Original Article

Arm Span to Height Ratio in Relation to Severity of Dyspnea

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Summary:

Background: Arm span is the closest physiologic measurement to standing height. Increased arm span to standing height ratio, which indicates a possible loss of height, due to aging, often results from osteoporosis-related vertebral collapse or other causes. This has possible consequences on lung functions.

Objective: To evaluate the effects of aging related loss of height to severity of dyspnea.

Method: Patients visited pulmonary function test laboratoryat Baghdad teaching hospital outpatient clinic department from first of November 2009 to thirty first of December 2010 for preoperative assessment were recruited to participate in our study. All recruited subjects were evaluated with a clinical history and physical examination followed by measurements of arm span, standing height, weight, forced expiratory volume in one second (FEV1) and forced vital capacity (FVC). Patients 40 years old of age and older were included .Patients with chronic disabilities (cardiac, respiratory or systemic diseases) were excluded. Patients were classified according to their gender and Medical Research Council severity of dyspnea.

Results: one hundred thirty one subjects aged 40 years and older were recruited for this study. Arm span to height ratio was significantly negatively correlated with FEV1/FVC ratio, FVC, and positively correlated with severity of dyspnea.

Conclusion: There is a significant association between increased arm span to height ratio with increased severity of dyspnea. The role of arm span measurements in assessment of pulmonary function tests in older patients and the association between loss of height and dyspnea deserves further evaluation.

Keywords: Arm Span,height ratio, dyspnea.

Introduction:

Arm span is the physiologic 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,genderand age (1). In situations where accurate measurement of standing height is not possible, estimated height can be calculated from arm span either through a fixed ratio(2,3) or, more accurately, through regression equations that also includes racial differences(4). Standing height may be reduced as a result of physiologic changes associated with aging, skeletal deformities, such as scoliosis, vertebral fractures, arthritis, and others. A reduction of 10 cm in height is reported to equate to 700 mL of lung volume loss in women with osteoporosis (5). Aging is also associated with physiologic changes in respiratory function, including reduced chest wall compliance, reduced elastic recoil, increased residual volume and impaired respiratory muscle strength, manifested as reduced FVC and FEV1(6).Loss of lung volume as a result of loss of height or vertebral fractures are therefore, likely to have greater effects On lung function in older people. Despite concerns Those osteoporotic vertebral fractures are prevalent inarm span is currently not required in any agegroup.Arm span, which approximates to height at Maturity does not reduce with age and might, therefore, be a better linear variable to compare with age andspirometric volumes in older people (8). Height may be difficult to measure in patients with deformities of the thoracic cage or those unable to stand up properly. Current practice is to substitute arm span to height, once corrected either by a fixed factor or by an age- and sex-dependent regression equation (9). The estimation of height from ID (identification card) height can be substituted to that from arm span when clinically relevant, providing ID height has been measured before the occurrence of stature problem (9).Loss of standing height is an established age-related problem (10). Low body weight, female sex, and steroid use are established risk factors for osteoporosis (11). The underlying causes of height reduction include loss of vertebral space, increased spinal curvature due to vertebral fractures, or osteoarthritis. Partial vertebral fractures are found in 60% of female and 30% of male subjects aged 75 or greater (12).

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Patients and methods:

Participants were recruited from subjects referred to the pulmonary function unit at Baghdad teaching hospital / outpatient clinic department. All subjects were evaluated with a clinical history and physical examination followed by measurements of arm span, standing height, weight, FEV1, and FVC. Patients 40 years old of age and older were included. The height of subjects measured without shoes, with thefeet together, standing as tall as possible with the eyes level and looking straight ahead, and with the use of an accurate measuring device. Arm span measured as maximal distance between the tips of the middle finger with the subject standing against the wall with the arms stretched. Patients with chronic disabilities (cardiac, respiratory or systemic diseases) were excluded; they were identified by history, Clinical examination; electrocardiography, chest x-ray and simple blood tests. Participants classified according to gender and criteria of Medical Research Council severity of dyspnea (Table1) as control (grade 1and2), and cases (grad 3,4and 5). Subjects were classified according to gender in to 2 groups, male and female, cases and control.The Pulmonary Function Test (PFT)Equipment used for PFT was Spirometer (vitalograph, S.NO.25609, UKk;l.)The following parameters were considered:

1. FVC: the amount of air exhaled forcefully and quickly after maximum inspiration.
2. FEV1: Forced expiratory volume in one second.
3. FEV1/FVC ratio (FEV1%).

Recording of PFTsFEV1 and the FVC were determined in liters. The best of three measurements was considered. Predicted FEV1 and FVC were calculated according to age, sex, and height, using previously published reference ranges (1).

Table (1): MRC dyspnoea scale

Grade	Degree of breathlessness related to activities
1	Not troubled by breathlessness except on strenuous exercise
2	Short of breath when hurrying or walking up a slight hill
3	Walks slower than contemporaries on level ground because of breathlessness, or has to stop for breath when walking at own pace
4	Stops for breath after walking about 100m or after a few minutes on level ground
5	Too breathless to leave the house, or breathless when dressing or undressing

StatisticsAll statistical analyses were performed using statistical analysis software (SPSS 14.0 for Windows; SPSS; Chicago, IL). The arm span to height ratio was determined by dividing the arm span (in centimeters) by the height (in centimeters). Age and other continuous variables were expressed as mean ± SD. Variables were plotted as histograms, and their skewness and kurtosis determined to ensure normal distributions. Continuous variables were compared using the Kruskal-Wallis test correlation statistics (13) and significance levels were determined for the continuous variables of FEV1, FVC, age, and MRC scale. Adjustments for age, and sex were made using multiple linear regressions.If the p-value is near zero, this casts doubt on the null hypothesis and suggests that at least one sample median is significantly different from the others. It is common to declare a result significant if the p-value is less than 0.05 or 0.01.In this study p-value of less than 0.05 was considered as statistically significant.

Results:

The clinical characteristics of subjects and their association with arm span to height ratio are shown in Table A and B. One hundred thirty one subjects were included in the study. The mean age of 61 female is 58.3±8.11 years, while the mean age of 70 male is 60.2±12.85 (table A and B).

In this study there was no significant statistical difference in age between cases and controls.The mean arm span to height ratio for both gender cases were a statisticallysignificant difference from control (Table A and B).

Table A. Pulmonary function test characteristics of male subjects with their association with arm span to height ratio

Groups	Male cases	Male control	P_value
Total no.	33 (41%)	37 (59%)	
Age(years)	61±14	60±10	2.4
arm span/ height ratio	1.05±0.05	1.029±0.013	0.0027
FVC actual	2.5±0.9	3.5±0.8	0.0001
FVC predicted	3.7±0.7	3.7±1.4	0.11
FEV1% actual	57±11	79±3.9	0.00004

Table B. Pulmonary function test characteristics of female subjects with their arm span to height ratio

Groups	Female cases	Female control	P_value
Total no.	34 (53%)	27 (47%)	
Age (years)	58±8	59±7.5	6
arm span/ height ratio	1.1±0.014	1.032±0.012	0.005
FVC actual	1.7±0.5	2.5±0.4	0.0000003
FVC Predicted	2.6±0.4	2.7±0.5	5.5
FEV1% actual	57±13	72±9	0.00006

Discussion:

An increase in the arm span to height ratio would indicate a discrepancy between estimated height and actual height, suggesting the presence of loss of height(3). Because an understanding of the normal progression of changes in respiratory function is important in assessing the loss in pulmonary reserve for elderly people, (7) height estimated from arm span may be important for the assessment of lung function in osteoporotic patients with or without lung disease.

In our study multiple regression analysis revealed arm span to height ratio as independent predictors of severity of dyspnea, using the MRC scale.

Arm span to standing height ratio was negatively correlated with FVC and FEV1% (Table A and B) in patients who were investigated with pulmonary function test for preoperative assessment.

Other studies like for example, Allen (8) concluded that span measurements offer no advantage over height measurements in cross-sectional population studies of lung volume in old age.

Possible explanation is the difference in selected groups as our group were symptomatic (male and female) while Allen group were healthy, activefemale.

Maw P. Tan (12) found a significant association between increased arm span to height ratio, reduced respiratory airflow volumes, increased severity of dyspnea, and echocardiographic features of pulmo nary heart disease in a group of predominantly elderly subjects with multiple comorbidities, which supports our results.

Conclusion:

An increased arm span to height ratio, an indication of possible loss of height, is associated with increased severity of dyspnea and reduced FEV1/ FVC ratio and FVC in subjects of 40years of age and older. Future evaluations into the relationship between loss of height with dyspnea, as well as the importance of arm span measurements in lung function assessments should now be performed.

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