CORRELATION OF HEART DIAMETER AND CARDIO-THORACIC RATIO WITH BODY HABITUS FOR EVALUATION OF CARDIAC ENLARGEMENT IN A POPULATION OF BANKURA DISTRICT OF WEST BENGAL: A CROSS SECTIONAL STUDY
Dhruba Mandal¹, Abhijit Ray², Panchanan Kundu³

ABSTRACT: CONTEXT BACKGROUND: Cardiac enlargement may give the first indication of some of the cardiac diseases in man. In rural areas, where sophisticated investigating tools are not available or beyond the reach of common poor people, the cardiac enlargement can be evaluated by routine chest X-ray by the maximum transverse diameter of the heart (HD) and the cardio-thoracic ratio (CTR). The standard text books denote that the HD 15.5cms, cardio-thoracic ratio (CTR) 0.5 in Chest X-ray (PA view), are the upper limits of normal. These studies are mainly based on European population. As the heart diameter and CTR depends on TD of chest and this may vary in different body habitus of different racial groups. So to note any significant relationship expects to occur between HD and CTR with body habitus like height, weight, body mass index (BMI), body surface areas (BSA) so that we can find any significant relationship between HD and CTR with different parameters of body habitus and also to find out between HD and CTR which is least affected by the variations of the parameters of body habitus.

SETTING: Sub-divisional Hospital, Bishnupiu and Chhatna, Bankura, West Bengal.

DURATION OF STUDY: Three years.

METHOD: 850 people meeting the deserved criteria are chosen. Chest x-rays are taken. Body weight and body height are measured. We calculate the TD, CTR, BMI and BSA from the measured data.

STATISTICAL ANALYSIS: From this data we statistically calculate the correlation coefficient of the HD and CTR with the different parameters of the body habitus.

RESULT: Our study reveals that there is strong correlation of weight, height, BMI and BSA with Heart Diameter (HD) and poor correlation of the above parameters with CTR.

CONCLUSION: So we can conclude that Cardio-thoracic ratio is less affected by the body habitus changes as mentioned above; so CTR is better indicator in predicting cardiac enlargement than HD in routine x-rays.

KEYWORDS: Chest X-ray, Transverse Thoracic Diameter (TD), Heart Diameter (HD), Cardio-thoracic ratio (CTR), Body habitus, cardiac enlargement.

INTRODUCTION: Despite the invention of newer imaging techniques like computerized tomography scan (CT scan) or Magnetic Resonance Imaging (MRI) available to modern clinicians, the chest x-ray remains a simple, easy and inexpensive and good informative tool for evaluation of transverse thoracic diameter (TD), maximum heart diameter (HD) and Cardio-thoracic ratio (CTR), which can give fairly accurate idea of heart size.

An enlarged heart may or may not be indicative of underlying cardiac disease; other way round a normal sized heart does not guarantee the absence of cardiac disease. But still then an enlarged heart in respect of age, sex and body habitus may give the first hint of underlying cardiac...
Heart size in the absence of concurrent skeletal or chest deformity or underlying lung disease is assumed to be related to the habitus of the patient. Results of previous research papers depict the racial differences as a function of body habitus. Several studies also show the variation of heart size in different racial groups.

The cardiac enlargement can be evaluated by maximum transverse diameter of the heart and the cardio-thoracic ratio. In rural areas, where CT scan and MRI are not available, conventional x-ray which is available in most of the centers is the important first hand investigating procedure for evaluation of HD and CTR. The standard text books denote that HD > 15.5 cm. and CTR 0.5 in P. A. Chest X-ray plates when taken under standard procedures are the upper limit of normal. As these parameters depend upon the transverse diameter of chest and this may vary in different body size of different racial groups.

We conduct a study in a cohort of mixed population in Bankura, a district in western part of West Bengal where different racial groups including some tribal races habitats and we measure TD, CTR, HD of them and we intends to find out the relation of these with different parameters of body habitus that help us to build up different correlation coefficients which help us to compare the results with the standard reference values. From this values we can come into inference that out of HD and CTR which one is least affected by the variations of the different values of body habitus.

**AIMS AND OBJECTIVES:** Normal standard for dimensions like CTR, HD etc. are based mainly on studies conducted in European and American (Caucasian) population and few studies are conducted in African population. There are very few studies regarding relationship between CTR, TD and HD with general physical parameters of the body habitus e.g. height, weight, body mass index (BMI), body surface areas (BSA) in Indian population. Normal standard for these diameters and ratios those are available in the standard text book are often based on studies conducted on Caucasians population.

The chances of racial difference of these parameters thus exist. In practice the medical professionals give equal importance on both Maximum transverse Diameter of Heart (HD) and Cardio-thoracic Ratio (CTR) in evaluation of enlargement of the heart as these parameters i.e. HD and CTR depend upon the built of the chest of the individual, which intern depends on the different values of the body habitus as in a certain locality where a mixed population of different racial groups exist, we perform the study to delineate out of HD and CTR which one is least affected by the body habitus. So the parameters which are least affected by the values of the body habitus give more accurate and impartial evaluation of predicting cardiac enlargement.

**REVIEW OF LITERATURE:** The study conducted by Obikili EN and Okoye IJ et al. reveals that there occurs negative correlation of TD with age was significant in males but not in females with age range 20-30 years; but between 40-60 years and above there occurs significant decrease in age in females but not in males.

Milne and Lander also noted a more striking reduction in TD with increasing age in women than in men in older age group.

Cowen in a study of older people found a significant negative correlation of TD with age in females.
Anyanwu GE, Anibeze CIP et al² studied a total of 510 Nigerians in South East Africa and they found that various indices of body size such as weight, height, BMI and BSA shown various levels of correlation with the different indices of heart diameter, chest diameter and CTR. Their researches have shown that predicting heart size using body size, that use of cardiac diameter is more reliable indicator than CTR. Their work was published in J. of Biomedical Research.³ This observation also tallies with the observation made by Amundsen P.¹

M. Justin et al⁹ revealed an interesting fact that increased cardiac diameter was associated with increased age and BMI and increased CD and CTR between 0.42-0.49 had higher all-cause mortality.

MATERIALS AND METHODS: The subjects studied were individuals attending in the different sub divisional hospitals in Bishnupur, Chhatna blocks of Bankura district in the time span between January 2010 to January 2013. The inclusion criteria were:

a) The age range selected was in between 20 - 70 years.

b) Both males and females were selected.

c) The selected individuals were free from any cardiac, lung diseases or any abnormalities in the thoracic cage.

A total of 850 individuals were selected, out of which 450 were males and 400 were females. The research instruments used for our study were X-ray machines, weighing machines and height scale.

The weights were measured by weighing machine in kilograms, with minimum clothing and without footwear.

Heights were measured to the nearest 0.01 meter by height scale.

The postero-anterior chest X-ray (PA view) were obtained by X-ray machine available in the hospital with focus-film distance was 1.8 meter and exposures were made out with the persons standing erect at the end of normal quiet inspiration.

Transverse Thoracic Diameter (TTD) is measured at the level of the right dome of the diaphragm and the transverse diameter of heart (HD) the sum of the maximum projection to the right and left heart borders from midline.¹⁰,¹⁷

Body mass index (BMI) was calculated from the formula BMI = W/H² (W=Weight in kg, H = Height in meter).

Body surface area (BSA) was calculated⁷ from the formula BSA = W⁰.⁴²₅ x H⁰.⁷₂₅ x 0.007184.

RESULTS: Different body habitus like body weight, height etc is measured and chest x-rays are taken in proper manner and from them BMI, BSA, TD and CTR are calculated in selected 850 individuals. Using statistical software we calculated correlation coefficients between HD and CTR with measured and calculated body habitus parameters like body weight, height, BMI and BSA. Analyzing these data, it has been found that there are strong correlations of weight, height, BMI and BSA with Heart Diameter (HD) and poor correlation of the above parameters with CTR.

DISCUSSION: The observations made by different research works made it clear that heart size (HD) in normal individuals depend on different parameters of body size.¹⁶ As the body built is affected by the interplay of genetic, racial and environmental factors, the heart size also depends on them¹³, e.g.
there occurs steep decrease of TD with age in females where the decrease of TD with age in male is gradual. The study conducted by Anyawu GE et al\(^1\) showed that predicting heart size using body parameters, the use of HD is better indicator than CTR. The study of Obermann\(^15\) reveals that there lies a strong correlation between weight and heart diameter.

The finding of our study reveals that there occurs strong correlation of heart diameter with weight, height; BMI and BSA whereas the relationship of CTR with above mention parameter is poor or very weak.

In conclusion, this study shows that heart diameter has strong relation with the body habitus like body weight and height, BSA and BMI; these body habitus parameters other way round depend upon the structures of the body framework in different racial groups, whereas cardio-thoracic ratio (CTR) has poor relationship with the above mentioned body parameters. These findings should be born in mind in setting up the normal reference values in predicting cardiac enlargement in routine chest x-ray. Cardio-thoracic ratio is less affected by the body habitus changes as mentioned above; so CTR is better indicator in predicting cardiac enlargement than HD in routine x-rays.

So Cardio-thoracic ratio is least affected by the variation of the dimensions of the body habitus. So CTR gives better idea and is less affected by the variations of body built than HD for predicting cardiac enlargement.

REFERENCES:

| Sex | Parameter | Weight | Height | BMI | BSA (m²)
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<td>0.10+</td>
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**TABLE I: Relationship of the various measured values and calculated parameters with CTR and HD**

CTR=cardio-thoracic ratio, HD=heart diameter, BMI=body mass index, BSA=body surface area

* = significant correlation at p≤0.01 level (2 tailed)
+ = weak correlation

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