The correlation between FEV1 / FVC with Arm span to height or chest to waist ratio as an index of Pulmonary function in healthy subject.

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Summary:

Background: The interpretation of pulmonary function tests relies on reference values corrected for age, sex and height. Height may be difficult to measure in patients with deformities of the thoracic cage or those who are unable to stand up properly. Current practice is to substitute arm span to height and chest to waist circumferences, once corrected either by a fixed factor or by an age – and gender-dependent regression equation.

Objectives: This study is aimed to look for the parallel correlation between FEV1/FVC and arm span/ height ratio, or chest circumference/waist circumferences in healthy subject of both gender is related with pulmonary function.

Method :This study was derived from (407) healthy subjects, they were [189(46%) females and 218(54%) males] with age range from 20 to 80 year, weight (41-112 Kg) , height(148-188 Cm)) and measured arm span(60-95 Cm),chest circumference(69-124 Cm) and waist circumference(63-129 Cm).

All the subjects were non –smoker with no history or symptoms of cardiovascular or respiratory diseases. The study was carried out in ALyarmouke – teaching hospital during the period (beginning of February 2009 till May 2010. The arm span (cm)/height (cm) ratio and waist circumference (cm)/chest circumferenceem) ratio were calculated. The forced expiratory volume in first second (FEV1) and Forced vital capacity (FVC) were measured using Wright>s spirometer.The actual (measured) FEV1/FVC% was calculated

Results: The results were significant positive correlation between measured FEV1/FVC% with arm span/ height ratio and does not correlate between measured FEV1/FVC% with chest/waist circumferences ratio for both gender.

Conclusion: Gender factor should be taken in to an account in the assessment of the ratio of FEV1/FVC% with arm span/height ratio.

Keywords:-FEV1,FVC,Arm span/height ,chest/waist and healthy subjects

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Introduction:

Lung function test can be assessed by forced expiratory volume in one second (FEV1) and forced vital capacity (FVC) which are the most widely used tests in clinical studies for lung function tests [1] and usually interpreted by comparing measured values with reference value derived from healthy subjects without skeletal deformities[2].Several studies had indicated that these equations used or introduced by European Community for Coal and Steel (ECCS) [3] are significantly under estimate predicted FEV1 and FVC [4].These reference values are essentially dependent on age ,sex and height, detailed methods are available on how height should be measured[5]. Agreement between arm span and standing height has been found to be poor [6,7].Direct substitution of arm span for height was also questioned recently by Gol Shan et al.,[8] who found estimation from regression models to be superior in healthy subjects. Most reference equations for lung function use age and standing height as dependent variables. For patients in whom standing height cannot be measured (e.g. Patients with skeletal deformities or those unable to stand) the patients self-reported height, arm span, or height estimate from arm span have been substituted for standing height in the regression equation [8,9].A regression equation using arm span ,race, sex and age has been found to account for 87% of the variance in standing height [10],with the standard error of the estimate for height ranging from 3.0 to 3.7 cm. Estimating height introduces a further level of uncertainty with regard to predicted value of the lung function index, and the use of the fixed ratio has been shown to lead to misclassification of disease[11] In women, abdominal waist circumference and height were negatively associated with FEV1 percent predicted, while all five adiposity markers(weight, body mass index(BMI),waist circumference, Waist/hip ratio, and abdominal height) were negatively associated with FVC percent predicted[12].In men, all overall and abdominal adiposity markers were inversely associated with FEV1 percent predicted and FVC percent predicted[12] .Chest dimensions and pulmonary function are positive correlated in healthy individuals [13]. Classically chest circumferences have been for assessment of thorax

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excursion [14]. Overweight and obesity are significant risk factors for reduced lung function at school age after early childhood wheezing [15].Increasing waist circumference is associated with airflow obstruction [16].Predicting pulmonary parameters using equations based on arm span is as reliable as using equation based on standing height and are more accurate for patients in whom height cannot be measured reliably [17]. Tan et al..[18] found a significant association between increased arm span to height ratio, reduced respiratory airflow volumes and increased severity of dyspnea in a group of predominantly elderly subjects with multiple co-morbidities. From previous studies we did not observe a correlation between arm span/ height with FEV1/FVC% measured for male and female health subjects . This study is aimed to look for the parallel correlation between FEV1/FVC and arm span/height ratio, or chest circumference/waist circumferences in healthy subject of both gender is related with pulmonary function .

Method:

This study were derived from (407) healthy subjects, they were [189 (46%)females and 218(54%) males] with age range from 20 to 80 year, weight (41-112 Kg) and height(148-188 Cm) which they were tested at pulmonary function unit at Al-yarmouke-teaching hospital during the period from the beginning of February 2009 till May 2010.. All the subjects were non –smokers with no history or symptoms of cardiovascular or respiratory diseases.. The anthropometric measurements include arm span (60-95 cm), waist circumference (63-129 cm)and chest circumference(69-124 cm).The body mass index was calculated according to the Quetlet's equation:

BMI = weight (kg) / height (m^2).

The arm span (cm)/height (cm) ratio and waist circumference (cm)/chest circumference (cm) ratio were also calculated. The forced expiratory volume in first second (FEV1) and Forced vital capacity (FVC) were measured using Wright's spirometer.The actual (measured) FEV1/FVC % was also cal culated

Statistical Analysis:The results expressed as absolute number ,mean ,median, SD, lower and upper limits. The data were analyzed using two tailed unpaired student t-test and simple correlation test taking the probability ≤ 0.05 as the lowest limit of significance.

Results:

Table (1) shows that the there is no significant statically difference between males and females regarding the age. Significant low body weight and height are observed in females compared with males(Table 1) .Females have significant less arm span than males(74.005±4.765 vs 77.091±4.937).The measured values for forced expiratory volume in one second and forced vital capacity are significantly higher in males than females($p<0.001$) (Table 1). A significant positive correlation between measured FEV1/FVC % and arm span/height ratio in males($r=0.190$;$p<0.01$) and females($r=0.189$;$p<0.01$) was shows on figure 1(a and b),it has given the values of ratio on table 2.The figures have also shows a slight increase in the ratio of FEV1/FVC with increasing arm span/height ratio for both genders

Chest / waist circumferences ratio are significantly higher in females compared with males ($p<0.001$) (Table 1). Figure 2(aand b) shows the measured FEV1/FVC % does not correlate with chest/waist circumferences ratio for both gender [Table3].

Table (1):The characteristics and the comprehensions between male and female of this study

	Male (n=218)		Female (189)	
	Median (Min-Max)	Mean ± SD	Median (Min-Max)	Mean ± SD
Age (year)	42(20-80)	43.838±15.753	41(20-78)	42.550±14.156
Weight (kg)	78(56-153)	80.513±12.631	70(41-112)	71.253±11.341*
Height (m)	1.74(1.52-1.88)	1.738±0.054	1.65(1.46-1.85)	1.649±0.074*
BMI (kg/m^2)	26.122(17.020-42.560)	26.665±4.109	25.558 (16.979-43.75)	26.229±4.213
Arm span (cm)	77(68-90)	77.091±4.937	74(60-95)	74.005±4.765*
Arm span/height ratio	0.441(0.394-0.502)	0.443±0.024	0.446(0.379-0.565)	0.448±0.022
Chest circumference (cm)	97.5(71-124)	96.903±10.026	98(69-120)	98.370±9.889
waist circumference (cm)	96(69-129)	96.669±11.017	92(63-116)	91.973±10.412*
Chest/waist circumferences ratio	0.988(0.877-1.190)	1.005±0.056	1.065(0.887-5.12)	1.073±0.070*
Forced Vital capacity (L) (p)	4.715(2.8-5.87)	4.676±0.607	3.52(2.39-5.12)	3.555±0.511*
Forced Vital capacity (L) (m)	3.785(2.16-524)	3.741±0.547	2.86(1.97-3.96)	2.887±0.443*
Forced Expired volume (L) (p)	3.625(2.11-4.8)	3.579±0.592	2.79(1.68-4.1)	2.784±0.469*
Forced Expired volume (L) (m)	2.98(1.96-4.64)	2.984±0.499	2.36(1.357-3.36)	2.353±0.383 *
FEV1/FVC % (p)	76.92(60.52-101.31)	76.31±5.81	78.59(57.37-110.2)	78.41±4.90*
FEV1/FEC % (m)	80.07(47.8-130.97)	80.20±10.64	81.7(63.13-108.8)	81.75±8.64

*Significance P = 0.05 compared female with male group
(p) predicated (m) measured

Table (2) : Correlation between (FEV1/FVC%) measured (m) with arm span/height ratio for male and female

	Arm span/ height ratio Mean± SD	FEV1/ FVC%(m) Mean± SD	Correlation Coefficient (r)	P-value
Male	0.443±0.024	80.20±10.64	0.190	<0.01*
Female	0.448±0.022	81.75±8.64	0.189	<0.01*

P-value for comparison between (FEV1/FVC) measured with arm span/height ratio
Significant difference . *

Table (3) : Correlation between (FEV1/FVC%) measured (m) with chest /waist circumferences ratio for male and female

	Chest/waist circumferences ratio Mean± SD	FEV1/ FVC%(m) Mean± SD	Correlation Coefficient(r)	P-value
Male	1.005±0.056	80.20±10.64	0.064	>0.05(NS)
Female	1.073±0.070	81.75±8.64	0.068	>0.05(NS)

P-value for comparison between (FEV1/FVC) for p and m with chest/waist circumferences ratio
NS=non-significant difference

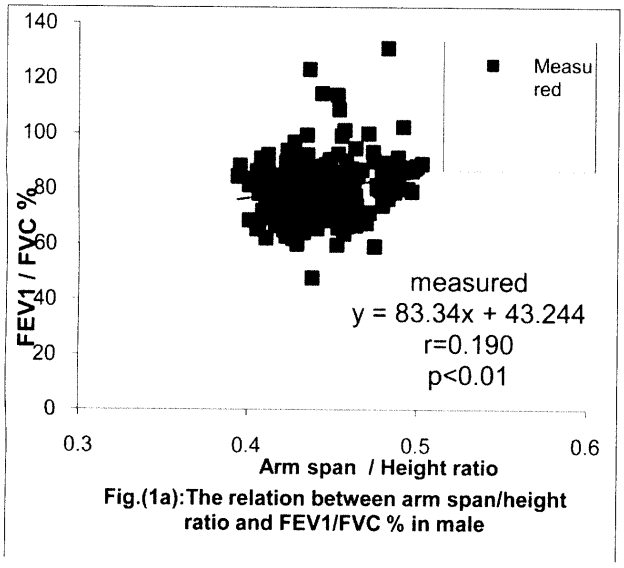
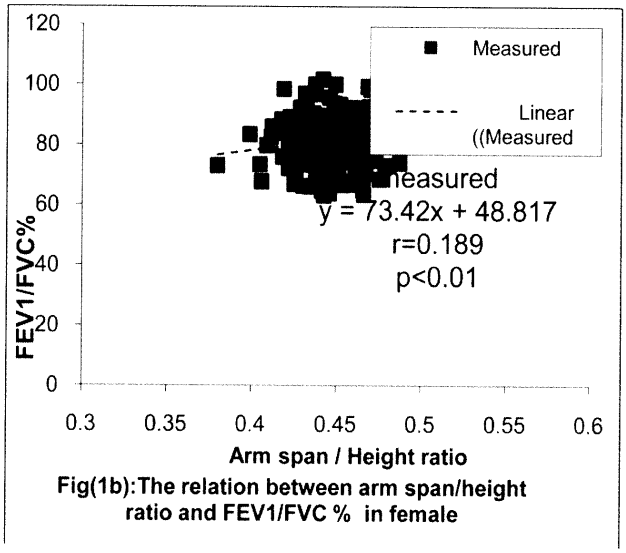
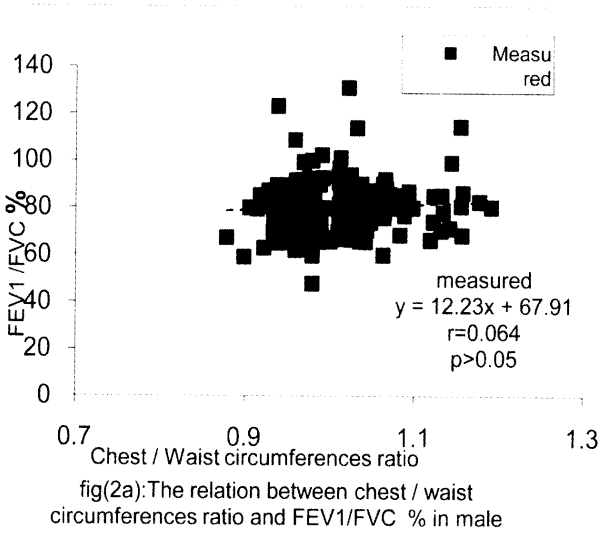


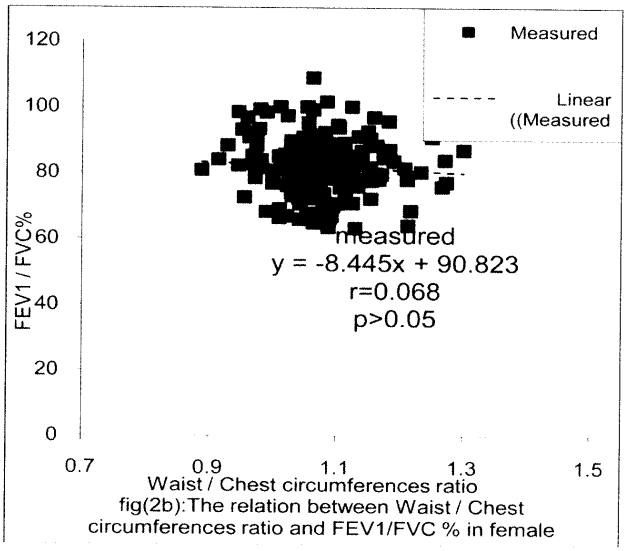
Fig.(1a):The relation between arm span/height ratio and FEV1/FVC % in male



Fig(1b):The relation between arm span/height ratio and FEV1/FVC % in female



fig(2a):The relation between chest / waist circumferences ratio and FEV1/FVC % in male



fig(2b):The relation between Waist / Chest circumferences ratio and FEV1/FVC % in female

Discussion:

Results of this study showed a statically significant correlation between arm span/height ratio and measured FEV1/FVC% while no statically significant correlation between chest/waist and measured FEV1/FVC% but statically significant correlation between chest/waist and predicted FEV1/FVC% . These correlation were found according to the both gender factor while significant correlation between arm span/height ratio and predicted FEV1/FVC% were found in male only. The correlation between standing height and arm span is usually excellent[19]. Therefore, when actual standing height cannot be measured or is affected by disease, arm span has been recommended as a substitute for standing height and calculation of the predicted FVC [20,21].

The fixed ratio values of arm span/height(AS/H) calculated for male and female were slightly different they were within the range (1.01 -1.04 for male and 1.00 -1.02 for female) [22],although ethnicity and population differed the 1.06 value suggested by Miller et al [5].Parker et al[10] observed that fixed arm span-to-height ratio may also be used to estimate height with reason able accuracy, but there were errors in its extremes of stature. Aggarwal et al [11] observed that height obtained by substitution of arm span or estimation by(AS/H) ratio method resulted in similar errors interpretation of spirometeric data; thus, the use fixed ratio may introduce a further level of uncertainty with regard to the predicted value of lung function index and may potentially lead to misclassification of disease[5,23].

Two previous studies in Canada and UK found that WC was significantly

associated with decreased FVC and FEV1, but not with FEV1/FVC% measurements [24,25]and there was no statistical difference in any of the chest circumferences and(FEV1/FVC%) measurements [26] so these results are in agreement with our study, this is because that both FEV1/FVC% are reduced by the same ratio which maintain the ratio at most constant.

Arm span is the physiological measurement with the closest correlation to standing height accurate spirometry or lung function estimation requires comparison between the measured (FEV1) and (FVC) with the predicted FEV1 and FVC based on height and age [27] .

No reference value for arm span / height body ratio for pulmonary function measurement in similar population could be identified in literature. for arm span/height there was no doubt, since height could be used considering that on the present sample the two measurement could be used .

Moreover, significant correlation were found between measured FEV1/FVC% with arm span/height ratio for male and female this is because that both FEV1/FVC% are reduced by the different ratio. complementary studies are required to confirm the results of the present study with the objective of establishing reference value for pulmonary function in adult who are eligible for pulmonary function assessment based on arm span/height ratio for male and female

Conclusion:

Gender factor should be taken in to account in the assessment of the ratio of FEV1/FVC% with arm span/height ratio .

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