Journal of Yoga & Physical Therapy
ISSN: 2157-7595

Research Article Open Access

Reference Values for Chest Expansion among Adult Residents in Ile-Ife

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Abstract

Background: Chest excursion measurements are used to evaluate a patient's baseline status, treatment effectiveness, and progression of disease with regards to chest wall mobility and respiratory muscle function, although current research regarding normal chest expansion measurements, consistent patient position and site of measurement is limited. This study was designed to access chest expansion of healthy adults resident in Ile-Ife, Nigeria**.**

Methods: Four hundred and twenty-eight (200 males, 228 females) volunteers were recruited for the study. Their age ranged between 20 and 70 years. Participants were apparently healthy and non smoking individuals who are recruited by purposive sampling technique. Data was obtained by measuring chest expansion of both upper and lower thoracic excursion using an inelastic tape with measurement taken twice and the average being recorded. Measurements were taken at the height of maximal inspiration and expiration. For the upper thoracic excursion, the tape measure was placed at the level of the fifth thoracic spinous process and the third intercostals space at the midclavicular line and for the lower thoracic excursion, the tape measure was placed at the level of the 10th thoracic spinous process and the tip of the xiphoid process. The difference of the two measurements was recorded as chest excursion. Data was analyzed with descriptive and inferential statistics. Level of significance was set at 0.05 α-level.

Results: Results showed that male participants have significant higher chest expansion than female participants in upper thoracic (2.6+1.4cm, 2.2+1.2cm) for male and female respectively and at lower thoracic (2.3+1.2cm, 1.7+1.1cm) ($p < 0.05$) for male and female respectively. Chest expansion of male and female participants at both upper and lower thoracic peak at age 20-29 and decreases thereafter with increasing age. The result showed that chest expansion was negatively correlated with age in male ($r = -0.370$; $p < 0.05$); $r = -0.153$; $p < 0.05$); and in female ($r = -0.319$; $p < 0.05$); $r = -0.458$; $p < 0.05$) for both upper and lower thoracic respectively. In female participants, chest expansion was significantly correlated with BMI ($r = -0.141$, 0.197; $p < 0.05$). For the entire participants, values less than 25th, between 25-75th and greater than 75th are considered to be poor, moderate, and good excursion respectively. For the upper expansion and lower expansion, the values are 1.4 cm, 3.1 cm, 5.1 cm and 1.0 cm, 2.7 cm and 4.3 cm respectively.

Conclusion: It was concluded that chest expansion of both upper and lower thoracic increase with age increases until the 3rd decade of life, and then steadily declines after this. Male chest expansion was significantly higher than female participants.

Keywords: Chest expansion; Adults; Reference values

Introduction

Physical therapy plays a major role for a variety of patients with respiratory diseases with the use of techniques such as chest percussion, postural drainage, chest vibration, cough maneuver, breathing exercises, relaxation techniques and endurance exercises Although, the rationale and validity of many of these interventions has been challenged. Little attention was placed to evaluating group of patients with specific lung disease to determine the efficacy of chest physical therapy [1]. In patient with pulmonary diseases, chest excursion evaluation provides base line values for comparison to assess the efficacy of the intervention.

Professionals such as Physiotherapists, doctors, osteopathic physicians and other health care professionals commonly use Chest excursion measurements to evaluate the effect that restrictive pulmonary diseases, such as Ankylosing spondylitis, idiopathic scoliosis, muscular dystrophy, spinal cord injuries, and obstructive diseases such as chronic obstructive pulmonary diseases, have on chest wall range of motion [2,3] Chest excursion is also an indicator of respiratory muscle function in patients with rheumatological disease [4].

In clinical setting, a simple and inexpensive technique for measuring chest expansion is a tape measure which has been shown to be reliable in healthy volunteers [5,6].

Considering the importance of chest expansion as a diagnostic tool in clinical setting, the interpretation is dependent on reference values or normative data drawn from the normal individuals to detect variation from normal. There are no reference values for Nigeria population presently. The values from other populations as reported in the literature cannot be extrapolated because lung functions are known to be different across race and ethnic groups [7]. Establishment

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Received February 22, 2012; **Accepted** May 19, 2012; **Published** May 21, 2012

Citation: Adedoyin RA, Adeleke OE, Fehintola AO, Erhabor GE, Bisiriyu LA (2012) Reference Values for Chest Expansion among Adult Residents in Ile-Ife. J Yoga Phys Ther 2:113. doi:10.4172/2157-7595.1000113

of reference values for people of African descent is critical as incidence of chronic disease such as respiratory disease is on the increase.

Materials and Methods

Participants

The participants were 428 apparently healthy volunteers with age range of 20 and 70 years. Subjects were staff and students of the Obafemi Awolowo University Community in Ile-Ife, and Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC). They were recruited *via* research advertisements, offices and by invitation.

The Inclusion Criteria were: Volunteers within age 20-70 years. Individuals with BMI within normal range (18.5 - 24.9). Participants without any neurological, orthopaedic, rheumatological or respiratory diseases or injury causing impairment in rib-cage or having pneumonia during the last month and smokers were excluded from the study.

Procedure

Ethical approval was sought and obtained from the Ethics and Research Committee of the Obafemi Awolowo University Teaching Hospitals Complex, Ile-Ife.

Informed consent was obtained from all participants. The experimental protocol was explained to the subjects before the measurement were taken. Anthropometric measurements were performed with participants wearing light apparel and without shoes. Weight was measured using a portable weighing scale to the nearest 0.1kg and height was measured with a stadiometer to the nearest 0.1 kg. Age and sex of subjects were also recorded.

The subject's chest expansion was taken in standing position with the feet 5cm apart and arms elevated. The upper limbs at the sides with the shoulder abducted the elbow in semi flexion, the wrist extended, the thumb abducted with the web between the thumb and the first fingers placed on the level of the iliac crest [8].

The chest expansion was taken as thoracic circumference at the end of forced inspiration minus thoracic circumference at the end of forced expiration. Two readings from upper and lower thoracic expansion were measured at an interval of 5 minutes with the inelastic tape around the body. The averages of the two readings were recorded. For the upper thoracic excursion, the tape measure was placed at the level of the fifth thoracic spinous process and the third intercostal space at the midclavicular line and for the lower thoracic excursion, the tape measure was placed at the level of the 10th thoracic spinous process and the tip of the xiphoid process. Measurements were taken at the height of maximal inspiration and expiration and considerable care was exercise not to pull the tape too tightly while making the measurements.

Statistical analysis

Descriptive statistics was used to compute the means, median, range, percentiles and standard deviations of the demographic data. Independent-*t*-test was used to test the differences in measurements of chest expansion between men and women. Pearson product moment correlation analysis was used to test the relationship between chest expansion and the participants' general characteristics. The level of significance was set at 0.05 Analysis was performed using SPSS version 16.0(SPSS Inc.,Chicago,IL,USA).

Results

Participants profile

A total of 428 (200 males, 228 Female) were recruited for the study. Participants' mean age was 41.5 ± 1.4 for male and 40.5 ± 1.4 for female; mean weight was 65.5 ± 7.9 for male and 61.8 ± 9.8 for female. Male is significantly taller than female ($p < 0.05$) Table 1.

The result of the *t* test showed that there male has significant higher chest expansion of the lower thoracic than female ($t=4.206$, $p < 0.001$) Table 1.

Percentage data for chest expansion of upper thoracic of the entire subject by age is presented in Table 2. Male is having higher expansion more than female across all the age group. The 25th percentile, 75th percentile and 95th percentile for upper thoracic are 1.5 cm, 3.5 cm, and 5.2 cm, respectively for male and 1.3 cm, 2.7 cm, and 4.9 cm, for female respectively.

For lower thoracic, the 25th, 75th and 95th percentile are 1.3 cm, 3.0 cm, and 4.9 cm, respectively for male and 0.9 cm, 2.5 cm, and 3.6 cm, respectively for females Table 3. Chest expansions of both male and female participants of lower thoracic peaked at age 20-29 (Table 3).

For the entire participants, values less than 25^{th,} between 25-75th and greater than 75th are considered to be poor, moderate, and good excursion respectively. For the upper expansion and lower expansion, the values are 1.4 cm, 3.1 cm, 5.1 cm and 1.0cm, 2.7 cm and 4.3 cm respectively.

Pearson product moment correlation was used to test the relationship between chest expansion, age, weight, height and BMI of male and female participants (Table 4). Among the male participants, the results shows that there was an inverse significant relationship of chest expansion (of both upper and lower thoracic) and age ($r= -0.153$, $p<0.030$). Among the female participants, the results shows inverse significant relationship between age, ($r= -0.458$, $p <0.01$); weight ($r=0.145$, $p< 0.029$) and chest expansion.

Variable	Male(n=200)				Female(n=228)				t	p
	Mean ± SD	Median	Minimum	Maximum	Mean ± SD	Median	Minimum	Maximum		
Age (yr.)	41.5 ± 1.4	41.0	20.0	70.0	40.5 ± 1.4	40.0	20.0	70.0	0.694	0.488
Weight (kg)	65.5 ± 7.9	66.0	46.0	86.0	61.8 ± 9.8	62.0	36.0	91.0	7.943	0.000*
Height (m)	1.68 ± 0.1	1.68	1.19	1.88	1.6 ± 0.4	1.63	1.4	1.8	-0.453	0.000*
BMI (kg/m^2)	23.5 ± 3.9	23.4	16.6	56.5	23.6 ± 4.2	23.6	16.0	38.9	3.145	0.651
CEUT (cm)	2.6 ± 1.4	2.3	0.5	7.2	2.2 ± 1.2	2.0	0.2	7.3	4.636	0.002
CELT (cm)	2.3 ± 1.2	2.1	0.3	6.4	1.7 ± 1.1	1.4	0.2	6.5	4.206	0.000*

Table 1: Unpaired t test comparison of general characteristics and chest expansion between male and female participants.

Age	Sex	n	Mean±SD	Minimum	25th percentile	75th percentile	Medium	95th percentile	Maximum
20-29	M	44	3.5 ± 1.6	0.9	2.4	5.0	3.7	6.3	7.2
	F	56	2.9 ± 1.7	0.3	1.6	3.8	2.5	6.3	7.3
	All	100	3.2 ± 1.7	0.3	1.8	4.5	2.9	6.3	7.3
30-39	M	45	2.7 ± 1.2	1.1	1.9	3.3	2.5	5.1	5.1
	F	49	2.0 ± 1.0	0.3	1.1	2.6	2.1	4.0	4.1
	All	94	2.3 ± 1.1	0.3	1.5	2.8	2.3	4.8	5.1
40-49	M	39	2.3 ± 1.1	1.0	1.4	3.4	2.1	4.5	4.8
	F	43	2.3 ± 1.0	1.0	1.3	3.1	2.2	4.3	5.1
	All	82	2.3 ± 1.1	1.0	1.4	3.1	2.2	4.4	5.1
50-59	M	46	2.1 ± 1.2	0.5	1.1	2.9	1.7	5.1	5.4
	F	49	1.8 ± 1.0	0.3	1.1	2.2	1.7	3.9	4.0
	All	95	1.9 ± 1.1	0.3	1.1	2.4	1.7	4.0	5.4
60-70	M	26	2.1 ± 0.7	1.1	1.6	2.8	2.0	3.7	3.9
	F	31	1.7 ± 0.9	0.2	0.8	2.3	1.7	3.6	5.1
	All	57	1.9 ± 0.9	0.2	1.5	2.4	2.0	3.3	5.1
20-70	M	200	2.6 ± 1.4	0.5	1.5	3.5	2.3	5.2	7.2
	F	228	2.2 ± 1.3	0.2	1.3	2.7	2.0	4.9	7.3
	All	428	2.4 ± 1.3	0.2	1.4	3.1	2.1	5.1	7.3

Table 2: Baseline mean and percentile data for chest expansion of upper thoracic (in cm) of all the subjects by age and sex (n=428).

Age	Sex	N	Mean ±SD	Minimum	25th percentile	75th percentile	Medium	95th percentile	Maximum
20-29	M	44	2.6 ± 1.6	0.3	1.3	3.9	2.4	5.6	6.4
	F	56	2.6 ± 1.4	0.3	1.7	3.2	2.5	5.3	6.5
	All	100	2.6± 1.4	0.3	1.4	3.6	2.5	5.2	6.5
30-39	M	45	2.7 ± 1.2	0.5	2.1	3.5	2.8	5.0	5.1
	F	49	1.6 ± 0.7	0.6	1.1	2.2	1.4	3.1	3.2
	All	94	2.1 ± 1.1	0.5	1.3	2.8	2.1	4.0	5.1
40-49	M	39	1.7 ± 0.7	1.0	1.2	2.1	1.5	3.0	3.5
	F	43	1.6 ± 0.8	0.3	0.9	2.5	1.4	2.8	2.8
	All	82	1.6± 0.8	0.3	1.0	2.3	1.5	2.8	3.5
50-59	M	46	1.7 ± 1.0	0.4	1.0	2.5	1.4	3.4	5.1
	F	49	1.4 ± 0.8	0.4	0.7	2.1	1.0	3.2	3.3
	All	95	1.5 ± 0.9	0.4	0.8	2.2	1.2	3.2	5.1
60-70	M	26	2.7 ± 1.1	0.4	1.8	3.5	2.7	5.0	5.1
	F	31	1.1 ± 0.7	0.2	0.6	1.5	1.0	3.0	3.5
	All	57	1.9 ± 1.2	0.2	1.0	2.7	1.5	4.4	5.1
20-70	M	200	2.3 ± 1.2	0.3	1.3	3.0	2.1	4.9	6.4
	F	228	1.7 ± 1.1	0.2	0.9	2.5	1.5	3.6	6.5
	All	428	2.0 ± 1.2	0.2	1.0	2.7	1.7	4.3	6.5

M=male, F= Female.

Table 3: Baseline mean and percentile data for chest expansion of lower thoracic (in cm) of all the subjects by age and sex (n=428).

Discussion

Assessment of chest excursion is critical during cardiopulmonary rehabilitation. It provides the patient's initial limitations and also useful in monitoring improvement during rehabilitation. This study established the age and sex reference values for chest expansion among African population and as well investigated the relationship of anthropometry with chest expansion.

The average chest expansion scores for all the age groups are lower than the previous studies among the whites [2] but similar to that reported among the Thais [9]. In our previous study we found lung

Male participants						
Age	1.00	0.251 0.000*	-0.174 0.014*	0.255 0.000*	-0.370 0.000*	-0.153 0.030*
Weight		1.00	0.115 0.105	0.680 0.000*	-0.105 0.137	-0.84 0.236
Height			1.00	-0.613 0.000	0.036 0.611	0.85 0.230
BMI				1.00	-0.065 0.361	-0.117 0.098
CEUT					1.00	0.414 0.000*
CELT						1.00
Female participants						
Age	1.00	0.159 0.016*	-0.144 0.030*	0.221 0.001*	-0.319 0.000*	-0.458 0.000*
Weight		1.00	0.218 0.001*	0.854 0.000*	-0.144 0.030*	-0.145 0.029*
Height			1.00	-0.314 0.000*	0.002 0.977	0.121 0.069
BMI				1.00	-0.141 0.033*	-0.197 0.003*
CEUT					1.00	0.364 0.000*
CELT						1.00

BMI =body mass index; CEUT=chest expansion of upper thoracic; CELT=chest expansion of lower thoracic. *p<0.05

Table 4: Relationship between chest expansion and age, weight, height and body mass index (BMI).

function of the whites to be higher than that of the African-Americans and Nigerians [6]. The reason for the difference in lung function among the races is unclear. However, low socioecomic factors, low birth weight and occupational exposure are predisposing factors for low lung function in Africa [10,11] .

The reduced chest excursion recorded in this study may account for the low lung function observed among the people of Africa. Previous studies reported directly significant relationship between chest expansion and lung function. Chanavirut et al. reported direct relationship between lung function and chest expansion. Their study suggests that short-term Yoga exercise improves respiratory breathing capacity by increasing chest wall expansion and forced expiratory lung volumes [9]. In a study by Fisher et al. among subjects with Ankylosing spondylitis, correlating measurements of chest expansion, spinal flexibility, vital capacity, and exercise tolerance, they found a significant association between chest expansion and vital capacity [12]. Their study thereby supports the clinical value of measuring thoracic excursion during patient management.

Our study use tape measurement which is simple and cheap, to measure chest expansion, its main limitations are that measurement sites have not been standardized, information on the symmetry of motion is not possible, and measurements at different sites are not made simultaneously. The study of Bockenhauer et al. has confirmed that the tape-measure method of measuring thoracic excursion at two levels could be reliable and useful in a clinical setting [2]. Although modern measurement instruments for measuring chest expansion exits such as Respiratory Movement Measuring Instrument, Opto-electronic plethysmography, and video systems for movement measuring, they are not readily available in this part of the world, are expensive, and may need expert handling.

Nevertheless, our study has provided the preliminary baseline for the chest excursion measurements obtained from subjects of African without impairments.

References

1. Kirilloff LH, Owens GR, Rogers RM, Mazzocco MC (1985) Does chest physical therapy work? Chest 88: 436-444.
2. Bockenhauer SE, Chen H, Julliard KN, Weedon J (2007) Measuring thoracic excursion: reliability of the cloth tape measure technique. J Am Osteopath Assoc 107: 191-196.
3. Sharma J, Hideaki S, William L (2003) Comparison of Chest Expansion Measurement in Clients with Ankylosing Spondylitis and Healthy Individuals. J Phys Ther Sci 15: 47-51.
4. Sahin G, Calikoglu M, Ozge C, Incel N, Bicer A, et al. (2004) Respiratory muscle strength but not BASFI scores relates to diminished chest expansion in ankylosing spondylitis. Clinical Rheumatology 23: 199-202.
5. Malaguti C, Rondelli RR, de Souza LM, Domingues M, Dal Corso S (2009) Reliability of chest wall mobility and its correlation with pulmonary function in patients with chronic obstructive pulmonary disease. Respiratory Care 54: 1703-1711.
6. Lapier TK, Cook A, Droege K, Oliverson R (2000) Intertester and Intratester reliablity of chest excursion measurement in subjects without impairment. Cardiopulmonary Phys Ther. 3: 94-98.
7. Adedoyin RA, Erhabor GE, Olajide A, Anifowose OJ (2010) Influence of self-reportedsocio-economic status on lung function of adult Nigerians. Physiotherapy 96: 191-197.
8. Moll J.M.H, Wright V (1972) An objective clinical study of chest expansion of chest expansion. Ann Rheum Dis 31: 1-8.
9. Chanavirut R, Khaidjapho K, Jaree P, Pongnaratorn P (2006) Yoga exercise increases chest wall expansion and lung volumes in healthy thais. Thai journal of physiological sciences 19: 1-7.
10. Ige OM, Onadeko BO (2000) Respiratory symptoms and ventilatory function of the sawmillers in Ibadan, Nigeria. Afri J Med Sci 29: 101-104.
11. Ijadunola KT, Erhabor GE. Onayade AA, Ijadunola MY, Fatusi AO, et al. (2005) Pulmonary functions of wheat flour mill workers and controls in Ibadan. Am J Ind Med 48: 308-317.
12. Fisher LR, Cawley MI, Holgate ST (1990) Relation between chest expansion, pulmonary function, and exercise tolerance in patients with ankylosing spondylitis. Ann Rheum Dis 49: 921-925.