Original Article

Evaluation of lung ventilation in relation to the waist/hip ratio among healthy adults

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Abstract

Background: lung function is closely related to anthropometric variables. Anegative relationship between different adiposity markers and lung function has been well established, however, differences in their predictive power are still debated.

Objective: To evaluate the association between waist/hip ratio(WHR)and lung ventilation in both sexes among different weight categories in comparison with the other abdominal adiposity markers waist circumference and body mass index(BMI).

Patients and Methods: This study was conducted during May and June 2011. Ninety six healthy adults from both sexes volunteers in this cross-sectional study (55 males aged 18-65 years and 41 females aged 18-60 years) among health staff workers and patient relatives. After collecting personal and health information necessary for the study, all subjects underwent anthropometric measurements(height, weight,waist circumference, and hip circumference) before spirometry test using computerized spirometer.Descriptive data analysis was used to describe different variables in addition to Pearson correlation test of association between variables using the SPSS statistical package (windows version 17.0) was used to analyze the data.

Results: all spirometric data were within 80-120% of the normal predicted values, thus excluding the possibility of any asymptomatic airway disease.Data revealed a consistent negative correlation between BMI, waist circumference, and WHR with FVC and FEV1in both sexes.The relationship was significant and stronger with the waist circumference compared to BMI and WHR. Unlike BMI and waist/hip ratio, the waist circumference revealed a stronger and significant negative relation with lung function when subjects were re-grouped according to gender especially in males. Furthermore, both BMI and waist circumference continued to show negative correlation with, FVC and FEV1, however, the WHR revealed weaker and non significant correlation than BMI and WHR among all body weight groups.

Conclusions: Present results revealed that waist circumference, as abdominal adiposity marker, is a better predictor of pulmonary function than BMI or waist/hip ratio, and investigators should consider it when investigating the determinants of pulmonary function.

Key words: waist circumference, hip circumference, WHR, body fat distribution, lung function tests.

Introduction:

The prevalence of obesity is increasing, and there is evidence that obesity, in particular abdominal obesity as a marker of insulin resistance, is negatively associated with pulmonary function. The mechanism for this association and the best marker of abdominal adiposity in relation to pulmonary function is not known.Weight and body mass index (BMI) as measures of overall adiposity are used as predictors of pulmonary function in many epidemiologic studies. 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.(1) In most epidemiologic studies, waist circumference and/or waist/hip ratio(WHR) represent abdominal adiposity.(2,3).WHR can help to distinguish between patterns of fat distribution in the upper and lower body. In our previous study(4), we found that waist circumference, as a marker of abdominal adiposity, is a better predictor for pulmonary function than BMI. In this study, however, we aimed at investigating other marker of abdominal adiposity, the WHR, in relation to pulmonary function in comparison with the BMI and waist circumference.

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Subjects and Methods

The present study was conducted in the lung function unit at Ibn-Sina hospital from May-June-2011. Subjects were recruited among health staff workers and patient relatives. One hundred healthy adults (55 males and 41 females) were volunteered in the present study.Details of age and anthropometric measurements are shown in table (1).

Table(1):The anthropometric characteristics of subjects according to gender. Values are expressed as range(mean± SD).

Parameter	Total n=96	Male n=55	Female n=41
Age(year)	18-65 (31.21±9.6)	18-65 (30.63±9.00)	18-60 (32.00±10.59)
Height(Cm)	147-190 (1.65±0.08)	158-190 170.0±0.07	147-173 158±0.04
Weight(Kg)	43-120 73.5±16.9	52-120 78.411±16.85	43-110 66.90±14.72
Body mass index	18.5-39 26.94±5.66	18.8-39 26.97±5.11	18.5-39 26.89±6.40
Waist circumference(cm)	59-125 89.1±16.8	59-116 92.01±12.3	63-125 85.19±14.93
W/H ratio	0.68-0.98 0.87±0.08	0.70-0.98 0.90±0.06	0.68-0.97 0.82±0.08

All personal and health information necessary for the study were included in the data sheet. Subjects included in the present study fulfilled the following criteria:

1-Never smoker.

2-Clear chest on physical examination.

3-Absence of any neuromuscular or musculoskeletal disorders which could affect spirometry test.

4-Absence of any chronic lung disease, cancer, and prevalent cardiovascular disease (eg, prior myocardial infarction, coronary artery bypass graft surgery, angioplasty, or diagnosis of angina pectoris).

5-BMI below 18.5(underweight) and 40 were excluded.

Anthropometric measurements: body height, weight, waist/hip ratio were measured by using standard techniques as follows: height to within 0.5 Cm, without shoes; weight to within 100g,without heavy clothing; For waist and hip measurements, participants were instructed to stand erect with the abdomen relaxed, arms at their side, and feet together (without shoes). Interviewer used tapes to measure the waist at the narrowest circumference between the bottom of the ribcage and the top of the iliac crest following normal expiration. The interviewer measured hip circumference at the largest point between the iliac crest and the symphysis pubis.(3).

Spirometry: forced vital capacity(FVC) and forced expiratory volume in 1 second (FEV1) were measured by using electronic spirometer(Masterscope-Carefusion) Standard procedure were adopted following the recommendations of the American Thoracic Society(ATS) (5) The forced expiratory vital capacity procedure was described and demonstrated to the subject before the test, emphasizing the tight fit between lips and tongue and encouraging the subject to breathe out as long and forcefully as possible. The best of three technically satisfactory maneuvers was recorded. Descriptive data analysis was used to describe different variables in addition to Pearson correlation test of association between variables using the SPSS statistical package (windows version 17.0) was used to analyze the data.

Results:

Table(1) shows the anthropometric data of subjects distributed according to gender. The study groups included normal weight, overweight as well as obese subjects for both sexes. Table(2) presents the percent predicted values for lung function parameters in both sexes. All spirometric parameters were well within the normal predicted range (80-120%) confirming the absence of any asymptomatic airway disease.

According to data given in table (3) , a consistent negative correlation was clearly observed between BMI, waist circumference, and W/H ratio with FVC and FEV1in both sexes. However, the relationship was significant and stronger with the waist circumference(r = -62 for FVC and r = -61 for FEV1) compared to BMI(r = -30 for FVC and r = -29 for FEV1) and W/H ratio(r = -10 for FVC and r = -20 for FEV1). Unlike BMI and waist/hip ratio, the waist circumference revealed a stronger and significant negative relation with lung function when subjects were regrouped according to gender especially in males(table 3).

Table(4): Following regrouping of the study subjects into normal weight, overweight and obese, both BMI and waist circumference continued to show negative correlation with, FVC and FEV1, however, the W/H ratio revealed weaker and non significant correlation than BMI and W/H ratio among all body weight groups.

Table (2): Spirometric parameters according to gender. Percent predicted values are given expressed as range(mean±SD) .

Parameter	Total n=96	Male n=55	Female n=41
FVC	80-118 (94.22±12.54)	88-118 (93.66±13.59)	80-110 (88.7±13.88)
FEV1	82-114 (96.10±12.35)	90-114 (94.49±16.87)	82-110 (91.72±14.46)
FEV1%	85-115 (85.85±6.61)	88-115 (101.35±8.23)	85-99 (94.91±15.07)
PEF	80-110 (88.11±13.20)	86-110 (97.38±9.57)	80-95 (94.36±8.29)
FMF	77-1[illegible] (90.66±8.2)	95-118 (101.6±11.17)	90-112 (88.55±9.72)

FVC Forced Vital Capacity.FEV1 Forced Expiratory volume in the first second. FEV1% Percent Forced Expiratory volume in the first second. PEF Peak Expiratory

Flow rate, FMF=Forced Midexpiratory Flow.

Table(3): Correlation between waist circumference, BMI and W/H ratio regarding their relationship with FVC and FEV1 according to gender.

		FVC		FEV1	
		r	p	R	P
Body mass index	Total (n=96)	-0.30	NS	-0.29	NS
	Male(n=55)	-0.27	NS	-0.22	NS
	Female (n=41)	-0.24	NS	-0.26	NS
Waist circumference	Total (n=96)	-0.62	*	-0.61	*
	Male(n=55)	-0.66	**	-0.70	*
	Female (n=41)	-0.40	**	-033	*
W/H ratio	Total (n=96)	-0.10	NS	-0.20	NS
	Male(n=55)	-0.7	NS	-0.18	NS
	Female (n=41)	-0.8	NS	-0.15	NS

FVC=Forced Vital Capacity,FEV1=Forced Expiratory volume in the first second.

** correlation is significant at the 0.01 level (2-tailed).

* correlation is significant at the 0.05 level (2-tailed).

Table(4): Correlation between waist circumference, BMI and W/H ratio regarding their relationship with FVC and FEV1 according to body weight.

		FVC		FEV1	
		r	p	r	P
Body mass index	Normal weight (n=48)	-.37	NS	-.24	NS
	Overweight (n=22)	-.32	NS	-.20	NS
	Obese (n=26)	-.42	NS	-.22	NS
Waist circumference	Normal weight (n=48)	-.42	*	-.38	*
	Overweight (n=22)	-.68	**	-.62	*
	Obese (n=26)	-.60	*	-.55	*
W/H ratio	Normal weight (n=48)	-.11	NS	-.16	NS
	Overweight (n=22)	[illegible]	NS	-.13	NS
	Obese (n=26)	-.13	NS	-.09	NS

FVC Forced Vital Capacity,FEV1 Forced Expiratory volume in the first second

* correlation is significant at the 0.05 level (2-tailed

Discussion:

It is know that high amount of fat in our [illegible] is a health risk. Fat may be stored at any part of our [illegible]. For many people, it is stored in their hips and thighs, while others around the waist. Excess fat regardless of its distribution pattern in the body has been linked to several serious medical conditions. Fat distribution is also important(6).

In the present study, the relation of markers of overall body adiposity(BMI) and abdominal adiposity (waist circumference and WHR) with lung function is evaluated through different body weight categories For that reason, subjects were regrouped into different weight categories according to the international classification of obesity for Asian populations (7) as follows:

1.Normal weight group: BMI=18.5-25

2. overweight group: BMI=25-30

3. obese group(class I, class II): BMI=30-40

Subjects with BMI ≥ 40(class III obesity) were excluded from the study because measurement of waist circumference in this category adds little to the predictive power of BMI as most individuals with this BMI have an abnormal waist circumference(8).In addition to difficulty collecting such obese subjects.

Different studies reported different associations between pulmonary function and waist circumference, waist/hip ratio. Chen et al, in his study on waist circumference and pulmonary function in a sample of men and women in the United Kingdom, has reported an inverse associations of waist circumference and pulmonary function which is similar to our study(8). Harik-Khan et al investigated the association of fat distribution and pulmonary function using waist/hip ratio, the study reported an inverse association of FEV1 and waist/hip ratio in men only(9), which did not agree with our findings which revealed negative association in both sexes. Our results also supported an inverse association between FVC and waist/hip ratio however weaker than that observed with waist circumference(r=-10 for waist/hip ratio compared to r=-62 for waist circumference); this association was stronger in males(table 3) . Lazarus et al found no inverse associations of waist circumference or waist/hip ratio with FVC in women(10) which is not in agreement with our findings whichshowed an inverse associations of waist circumference and waist/hip ratio with FVC in both sexes. Sample size as well as anthropometrical variations with the western population may partially explain such different conclusions.

Other investigators explored the association of obesity with pulmonary function. Canoy et al 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(11). Results of the present study were similar in that the association was negative, however non significant among different body weight categories(normal weight, overweight and obese) however, the negative association was stronger with waist circumference(r=-42 for normal weight, -68 for overweight and – 60 for obese) compared to the waist/hip ratio (r=-11 for normal weight, -6 for overweight and – 13 for obese) as shown in table4.

Waist/hip ratio can help to distinguish between patterns of fat distribution in the upper and lower body. The WHR is strongly associated with visceral fat and appears to be an acceptable index of intra-abdominal fat (3). Generally, young adults with WHR values in excess of 0.94 (men) or 0.82 (women) are at high risk for adverse health consequences (12).

The finding of the stronger association of abdominal adiposity and pulmonary function in men points to the importance of what has been called "apple vs pear-shaped" body types. As with other chronic conditions, increased abdominal adiposity or having an "apple-shape" may be an important indicator of lung health. Further research should be focused on characterizing the mechanism for the association of abdominal adiposity and reduced pulmonary function. In conclusion, these results suggest that waist circumference is a better predictor of pulmonary function than BMI or waist/hip ratio.

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