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# The Chest Expansion Values among Adult Healthy Iraqi People

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## Abstract

**Background:** the measurements of chest expansion are performed to appreciate a patient's treatment efficacy, standard status, and evolution of disease in relation to respiratory muscle function and chest wall mobility .

**Methods:** In this study random collection of 1020 persons (530 male and 490 female) aged between 20 to 70 years old from Baghdad and Al-Najaf city, Participants have no history of orthopedic, neurological, rheumatologic or respiratory diseases , the smokers were excluded from this study. The chest expansion measured in 2 sites, the first site is the upper thoracic excursion, at the level of the fifth thoracic spinous process and the third intercostal space at the mid clavicular line.

The second site is 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 by using tape measure.

**Results:** The men group shows a significant larger chest expansion than women group in upper thorax ( $5\pm0.6\text{cm}$ ,  $4.2\pm0.7\text{cm}$ ) for men and women respectively and at the chest expansion in the lower thorax ( $4.5\pm0.6\text{cm}$ ,  $3.7\pm0.6\text{cm}$ ) for men and women respectively ( $p < 0.05$ ). Chest expansion of men and women groups at the upper and lower thorax is highest at ages 20-29 year and declines thereafter with older ages. In women group, chest expansion was considerably correlated with BMI, which is decreased in the obese female.

**Conclusion:** Chest expansion in the upper and lower thorax rise with age upsurgers until the fortieth years of life, Men group have chest expansion larger than women group.

**Keywords:** Chest Expansion, Adult Healthy

## الخلاصة

**الخلفية:** تتم القياسات لتوسيع الصدر لتقدير فعالية علاج المريض وحالة القياسية وتطور المرض فيما يتعلق بالتقلل جدار الصدر ووظيفة العضلات التنفسية.

**الأساليب:** في هذه الدراسة مجموعة عشوائية من الأشخاص ١٠٢٠ (٥٣٠ الذكور، ٤٩٠ الإناث) الذين تتراوح أعمارهم بين ٢٠ إلى ٧٠ عاماً من مدينة بغداد والنجف، المشاركين لا تاريخ من أمراض العظام والجهاز العصبي والروماتيزم أو الجهاز التنفسي، استبعدت المدخنين من هذه الدراسة. توسع الصدر المقاسة في المواقع ٢، هو أول موقع الرحلة الصدر العلوي، على مستوى العملية الشائكة الخامس الصدري والفضاء ضلعيه الثالثة في منتصف السطر العضدي. الموقع الثاني هو رحلة الصدري السفلي، ووضع شريط قياس على مستوى العملية الشائكة الصدرية العاشرة ونصيحة عملية الرهاية بواسطة استخدام شريط قياس.

**النتائج:** مجموعة الرجال يظهر توسع ملحوظ في صدر أكبر من مجموعة النساء في أعلى الصدر ( $5\pm0.6\text{سم}$ ،  $4.2\pm0.7\text{سم}$ ) للرجال والنساء على التوالي، وفي توسع الصدر في الصدر السفلي ( $4.5\pm0.6\text{سم}$ ،  $3.7\pm0.6\text{سم}$ ) للرجال والنساء على التوالي ( $p < 0.05$ ). توسع الصدر مجموعات الرجال والنساء في الصدر العلوية والسفلية هو أعلى في سن ٢٠-٢٩ سنة، وينخفض بعد ذلك مع كبار السن. في مجموعة نساء، توسع الصدر كان يرتبط ارتباطاً كبيراً مع مؤشر كتلة الجسم، الذي انخفض في الإناث يعانون من السمنة.

**الاستنتاج:** الصدر يرتفع التوسع في الصدر العلوي والسفلي مع يؤججه العمر حتى السنوات الأربعين من العمر ومجموعة الرجال قد توسع الصدر أكبر من مجموعة النساء.

**الكلمات المفتاحية:** توسيع الصدر، بالغ صحي

## Introduction

### Definition

The measurements of chest expansion are performed to appreciate a patient's treatment efficacy, standard status, and evolution of disease in relation to respiratory muscle function and chest wall mobility (Adedoyin *et al.*, 2012).

### Physiology of Chest Wall Mobility

During respiration, the motion of the lung outer layer in relation to the rib cage is assisted by sliding touching base between the visceral and parietal pleura, which shield the lung and inner layer of the chest wall respectively, and are normally in close separation. Inspiration comprises the downhill and the uphill movement of the diaphragm, the outer movement of the ribs, brought about retrenchment of the external intercostal muscles. Expiration is generally inactive, compelled eventually by elastic withdrawal of the lung (Reid and Innes, 2014).

Impairment or disease relates to ineffective chest wall movement are listed below: (Donrawee, 2012).

1. Kyphosis or Scoliosis (Leonget *et al.*, 1999).
2. Ankylosing spondylitis or Osteoporosis (Neillet *et al.*, 2005).
3. Nerve injury (Baydur *et al.*, 2001).
4. Scleroderma, multiple sclerosis etc. (Woo *et al.*, 2007).
5. Chest pain or myofascial pain (Wiseet *et al.*, 1992).
6. Post thoracic surgery (Macciarini *et al.*, 1999).
7. Long term use of mechanical ventilator (Gillespie *et al.*, 1985).
8. Pneumonia or chronic lung disease (Hoare and Lim, 2006).
9. Long term bed rest (Suesada *et al.*, 2007) or aging (Chaunchaiyakul *et al.*, 2004).
10. Other causes; posture, diaphragm dysfunction and pain (Vibekk, 1991).

The study aims:

1. Knowing the basic information about normal range of chest expansion measures among healthy Iraqis.
2. Knowing the variation of the chest expansion among Iraqi population in relation with age, body built and sex.

### Patients and methods

Study design: cross-sectional study. This study was conducted among healthy adult people of both sexes, in the period from first of July 2014 to 31<sup>st</sup> of March 2015 in Baghdad city & Al-Najaf city.

### The Inclusion Criteria:

Participants have no history of orthopedic, neurological, rheumatologic or respiratory diseases, the smokers were excluded from this study.

### Study Instruments:

The procedure was described to the participants before the application of the procedure. Anthropometric estimations were taken with volunteers' wearisome light clothes, and without shoes. Weight was calculated by means of a handy weighing measure to the nearby 0.1kg and stature was calculated by using a stadiometer to the nearby 0.1 cm. Gender and age of the participants were reported. The volunteers' chest expansion might have been taken to erect position, for those legs 5cm separated what's more arms raised. The arms at those sides with the shoulder abducted, the elbow prepared in semi flexion, the wrist extended, the thumb abducted, the web of the middle thumb and the 1st finger putted on the level of the iliac crest. Chest expansion measured at chest

boundary in the completion of deep inspiration minus chest boundary in the completion of deep expiration. Two measures starting with inelastic tapes around the chest. The mean of these two measures were reported. For the upper part of the chest, the tape measure was placed at the third of the intercostal space at the midclavicular line and for the lower part of the chest, the tape measure was placed at the tip of the xiphoid process. Estimations were reported at the peak of deep breathing and exhalation and significant consideration might have been exercise not with draw the tape excessively firmly same time settling on the estimations.

**Data Analysis:** This study is cross-sectional evidence - based and descriptive, the statistical analysis was used in this study in addition to the use of statistical analysis package for Social Science-version 22 (SPSS V.22) for data input and analysis, where p-value of  $\leq 0.05$  was significant.

## Results

The total number of volunteers were (1020); 530 are males (52%) and 490 are females (48%) as shown in Figure 3.1, the mean of age for male was  $35.26 \pm 12.08$  and median was 34y and the mean of age for female was  $36.49 \pm 13.76$  and median was 34y, the range of both male and female was 50 (20 -70 years old) as shown in table 3.1.

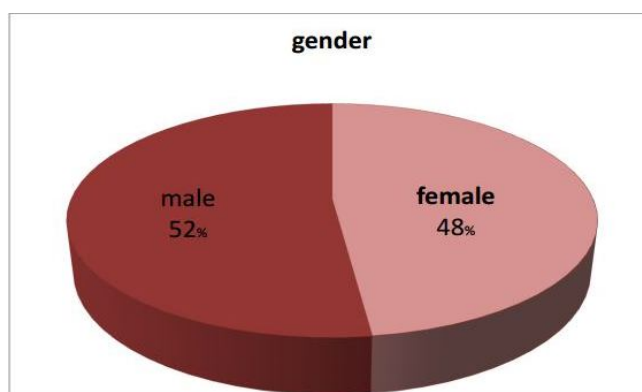


Figure 3.1: distribution of patients according to gender

The mean for the chest expansion in the upper thorax for male is ( $5.072 \pm 0.691$  SD) while in lower thorax ( $4.524 \pm 0.648$  SD), while the mean for the chest expansion in upper thorax for female was ( $4.239 \pm 0.733$  SD) and in lower thorax ( $3.727 \pm 0.660$  SD) as it is shown in table (1):

**Table 3.1: comparison of upper & lower chest expansion between male and female participants**

Variable	Male(n=530)				Female(n=490)			
	Mean $\pm$ SD	Median	Min.	Max.	Mean $\pm$ SD	Median	Min.	Max.
Age (years)	35.26 $\pm$ 12.08	34.0	20	70	36.49 $\pm$ 13.76	34.0	20	70
CEUT (cm)	5.072 $\pm$ 0.6	5.0	3.0	6.0	4.239 $\pm$ 0.7	4.1	3.0	5.1
CELT (cm)	4.524 $\pm$ 0.6	4.5	2.9	5.5	3.727 $\pm$ 0.6	3.6	2.5	4.7
❖ CEUT mean chest expansion of upper thorax								
❖ CELT mean chest expansion of lower thorax								
❖ P value < 0.05 (significant )								

All these patients age ranged from (20–70) years old. (38.6%) of them are ages between 20-29 years (as it is shown in table 3.2), and their body mass index (BMI) ranged mainly between normal body weight (37.3%) and over weight (38%) (as it is shown in table 3.3).

The chest expansion measurements in upper thorax for males range between 3-6 cm (see figure 3.2), 214 of them 40.4% were measured in 5 cm (See table 3.4), while the measurement for the lower thorax are between 2.9-5.5 cm (see figure 3.3), 63 of them 11.9% are measured in 4.5 cm (See table 3.4).

For females, the range for upper chest expansion is between 3 -5.1 cm (see figure 3.4), 194 of them 39.6% are measured in 5cm (See table 3.5).the range for lower thorax is between 2.5- 4.7cm (see figure 3.5), 85 of them 17.3% is measured in 4.4cm (See table 3.5).

**Table 3.2: distribution of patients according to age groups**

Age groups	male	female	total
20-29	210	184	394 (38.6%)
30-39	157	151	308 (30.1%)
40-49	108	75	183 (17.9%)
50-59	26	26	52 (5.1%)
60-70	29	54	83 (8.1%)
total	530	490	1020

**Table 3.3: distribution of patients according to BMI**

BMI	male	female	total
< 18.5	20	46	66 (6.4%)
18.5-24.9	166	215	381 (37.3%)
25-29.9	270	118	388 (38%)
>30	74	111	185 (18.1%)
total	530	490	1020

In the third decade of life (20-29), the chest expansion in the lower thorax in (49 out of 210) male subjects is 5.3 cm and this value decrease to (3.5)cm when the age ranges go up (60-70) this is the case of 21 subjects out of the total 29. In other hand, there are 84 out of 184 female whose chest expansion measurement in the upper thorax were 4.4 cm in age group (20-29) this value decreases to 2.5 with the increase in the ranges of age (60-70). This is the case of 23 out of 54 female subjects.

In the three groups (underweight, over weight & obese) of male, the measurements of chest expansion of upper thorax were 5 cm while in normal population was 6 cm. In female, three groups (underweight, normal & over weight) the measurements of chest expansion of upper thorax were 5 cm while in obese population was 4 cm. In the three groups (underweight, over weight & obese) of male, the values of chest expansion of lower thorax ranged between (4.4 -4.5) cm while in normal population was 5.3 cm. In female, two groups (underweight & normal) the measurements of chest expansion of lower thorax were 4.4 cm while in obese population was 3 cm.

**Table 3.4: frequencies of the chest expansion of upper & lower thorax for male**

Chest expansion	chest expansion of upper thorax male			chest expansion of lower thorax male		
	Frequency	Percent	Cumulative Percent	Frequency	Percent	Cumulative Percent
2.9	0	0	0	1	.2	.2
3.0	1	.2	.2	0	0	0
3.3	0	0	0	3	.6	.8
3.5	0	0	0	56	10.6	11.3
3.6	0	0	0	39	7.4	18.7
3.7	0	0	0	1	.2	18.9
3.9	0	0	0	1	.2	19.1
4.0	97	18.3	18.5	24	4.5	23.6
4.1	3	.6	19.1	4	.8	24.3
4.2	0	0	0	37	7.0	31.3
4.3	0	0	0	21	4.0	35.3
4.4	8	1.5	20.6	52	9.8	45.1
4.5	11	2.1	22.6	63	11.9	57.0
4.6	5	.9	23.6	28	5.3	62.3
4.7	6	1.1	24.7	36	6.8	69.1
4.8	2	.4	25.1	2	.4	69.4
5.0	214	40.4	65.5	14	2.6	72.1
5.1	8	1.5	67.0	8	1.5	73.6
5.2	13	2.5	69.4	15	2.8	76.4
5.3	1	.2	69.6	50	9.4	85.8
5.4	0	0	0	35	6.6	92.5
5.5	12	2.3	71.9	40	7.5	100.0
5.6	1	.2	72.1	0	0	0
5.7	8	1.5	73.6	0	0	0
5.8	1	.2	73.8	0	0	0
5.9	13	2.5	76.2	0	0	0
6.0	126	23.8	100.0	0	0	0
Total	530	100.0		530	100.0	

**Table 3.5: frequencies of the chest expansion of upper & lower****thorax for female**

Chest expansion	chest expansion of upper thorax female			chest expansion of lower thorax female		
	Frequency	Percent	Cumulative Percent	Frequency	Percent	Cumulative Percent
2.5	0	0	0	23	4.7	4.7
2.7	0	0	0	2	.4	5.1
2.8	0	0	0	10	2.0	7.1
2.9	0	0	0	13	2.7	9.8
3.0	45	9.2	9.2	82	16.7	26.5
3.1	2	.4	9.6	7	1.4	28.0
3.2	8	1.6	11.2	11	2.2	30.2
3.3	11	2.2	13.5	18	3.7	33.9
3.4	26	5.3	18.8	25	5.1	39.0
3.5	43	8.8	27.6	45	9.2	48.2
3.6	9	1.8	29.4	13	2.7	50.8
3.7	10	2.0	31.4	11	2.2	53.1
3.8	0	0	0	1	.2	53.3
3.9	1	.2	31.6	0	0	0
4.0	88	18.0	49.6	24	4.9	58.2
4.1	3	.6	50.2	0	0	0
4.2	5	1.0	51.2	7	1.4	59.6
4.3	10	2.0	53.3	47	9.6	69.2
4.4	0	0	0	85	17.3	86.5
4.5	9	1.8	55.1	39	8.0	94.5
4.6	15	3.1	58.2	26	5.3	99.8
4.7	1	.2	58.4	1	.2	100.0
4.8	1	.2	58.6	0	0	0
4.9	8	1.6	60.2	0	0	0
5.0	194	39.6	99.8	0	0	0
5.1	1	.2	100.0	0	0	0
Total	490	100.0		490	100.0	

## Discussion

No information is accessible regarding the typical extent of chest expansion of adult Iraqi individuals. the calculation of chest expansion is serious and significant during the cardiopulmonary rehabilitation and it is helpful in checking change in rehabilitation. So this study is expected to be valuable as it measures the variety of the chest expansion among Iraqi people and it examine the relationship between the chest expansion and sex, age and body built. In this ponder, the mean for the chest expansion in upper thorax for male was (5.072 $\pm$ 0.6 SD) and it is in lower thorax (4.524 $\pm$ 0.6 SD), while the mean for the chest expansion in upper thorax for female was (4.239 $\pm$ 0.7 SD) and it is in lower thorax (3.727 $\pm$ 0.6 SD), these findings are comparable to that reported findings among the white peoples (Bockenbauer *et al.*,2007), But they are higher than those recorded for Nigerian people (Benjamin *et al.*,2015),and higher than those recorded for the Thais (Chanavirut *et al.*,2006) .The reason for the distinction in lung expansion among the races is indistinct. Nonetheless, low birth weight,occupational exposure, and

low socioeconomic factors are predisposing factors for low lung expansion in Africa (Ige OM and Onadeko BO, 2000; Ijadunola *et al.*, 2005). In previous study by Fisher *et al.* for patients suffered from Ankylosing spondylitis, the findings of vital capacity, chest expansion, exercise tolerance and spinal flexibility, report important correlation between vital capacity and chest expansion, this ponder upkeep the clinical outcome of evaluating chest expansion during patient supervision (Fisher *et al.*, 1990). Our review utilize tape estimation which is basic and modest, to gauge chest expansion, Bockenhauer *et al.* (2007) found that the tape-measure procedure of calculating chest expansion at two sides could be dependable and suitable in an experimental setting. The result of our study shows that men have significantly greater chest expansion of the upper and lower chest than women and the men having greater expansion than women all over the age group, this finding is similar to those mentioned in (Adedoyin *et al.*, 2012) study the results in our study are the same results to (Chaunчайyakul *et al.*, 2004) study the chest expansion declines with older ages because of the decline in the elastic recoil of the chest wall (Benjamin *et al.*, 2015). In this study, the overweight and obese males had the chest expansion less than that in the normal weight or underweight. In females, the obese have the lowest values; because of the influence of increase of body built on lung function and vital capacity, both have a significant effect on chest expansion (Fisher *et al.*, 1990).

## **Conclusion**

1. In our study, the mean of chest expansion for male is about 5 cm ranged between (3-6) cm and for female is about 4.2 cm ranged between (3-5.1) cm.
2. There is noteworthy relationship between mean of chest expansion and age processing.
3. There is noteworthy relationship between mean of chest expansion and body built.

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