25-75\%}$.* ***Results and Conclusion****: The results using Pearson correlation coefficients analysis and the stepwise multiple regression analysis showed that all classes exhibit a statistically significant compromise in all ventilatory parameters and the compromise increases as obesity increases. These results suggest that abdominal adiposity is a better predictor of pulmonary function than weight or BMI, and investigators should consider it when investigating the determinants of pulmonary function.*
Key words: *Ventilatory function, Spirometry, Body mass index, Obesity.*

INTRODUCTION

Obesity is of growing concern all over the world since >312 millions of individuals has a body mass index >30 kg/m^2. Respiratory consequences of obesity are now of major concern in the pulmonary specialty, including asthma, obstructive sleep apnea syndrome, obesity hypoventilation syndrome and some acute situations like hypercapnic respiratory failure and respiratory post surgical complications. Obstructive sleep apnea is commonly defined as the association of obesity with daytime hypercapnia ($PaCO_2$ > 45 mmHg) in the absence of any other respiratory disease[11].

Weight and body mass index (BMI) as measures of overall adiposity are used as predictors of pulmonary function in many epidemiologic studies[10]. While these measures are widely accepted as determinants of pulmonary function, abdominal adiposity may influence pulmonary function through a mechanism that is distinct from that of overall adiposity. Abdominal adiposity may restrict the descent of the diaphragm and limit lung expansion, compared to overall adiposity, which may compress the chest wall[2]. In most epidemiologic studies, waist circumference and/or waist/hip ratio represent abdominal adiposity[9]. Within the limit of authors knowledge, there is no consensus on the best for obesity index (BMI, WC…etc.) as a predictor for pulmonary function; particularly among Egyptian population. So, the present study was conducted to investigate the association of total body adiposity (BMI and Fat %) and abdominal adiposity (WC) with pulmonary function in Egyptian females. It was hypothesized that a specific effect of fat distribution on pulmonary function exists.

SUBJECTS, MATERIAL AND METHODS

Subjects

Three hundreds obese females were selected for this study, their mean age was 30.77±5.22 years, their mean height was 158.15±6.39 cm. and the mean weight was 80.51±7.34 kg. They were recruited from Social Clubs at Cairo City. The eligible three hundreds participants were divided into three equal groups according to their BMI (Class I, 30≤BMI≤34.9 kg/m^2, Class Π, 35≤BMI≤39.9 kg/m^2 and Class III, BMI≥40kg/m^2.

A complete physical examination was performed, including neurological, cardiopulmonary, and ear, nose and throat evaluations. For the clinical laboratory examination, pulmonary function tests, ECG and thyroid echography were performed. None of the subjects participating in this study had a previous diagnosis of sleep apnea or was spontaneously complaining of sleep apnea signs or symptoms. Moreover, none of them showed any clinical endocrinological disease, narcolepsy or idiopathic hypersomnia, neuromuscular disease, psychiatric disorders, overt cardiopulmonary disease, airway obstruction (FEV_1/FVC < 70% of predicted values), anatomic maxillo-mandibular skeletal abnormalities, heavy ear, nose and throat pathology, abuse of alcohol or any kind of drug. None of women were pregnant. None of participants had diabetes mellitus in accordance with the report of the Expert Committee on the diagnosis and classification of diabetes mellitus or positive clinical history of stroke (report of the Expert), transient ischemic attack, angina pectoris, heart infarction, intermittent claudication, congenital heart disease or ECG abnormalities. Biochemical markers of thyroid, liver and kidney function were within the normal range in all subjects. During the testing period, all subjects were asked to keep their normal mixed diet and not to perform any sport activity.

Procedure

Weight and height were obtained with the participants wear light clothes. The trained interviewers measured height using a wall-mounted stadiometer and weight using a balance beam scale to calculate Body Mass Index which equals= weight (Kg)/height (m^2).

Central fat accumulation was evaluated by the waist circumference (WC); participants were instructed to stand erect with the abdomen relaxed, arms at their side and feet together without shoes. It was measured as the midway between the lower rib margin and the anterior superior iliac spine.

Neck circumference was determined at the level of the cricothyroid membrane and the percentage of predicted normal neck circumference was calculated.

A calculation of fat percentage was done by using the following equation: Body fat percentage= [1.2 (BMI) + 0.23 (age) - 10.8 (gender) - 5.4]. In this equation the value of gender is (1) for men and (0) for women[18].

A flow volume spirometry was performed with the patient in the sitting position and by using spirometer with disposable mouth piece (Schiller AG) Spirovit Sp-10 power 50/60 Hz, Made in Swiss.

Forced expiratory volume in one second (FEV_1) and forced vital capacity (FVC) were measured, and the ratio FEV_1/FVC was calculated. Also PEF, FEF_{25-75} and maximum voluntary ventilation (MVV) were measured.

All participants were interviewed in the presence of their partners, and they were also required to fill out a comprehensive questionnaire which was a modified version of the sleep and the health questionnaire[16]. Information concerning sleep habits and snoring were obtained. Loud snoring was assessed by the question "Has your snoring ever been so loud that it has disturbed others"? Moreover, the subjects were requested to quantitate the frequency of symptoms with the use of a four- point scale that included the responses: never = 0; sometimes (1-2 times/week) = 1; frequently (3-4 times/week) = 2; almost always or always (5-7 times/week) = 3.

Statistical Analysis

It was performed using the Statistica 6.0 for Windows, StatSoft Inc. (1995) software (Tulsa, Ok, and USA). Results were represented as mean and standard deviation. Comparison between groups was performed by using student's t-test, whereas comparisons among three groups were carried out by analysis of variance or χ^2 test, when appropriate. Pearson's correlation coefficient was used to quantify the univariate associations among variables and a forward stepwise regression analysis was carried out to test the joint effect of different variables. P-value ≤ 0.05 were considered significant.

RESULTS

Regarding to table (1); the anthropometric measurements for three classes of obesity showed that; Class I obesity, the mean values of patient's age were (30.77±5.22 years). The mean values of patient's weight and height were (80.51±7.34Kg, and 158.15±6.39 cm) respectively. The BMI reported mean values of (31.54±1.34 Kg/m^2) while the mean values for WC were (99.57±5.6 cm), the mean value of neck circumference was (35.47±1.54 cm). The mean value of fat mass % was (37.74±3.44). Class Π obesity, the mean value of patient's age was (33.6±6.63 years), while the mean values of patient's weight and height were (92.69±10.54 Kg & 158.24±7.58 cm) respectively. The BMI reported mean value of (37.11±1.72 Kg/m^2). The mean value for WC was (108.22±7.78 cm), while the mean value of neck circumference was (38.28±2.33 cm). The mean values of fat mass percent were (46.91±2.94). Class III obesity, the mean value of patient's age was (36±5.12 years). The mean values of patients weight and height were (108.83±11.06 Kg, and 156.26±5.95 cm) respectively. The BMI reported mean value was (45.19±4.25 Kg/m^2). The mean value for WC was (117.75±8.92 cm). While the mean value of neck circumference was (38.52 ±2.35 cm). The mean value of fat mass percent was (56.83±5.21).

Table (1): Statistical analysis of the mean value of women demographic data between three classes of obesity.

Variables	Class I X±SD	Class II X±SD	Class III X±SD	F-Ratio	P-Value
Age (Years)	30.77±5.22	33.6±6.63	36±5.12	21	0.001
Weight (Kg)	80.51±7.34	92.69±10.54	108.83±11.06	210	0.001
Height (cm)	158.15±6.3	158.24±7.58	156.26±5.95	2.8	0.06
BMI (Kg/m^2)	31.54±1.34	37.11±1.72	45.19±4.25	616	0.001
Waist circumference (Cm)	99.57±5.6	108.22±7.78	117.75±8.92	144	0.001
Fat %	37.74±3.44	46.91±2.94	56.83±5.21	572	0.001
Neck Circumference (Cm)	35.47±1.54	38.28±2.33	38.52±2.12	70	0.001

X = Mean, SD = Standard deviation, Kg= Kilogram, cm=centimeter
Kg/m^2= Kilogram per meter square, P-Value=Probability level

Ventilatory functions among three classes of obesity:

Among class I, as observed in table (2); the mean values of FVC were (4.43±1.29 L), while the mean values of FEV_1 were (4.2±0.79 L). FEV_1/FVC reported mean percentage value of (90.4 ±4.15%), The PEF mean value was (7.32±1.35 L/sec), while the MVV reported mean value of (147.26 ±16.57 L/min). The FEF_{25-75} mean value was (4.9±1.15 L). Class Π showed that the mean values of FVC were (4.34±.99 L), while the mean values of FEV_1 were (3.92±1 L). The FEV_1/FVC reported mean percentage value of (85.5±5.65%). The PEF mean value was (6.29±1.5 L/sec), while the MVV reported mean value of (140.16±32.42 L/min). The FEF_{25-75} reported mean value of (4.6±1.13) L.

Class III, the mean values of FVC was (3.68±0.84 L), while the mean values of FEV_1 were (3.33±0.96 L). The FEV_1/FVC reported mean percentage value of (78.24±7.45%).The PEF mean value was (3.32±0.63 L/sec), while the MVV reported mean value of (130.96±32.82 L/min). The FEF_{25-75} reported mean value of (4.33±1 L).

Table (2): Parameters of ventilatory function for women on three classes of obesity.

Variables	Class I X±SD	Class II X±SD	Class III X±SD	F-Ratio	P-Value
FVC(L)	4.43±1.29	4.34±.99	3.68±0.84	14	0.01
FEV_1(L)	4.2±.79	3.92±1	3.33±0.96	23.11	0.01
MVV(L/min)	147.26±16.57	140.16±32.42	130.96±32.82	8.33	0.01
$FEF_{25-75\%.}$ (L/Sec)	4.9±1.15	4.61±1.13	4.33±1.00	7.12	0.01
PEF(L/Sec)	7.32±1.35	6.29±±1.5	3.32±0.63	288.86	0,01
FEV_1/FVC (%)	90.4±4.15	85.5±5.65	78.24±7.45	107	0.01

X=Mean, SD= Standard deviation, FVC=Forced vital capacity, P-value =Probability level, Sig. =Significance, L= Litter

The frequency of reported snoring can be demonstrated in the following diagram as reported in class I (72%) who were non-snoring while there were (28%) had snoring. Class Π (36 %) who are non-snoring while there were (64%) are snoring. Class III there was (12%) non- snoring patients (88%) are snoring. Fig. (1).

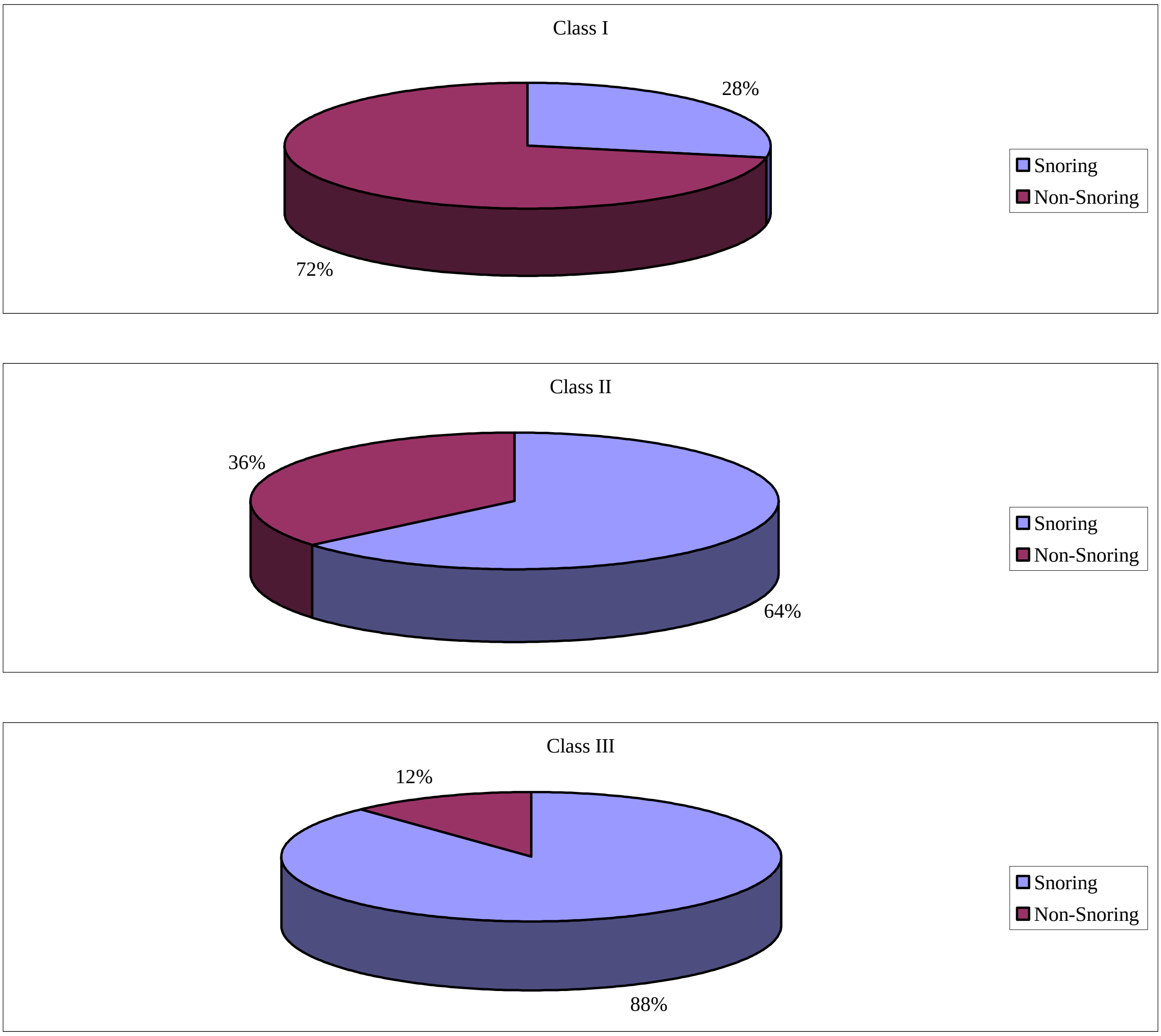

Fig. (1): Frequency of reported snoring among three classes of obesity.

Correlation analysis among the studied groups

Class (I), Pearson correlation coefficients analysis revealed the following statistical results; multiple measures of BMI showed a highly significant moderate inverse linear correlation (r=-0.52 & P<0.01, r=-0.55 & P<0.01, and r=-0.59 & P=0.01) with FVC, FEV_1 and PEF, respectively, and highly significant mild inverse linear correlation (r=-0.39 & P<0.01) for FEF_{25-75}. There were highly significant strong inverse linear correlation (r=-0.71 & P<0.01 and r=-0.71 & P<0.01) with FEV_1/FVC, and MVV, respectively. The WC showed a highly significant moderate inverse linear correlation (r=-0.65 & P<0.01, r=-0.64 & P<0.01, r=-0.59 & P<0.01, with FVC, FEV_1 and FEV_1/ FVC respectively, there was significant mild inverse linear correlation (r=-0.49 & P<0.01) with

FEF_{25-75}. There was highly significant strong inverse linear correlation (r=-0.73 & P<0.01 and r=-0.75 & P<0.01) with PEF, and MVV respectively. The percentage of fat mass showed a highly significant strong inverse linear correlation (r=-0.74 & P<0.01, r=-0.71 & P<0.01, and r=-0.74 & P<0.01) with FVC, PEF, MVV. There was highly significant moderate inverse linear correlation (r=-0.62 & P<0.01, r=-0.53 & P<0.01 and r=-0.62 & P<0.01) with FEV_1 and FEV_1/FVC, and FEF_{25-75} respectively. The WC had the most significant negative correlation with FEV_1, PEF and MVV compared to other anthropometric measures, while the fat mass had the strongest negative correlation with both FVC, and FEF_{25-75} when compared with other anthropometric measures. On the other hand, the BMI had the most significant negative correlation with FEV_1/FVC when compared with other anthropometric measures.

Class Π, Pearson correlation analysis revealed the following statistical results; multiple measures of BMI showed a highly significant strong inverse linear correlation with all ventilatory functions (r=-0.91 & P<0.01, r=-0.93 & P<0.01, r=-0.76 & P<0.01, r=-0.72 & P<0.01, r=-0.78 & P<0.01, and r=-0.86 & P<0.01) with FVC, FEV_1, PEF, MVV, FEV_1/FVC and FEF_{25-75} respectively. Multiple measures of The WC showed a highly significant strong inverse linear correlation with all ventilatory functions (r=-0.86 & P<0.01, r=-0.91 & P<0.01, r=-0.87 & P<0.01, r=-0.81 & P<0.01, r=-0.78 & P<0.01, and r=-0.94 & P<0.01) with FVC, FEV_1, PEF, MVV, FEV_1/FVC and FEF_{25-75} respectively. Multiple measures of the percentage of fat mass showed a highly significant strong inverse linear correlation with all ventilatory functions (r=-0.88 & P<0.01, r=-0.93 & P<0.01, r=-0.81 & P<0.01, r=-0.77 & P<0.01, r=-0.82 & P<0.01, and r=-0.88 & P<0.01) with FVC, FEV_1, PEF, MVV, FEV_1/FVC and FEF_{25-75} respectively. The WC had the most significant negative correlation with, FEV_1, MVV, PEF, and FEF_{25-75} compared to other anthropometric measures, while the fat mass had the most significant negative correlation with FEV_1/FVC, when compared with other anthropometric measures. On the other hand, the BMI had the most significant strong negative correlation with FVC, when compared with other anthropometric measures.

Class III, Pearson correlation analysis revealed the following statistical results; multiple measures of BMI showed a highly significant strong inverse linear correlation all ventilaroy function (r=-.86 & P<0.01, r=-0.91 & P<0.01, r=-0.86 & P0.01, r=-0.91 & P<0.01, r=-0.86 & P<0.01, and r=-0.93 & P<0.01) for, FVC, FEV_1, PEF, MVV, FEV_1/FVC, and FEF_{25-75} respectively. Multiple measures of The WC showed a highly significant strong inverse linear correlation all ventilaroy functions (r=-0.87 & P<0.01, r=-0.93 & P, 0.01, r=-0.86 & P<0.01, r=-0.94 & P<0.01, r=-0.89 & P<0.01, and r=-0.96 & P,0.01) for FVC, FEV_1, PEF, MVV, FEV_1/FVC, and FEF_{25-75} respectively. The percentage of fat mass showed a highly significant strong inverse linear correlation with all ventilatory functions (r=-0.84 & P<0.01, r=-0.93 & P<0.01, r=-0.87 & P<0.01, r=-0.93 & P<0.01, r=-0.88 & P<0.01, and r=-0.96 & P<0.01) for FVC, FEV_1, PEF, MVV, FEV_1/FVC, and FEF_{25-75} respectively. The WC had the most significant correlation with, FVC, MVV, and FEV_1/FVC compared to other anthropometric measures, while the fat mass and WC had the most significant correlation with FEV_1, PEF, and FEF_{25-75} and PEF for fat mass only when compared with other anthropometric measures. On the other hand, the BMI did not have any significant correlation when compared with other anthropometric measures.

Correlation analysis between neck circumference and snoring

There was a strong positive significant linear correlation (r=0.76 & P<0.01) between the neck circumferences and the snoring in class (I), as well as class (Π) (r=0.77 & P<0.01). There was moderate positive significant linear correlation (r=0.62 & P<0.01) in class (III).

DISCUSSION

The main findings of the current study showed that the pulmonary function parameters were affected by obesity in Egyptian females. With no particular marker of obesity (BMI, WC or Fat %) had the specific prediction of certain parameters (FVC, FEV_1, and FEV_1/FVC ---).

The body mass index (BMI) is the best predictor for FEV_1/FVC in obese female on class I, and for FVC on class Π, then other anthropometric indices. While it does not show significant difference with WC or Fat % with respect to subjects on class III.

The abdominal adiposity, as referred by waist circumference (WC), considered the best predictor for FEV_1, PEF and MVV in class I obese female, also in class Π, in addition to FEF_{25-75}. With respect to class III; the WC is the best for FVC, MVV and FEV_1/FVC. This inconsistency is shown for fat percentage, where it is the best one for FVC and FEF_{25-75} on class I; FEV_1/FVC on class Π and FEV_1, FEF_{25-75} and PEF on class III.

The inverse relation between obesity and pulmonary function was explored by other investigators. Canoy et al.,[3] analyzed the association of waist / hip ratio and pulmonary function in the European Prospective investigation Into Cancer and nutrition study, and reported an inverse association that remained significant after adjustment for BMI. Our results are similar in that the association remained significant in never- smokers. Chen et al.,[4] analyzed waist circumference and pulmonary function in a sample of men and women in the United Kingdom. These authors found inverse associations of waist circumference and pulmonary function.Harik-Khan et al.,[9] investigated the association of fat distribution and pulmonary function using waist/ hip ratio. They reported an inverse association of FEV_1 and waist/ hip ratio in men only, which was similar to our findings. Our results also supported an inverse association between FVC and waist/hip ratio. Lazarus et al.,[17] found no inverse associations of waist circumference or waist /hip ratio with FVC in women. These authors also reported an inverse association of abdominal girth/hip breadth ratio with pulmonary function after adjustment for BMI in men over a narrow age in the Normative Aging Study. Collins et al.,[5] examined 42 normal to mildly obese firefighters and found decreased pulmonary function in men with a waist / hip ratio >0.95.

The underlying mechanism of association between body adiposity and pulmonary function is a mechanical limitation of chest expansion during the FVC maneuver. Increased abdominal mass may impede the descent of the diaphragm and increase thoracic pressure[17]. Abdominal adiposity is likely to reduce expiratory reserve volume via compressing the lungs and diaphragm[14]. This will result in lower FVC measurements, which we indeed observed via the strong association of every adiposity marker with FVC in men and women[20]. All spirometry maneuvers were performed with the subject in the sitting position[8]. Therefore, we cannot rule out the influence of sitting during spirometry on reduced pulmonary function, as one study[7] reported small but statistically significant differences in FVC compared to standing spirometry in individuals with a BMI of >30 kg/m^2. Also, there is evidence that FEV_1 values are larger if testing is performed with the subject in the standing position[18]. Current guidelines recommend either the standing or sitting position for spirometry[1].The results obtained with these techniques may reveal interchangeable results.

Another possible mechanism is the insulin resistance[13]. It is recognized as a low-grade inflammatory condition[6] and pro-inflammatory cytokines (i.e adiponectin, leptin, tumor necrosis factor-α, and interleukin-6) are associated with adiposity[12]. Systemic inflammation is also thought to play a role[7] in the association between reduced pulmonary function and cardiovascular mortality as well as all- cause mortality[19]. However, the exact mechanism for the latter association is not fully understood. Insulin resistance and inflammation that arise from abdominal adiposity may mediate the relation of pulmonary function and all- cause mortality.

The results of this study are particularly noteworthy in that none of the entire adiposity marker (BMI, WC, and Fat %) is a highly specific than other one. This may be attributed to the greatest amount of variance in pulmonary function and to many classes involved in the study.

According to R^2 values in linear regression models; it was noted that increase the body weight indices, resulted in more impaction on pulmonary function. This finding may explained by the results of longitudinal studies of pulmonary function decline allow for the determination of the effect of changes in body composition on pulmonary function. These studies[4] have implicated weight gain as an important predictor of pulmonary function decline, an association that appears to be stronger in men. In one study of obese women ($BMI>30kg/m^2$), weight loss during a 6-month period improved FVC and FEV_1; however, it did not change the FEV_1/FVC ratio. A dietary intervention for weight loss in obese men showed improved FEV_1 and FVC with the loss of abdominal fat after three months on a hypocaloric Mediterranean diet. The results of these studies combined suggest that weight gain is associated with pulmonary function decline; however, these negative effects on pulmonary function may be potentially reversible with weight loss.

An interesting finding in the current study, the ratio of subjects complaining of snoring. Where, they were 28%, 64%, 88% on class I, Π, and III of obesity respectively. Concerning the influence of body fatness and body fat distribution on breathing disorder, neck circumference was the best predictor of breathing disorder in obese men suggesting that upper body fat accumulation is more important than the total amount of body fat for the risk of sleep apnea[15]. Accumulation of adipose tissue in the neck and enlarged neck have been proposed as possible causes of obstructive sleep apnea in obese patients[11]. Neck circumference was a better predictor of breathing disorder than waist circumference, and this result is apparently opposite to that reported by Grunstein et al.,[7] in obese men. However, it is notable that these authors investigated overweight and moderately obese patients, whereas we investigate females with different classes of obesity.

Conclusion

The results of this study indicated that there was a significant reduction in ventilatory function in the three classes of obesity. This reduction increased with increasing the degree of obesity. A greater deterioration of respiratory function was expected in centrally obese patients than peripherally obese because the abdominal fat limits the movement of the diaphragm. There was moderate positive significant linear correlation between the neck circumferences and the snoring.

REFERENCES

1- Ameracin thoracic society: Standardization of spirometry, 1994 up date. Am J Respir Crit care Med, 152: 1107-1136, 1995.
2- Biring, M.S., Lewis, M.I. and Liu, J.T.: Pulmonary Physiologic changes of morbid obesity. Am J Med Sci, 318: 293-297, 1999.
3- Canoy, D., Luben, R. and Welch, A.: Abdominal obesity and respiratory function in men and women in the Epic-Norfolk study, United Kingdom, Am J Epidmiol, 159: 1140-1149, 2004.
4- Chen, R., Tunstall-pedoe, H. and Bolton-Smith, C.: Association of diatery antioxidants and waist circumference with pulmonary function and air way obstruction. Am J Epidemiol, 153: 157-163, 2001.
5- Collins, L.C., Hoberty, P.D. and Walker, J.F.: The effect of body fat distribution on pulmonary function tests. Chest 107: 1298-1302, 1995.
6- Grag, R., Tripathy, D. and Dandona, P.: Insulin resistance as a pro inflammatory state: mechanisms, mediators and therapeutic interventions. Curr Drug Targets, 4: 487-492, 2003.
7- Grunstein, R., Wilcox, I., Yang, T.S., Gould, Y. and Hedner, J.: Snoring and sleep apnea in men: association with central obesity and hypertension. Int J Obes Relat Metab Disord, 17: 533-540, 1993.
8- Gudmundsson, G., Cerveny, M. and Shasby, D.M.: Spirometric values in obese individuals: effects of body position. AM J Respir Crit care Med. 156: 998-999, 1997.
9- Harik-Khan, R.I., Wise, R.A. and Fleg, J.L.: The effect of gender on the relation ship between body fat distribution and lung function. J Clin Epidemiol, 54: 399-406, 2001.
10- Heather, M., Ochs-Balcom, Brydom J.B., Grant Paola Muti, Christopher, T. Sempos, Jo L., Freudenheim, Maurizio T. and Holger, J.: Pulmonary function and abdominal adiposity in the general population . Chest 129: 853-862, 2006.
11- Janssens, J.P., Derivaz, S. and Breitenstein, E.: Changing patterns in long- term noninvasive ventilation: a 7-year prospective study in the Geneva Lake area. Chest 123: 67-79, 2003.
12- Katz, I., Stradling, J., Stulsky, A.S., Zamel, N. and Hoffstein, V.: Do patients with obstructive sleep apnea have thick necks? Am Rev Respir Dis. 141: 1228-1231, 1990.
13- Kern, P., Digregorio, G. and Lu, T.: Adiponectin expression from human adipose tissue: relation to obesity, insulin resistance and tumor necrosis factor- α expression. Diabetes, 52: 1779-1785, 2003.
14- Koeing, S.M.: Pulmonary complication of obesity. Am J Med Sci, 321: 249-279, 2001.
15- Kryger, M.H.: Restrictive lung diseases. In: Kryger MH, Roth T, Dement WC (eds). Principles and practice of sleep medicine W.B. Saunders: Philadelphia, PA; 769-775, 1994.
16- Kump, K., Whalen, C., Tishler, P.V., Browner, I., Ferrete, V., Rosenberg, C. and Redline, S.: Assessment of the validity and utility of a sleep – symptom questionnaire. Am J Respir Crit Care Med 150: 735-741, 1994.
17- Lazarus, R., Core, C.J. and Booth, M.: Effects of body composition and fat distribution on ventilatory function in adults. Am J Clin Nutr. 68: 35-41, 1998.
18- Peter, G. and Michael, J.: Epidemiology: Definition and Classification of obesity. Clinical Obesity; 5th ed. Ch (1):1, 2002.
19- Schunemann, H.J., Dorn, J. and Grant, B.: Pulmonary function is a long- term predictor of mortality in the general population, 29-year follow-up of the Buffalo Health Study. Chest; 118: 656-664, 2000.
20- Sugerman, H., Windsor, A. and Bessos, M.: Intra-abdominal pressure, sagittal abdominal diameter and obesity co morbidity. J Intern Med; 241: 71-79, 1997.

الملخص العربي

تأثير السمنة على وظائف التنفس لدى السيدات المصريات

أجريت هذه الدراسة لمعرفه تأثير درجات السمنة المختلفة على وظائف التهوية . وقد اختير لهذه الدراسة 300 سيدة بدينة تتراوح أعمارهن ما بين 20 إلى 40 عاماً وتتراوح مدى معدل كتلة الجسم ما بين 30 - $\geq$ 40 كجم / م^2 وقد تم تقسيم السيدات إلى ثلاث مجموعات حسب معدل كتلة الجسم كل مجموعة تحتوى على مائة سيدة المجموعة الأولى من 30 - 34.9 كجم/م^2 والثانية ما بين 35-39.9 كجم/م^2 والثالثة $\geq$ 40 كجم / م^2 وقد اشتملت القياسات على الوزن ، الطول ، محيط الوسط ، محيط الرقبة ، نسبة الدهون وقياسات التهوية الرئوية (المدى الحيوي القصرى / الحجم الزفيري القصرى في أول ثانية / أقصى معدل زفيرى / نسبة الحجم الزفيرى القصرى في أول ثانية للمدى الحيوي القصرى) . أظهرت النتائج أن جميع درجات السمنة تؤثر تأثيرا سلبيا على وظائف التهوية ، ويزيد هذا التأثير بزيادة معدل السمنة . هذه الدراسة توضح أيضا أن محيط الوسط هو أفضل القياسات المستخدمة لتقيم السمنة في تأثيره على وظائف التهوية .

الكلمات الدالة : السمنة - وظائف التهوية- معدل كتلة الجسم- جهاز قياس وظائف التنفس .