

Evaluation of Cardiothoracic Ratio of Normal Subjects in Al madinah Al Munawwara Using Chest Radiographs

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The aim of this study was to establish normal constant value for cardiothoracic ratio among Saudi people in Almadinah Almunawwarah. The cardiothoracic ratio of 66 male and 43 female aged between 6 to 83 years old were estimated from the transverse diameters of heart and thorax respectively using posteroanterior normal chest radiographs. The study was conducted at King Fahd Hospital in Radiology Department from the period of January to March 2014. The mean and standard deviation of cardiothoracic ratio, transverse cardiac diameter and transverse thoracic diameter were established. The mean values for cardiothoracic ratio for both males and females were 0.54 and 0.47 respectively and both showed highly significant difference. Conclusion: the cardiothoracic ratio of Saudi people is approximately similar to that of Africa(Nigerian).

Keywords: Evaluation, cardiothoracic ratio, Almadinah Almunawwarah, Normal Subjects, Radiographs.

Introduction:

The cardiothoracic ratio (CTR) is the ratio of the cardiac diameter (CD) to the thoracic diameter (TD) . It is a useful screening method to detect cardiomegaly. The importance of this study is to estimate the CTR among healthy population in order to establish a constant range or value which could be useful to detect enlargement of the heart.

The CTR is usually estimated from chest radiographs which taken from postero-anterior(PA) views which shows the shadows of the heart, lungs airway passages, blood vessels, thoracic vertebrae and wall of the chest.

The evaluation of heart size with the use of chest of chest radiographic images has been widely reported. Easy availability, affordability and simple nature of these means of assessing cardiac size have made it the most common methods despite improved imaging technology(Tatsu JIK et al, 1992, Obikili and Okoye, 2007) .

Posterior chest x-ray images used in in the detection of cardiomegaly and evaluation of CTR is regarded as an important method of cardiac size assessment (Danzer,1919). It also has the advantages of simple technical operation, availability of equipment particularly in the developing country.

The CTR is affected by factors such as age, phase of respiration, body posture, physique, attitude and race. (Kerwin ,1944) Ashcroft and Mial in 1969 noted a higher CRT in Blacks than Whites.

The aim of this study was to establish normal constant value for cardiothoracic ratio among Saudi people in Almadinah Almunawwarah.

Materiala and methods:

This is a retrospective study deals with the estimation of normal cardiothoracic ratio among normal individuals at Al madinah Almunawwarah. The study was conducted at King Fahd Hospital from the period of January to March 2014. The study uses digital radiography and the measurement was performed from postero-anterior (PA) erect chest radiographs taken under perfect condition.

The radiographs taken with the following technical imaging factors: 1- focal film distance(FFD) = 72 inches

2- Focal object distance(FOD) = 100 cm

3- Grid with bucky was used with exposure factors adjusted such: 70- 100 kilovoltage(Kv), 10 to 18 mill ampere seconds(mAs).

4- The patient is erect and the exposure is made at the end of full inspiration.

The radiographs were reported and CTR was measured by expert Radiologists on PACS from Agfa HealthCare. All the images were normal without cardiac or pulmonary lesions seen.

The study sample was 109 cases selected randomly. The cardiac diameter is measured at the widest distance across the heart shadow and the thoracic diameter was estimated from the widest distance from inner wall of the chest transversely to the inner point of the other side. Ratio was calculated by tools in the PACS.

Results:

The consists of 66 male and 43 female. Table (1) showed the means of the measured parameters of the study variables which were CTR= 0.46 , this is approximately similar to the literature. Transverse cardiac diameter(TCD)= 12.04, transverse thoracic diameter(TTD)= 26.27. Table (2) showed one sample T-test to compare the mean of CTR to the mean of the maximum one of the literature and there was highly significant difference(p-value=0.000).Table(3) revealed Pearson correlation of age with parameters of the study(CTR, TCD and TTD). Correlation was highly significant and positive between age and TTD and TCD($r = .55$, $r = 0.44$), p-values= 0.000

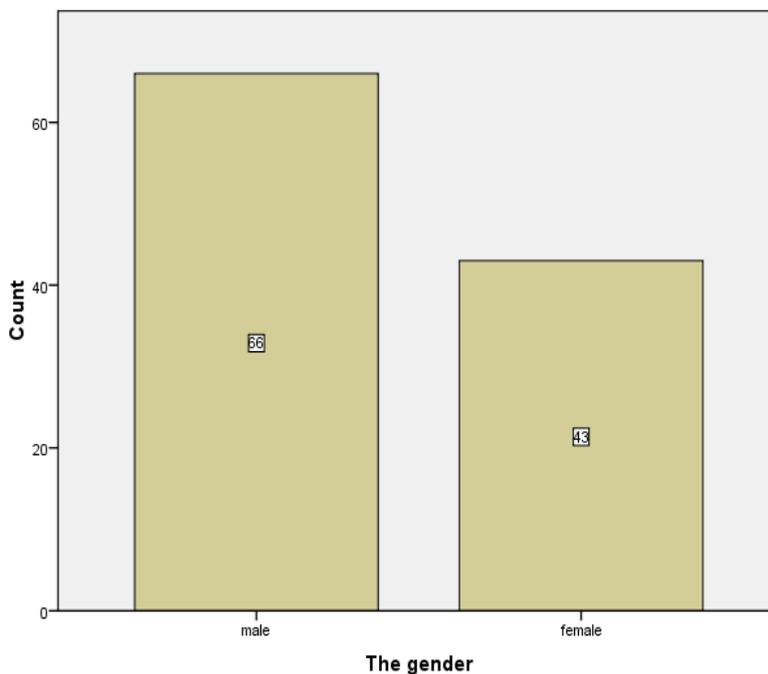
Table 4,5,6,7,8 and 9 revealed the difference between male and female as compared together with the measured parameters. Male and female were significantly different in CTR(p-value=0.009) and they were also different in TTD

Table(10) showed comparison between previous studies with our current studies. The CTR of Saudi Arabian population in Al madinah is approximatetly similar to the CTR of Nigerian people.

Table (1) shows descriptive statistic of CTR, TCD and TD

	N	Minimum	Maximum	Mean	Std. Deviation
Transverse thoracic diameter	109	16.66	31.84	26.275	2.924
Transverse Cardiac Diameter	109	8.03	15.72	12.039	1.436
Cardiothoracic Ratio	109	.39	0.54	0.460	0.039
Valid N (listwise)	109				

CTR: cardiothoracic ratio TCD: Transverse cardiac diameter TTD: Transverse Thoracic Diameter



Figure(1) shows distribution of male and female of study population

Table (2): shows the mean of CTR as compared with the universal one using One-Sample Test

	Test Value= 0.50			95% confidence interval of the difference	
	Degree of freedom	Sig.(2-tailed)	Mean difference	Lower	Upper
Cardiothoracic ratio	108	0.000	-0.03972	-0.0471	-0.032

Table (3) Descriptive Statistical Data, Pearson’s Correlation and Test of Significance for the Correlation of Age with CTR, transverse cardiac diameter and transverse thoracic diameter.

Parameters	Sample size	Mean (cm)	St.Deviation	r-value	Type of correlation	p-value	Inference
Cardiothoracic ratio	109	0.4603	0.0391	.173	+ve	0.072	Insignificant
Transverse Cardiac diameter	109	12.0394	1.436	.551	+ve	0.000	Highly significance
Transverse Thoracic diameter	109	26.2745	2.924	.442	+ve	0.000	Highly significance

Table(4) shows comparison between male and female with CTR

Group Statistics

	The gender	N	Mean	Std. Deviation	Std. Error Mean
Cardiothoracic Ratio	male	66	0.452	0.038	0.005
	female	43	0.472	.0382	0.006

N= total number

Table(5): Independent sample test to compare between male and female with cardiothoracic ratio

	Test of Levenes for equality of Variances		t-test of equality of means	
	F	Sig.	Sig.(2-tailed)	Mean difference
Cardiothoracic Ratio				
Equal variances assumed				
	0.012	0.914	0.009	0.007

Table (6) : shows comparison between male and female with transverse cardiac diameter

Group Statistics

	The gender	N	Mean	Std. Deviation	Std. Error Mean
Transverse Cardiac Diameter	male	66	12.151	1.517	.187
	female	43	11.869	1.302	.199

Table(7) shows significance between male and female at transverse cardiac diameter using Independent sample T-test

	Test of Levenes for equality of Variances		t-test of equality of means	
	F	Sig.	Sig.(2-tailed)	Mean difference
Transverse cardiac diameter Equal variances assumed				
	1.007	0.318	0.319	0.282

Table (8): shows comparison between male and female with transverse thoracic diameter

Group Statistics

	The gender	N	Mean	Std. Deviation	Std. Error Mean
Transverse thoracic diameter	male	66	26.996	2.807	.345
	female	43	25.1674	2.779	.424

Male thoracic diameter is higher than female

Table (9) shows significance between male and female at transverse thoracic diameter using Independent sample T-test

	Test of Levenes for equality of Variances		t-test of equality of means	
	F	Sig.	Sig.(2-tailed)	Mean difference
Transverse thoracic diameter Equal variances assumed				
	0.126	0.724	0.001	1.828

Table (10) Summary of Cardiothoracic ratio in present and previous studies

Authors	Country	Mean of CTR
Oladip et al(2012)	Nigeria	0.46± 0.040
Yousef et al(2014)	Sudan	0.42± 0.029
Present study	Saudi Arabia	0.46± 0.039

Discussion:

The cardiothoracic ratio (CTR) has been considered as a classic index of cardiac function (Tatsu et al,1996) However, its value has been questioned because echocardiography, radionuclide imaging, angiography, computed tomography (CT), and magnetic resonance imaging can provide more precise information about cardiac function (Obikili, and Okoye,2004 , Danzer ,1919). Nevertheless, clinicians continue to use the CTR because a quick decision is required under urgent situations, especially in

the emergency department (ED) or intensive care unit (ICU). Daily follow-up of chest radiography is still recommended in the ICU(Kerwin,1944) New information favoring CTR also has been being reported. CTR is calculated by dividing the cardiac diameter (CD) by the thoracic diameter (TD) as measured on posteroanterior chest radiography (chest PA)(Ashcrof and Mail, 1969)

The evaluation of CTR with the use of postero-anterior chest radiographs had been widely reported. The study population of the study composed of 66 male and 43 females(figure1).

In this study the mean values of cardiothoracic ratio(CTR), transverse cardiac diameter(TCD) and transverse thoracic diameter(TTD) were 0.46 ± 0.039 , 12.04 ± 1.44 , 26.27 ± 2.92 respectively. The overall mean value of CTR in this study was 0.46 and this is similar to the mean CTR of 0.46 estimated by Danzer in 1919. It was also approximately similar to a CTR value calculated by Oladip et al and it was 0.469 at Nigerian population (Oladip et al, 2012).In this study, the mean value of CTR is approximately similar to the CTR of Nigerian population.

Various studies reported that the maximum mean diameter value of CTR was 0.50, but in our study we find that the CTR was highly significant different from 0.50(p -value =0.000) as shown on table (2). In this study there was a positive correlation between age of population and CTR, also it is a weak correlation($r=17$) and was not significant(p -value = 0.07) but it means that increasing the age will increase the CTR since it was a positive correlation. This result is consistent with a study done by Yousef et al in 2014 who found the correlation between age and CTR($r = 0.379$) and it was a positive correlation.

The study confirmed that there was a high significant correlation between cardiac diameter and age of population (p -value= 0.00) with a positive correlation($r= 0.55$). So,cardiac diameter increases with increasing age. This result is consistent with earlier studies(Omerman et al,1967) The confirmed that the transverse cardiac diameter of male is slightly higher than female($12.15 > 11.87$) but was not significant difference(p -value = 0.319 which is > 0.05).

The transverse thoracic diameter showed high significant correlation with the age(p -value=0.00), also it is a weak correlation($r=0.44$) but it was positive(table3), that means thoracic diameter increases with increasing age.

In this study, the CTR of female was higher than male ($0.47 > 0.45$) as shown on table(4), there was significant difference ($p\text{-value} = 0.009$ which is < 0.05), that means CTR of female is different from CTR of male. This finding corresponds to the findings of Obikili and Okoye and Anyanwu et al in 2006 . Higher values of CTR were recorded for different black population.(Anyanwu, et al, 2006,(Obikili et al,2010, and Cowen,1964).

In this study, the transverse thoracic diameter of male was higher than female ($26.99 > 25.17$) with significant difference ($p\text{-value} = 0.001$). This finding is consistent with earlier studies (Omerman et al,1967,Amundsen, 1959,Inoue et al,1999,Sorkin et al, 1999).

Sexual variation in transverse cardiac diameter could be attributed to differences in morphology(body size) and levels of physical activities between genders (Zdansky ,1965). Gender, age, body size, race and ethnicity are other factors attributed to affect the TCD and CTR.(Zdansky ,1965, Nickol and Wade ,1982, Walker , 1985,Patrick, Boyd 1986).

Conclusion:

The main results of this study have conclusively established the CTR of Saudi population in Almadinah Almunawwarah. There was significant difference between male and female at their measured parameters(cardiothoracic ratio, transverse cardiac diameter and transverse thoracic diameter. The CTR of female is higher than male, the transverse thoracic diameter of male is higher than female. The transverse cardiac diameter of male is slightly higher than female. There were significant correlation between age and CTR in both gender and also with the transverse thoracic diameter. As age increases, both CTR and transverse thoracic diameter will increase respectively.

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