

## **Radiographic Determination of Normal Values of Aortic Arch Diameter in a Nigerian Population**

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### **ABSTRACT**

The aortic arch diameter has been noted to be affected by racial variations. 1018 postero-anterior (PA) chest radiographs of samples of normal male and female Nigerians of ages 4 years and above were used for this study. A nomogram of aortic arch diameters for the studied population has been determined for the studied population and also mean values for each of the age categories within the studied population. Age correlated positively and significantly with aortic arch diameters. Significant difference was noted between the aortic arch diameters of males and females. This diameter was noted to be about 6.7% longer in males than in females of the same age categories. Mean differences were noted and various values suggested in the aortic arch diameters between each decade of age groups. An overall mean difference of 0.15cm was noted between all the age groups.

**KEY WORDS:** Aortic arch diameter, Aortic shadow, Chest radiograph, Nomogram.

### **INTRODUCTION**

Ethnic, racial and geographical dependent factors have played major roles in variations of anatomical and physiological parameters.<sup>1,2</sup> Aortic arch diameter has been noted to vary with race.<sup>3-6</sup> This study is designed to determine within the Nigerian population, normal values of the aortic arch diameters, set mean value of the diameter for the whole distribution and also the various age groups within the distribution, and also establish the relationship between these diameters with age and sex.

### **SUBJECTS AND METHODS**

From a total number of 1885 Nigerians physically examined and enrolled into this research, only 1018 postero-anterior ( P A )

chest radiographs of the subjects that met the standards set by Kabala and Wide<sup>7</sup> were admitted for this study. These samples included both sexes from ages 4 years and above. The study was carried out in the University of Nigeria Teaching Hospital (UNTH) Enugu, Nigeria, and Hansa, Special Diagnostic Centre, Enugu, Nigeria. This sample population was selected from candidates that came for chest X-ray examination as a result of requirements such as pre-employment, pre-admission, visa application and volunteer candidates without signs of any cardiothoracic disease symptoms. The PA chest radiographs of all the candidates were taken in the erect position with a film focus distance of 1.8m. The exposures were made at normal quiet inspiration.

Subject's name, sex, age and medical history were noted. To ensure that only normotensive subjects were enrolled for this study, candidate's blood pressures were taken, and the values accepted to be normal for this research were cases where the systolic blood pressure fell between 110 and 145mmHg and the diastolic pressure between 60 and 110mmHg.

The width of the aortic shadow was measured as the sum of the maximum extension of the aortic shadow to the right and to the left of the midline<sup>8</sup>.

### **RESULT**

The studied population was made up of 510 males and 508 females their, ages ranging from 4 to 80 years with a mean of 32.8 years. The aortic arch diameter was measured in centimeters. Age was broken into 10 intervals. Table 1 gives a summary of the mean aortic arch diameters for the entire population and the various age groups of males and females. The table reports an overall mean of  $4.74 \pm 0.5$  for the entire distribution and also  $4.96 \pm 0.5$  and  $4.52 \pm$

0.5 for males and females respectively.

Age correlated positively and significantly with aortic arch diameter ( $P \leq 0.01$ ,  $r=22$ ). Table 2 gives a summary of the differences in aortic arch diameters between one age group and the next. This research reports a mean difference of 0.15cm or 3.12% length of aortic arch diameter, to be between each decade of the age group. Aortic arch diameter correlated significantly and positively in the males ( $P \leq 0.01$ ,  $r=16$ ) and females ( $P \leq 0.01$ ,  $r=49$ ). Significant difference was noted in between the aortic arch diameters of the males and the females. The males showed larger aortic arch diameters than females of the same age groups. Table 3 gives a summary of the differences in lengths of aortic arch diameters between both sexes in all the age groups. The least differences in aortic arch diameter lengths were noted in subjects less than 20 years. This study reports a mean difference of 0.34cm or 6.7% of the length of aortic arch diameter between the male and females of same age groups.

## **DISCUSSION**

One of the importance of studies on race dependent factors that affect the anatomical and physiological parameters of a population or community is the identification of the variations and documentation of the emergent nomogram for better clinical interpretation. This study has documented for Nigerians the nomogram of the aortic arch diameter for the entire distribution of sampled population and also for the various age categories of males and females.

The mean value of  $4.74 \pm 0.5$  noted in this work for the whole distribution is lower than some earlier values from works done in Nigeria and Zambia<sup>3-6</sup>. Obikili and Okoye<sup>3</sup> suggested difference in methodology of measurement for similar variations noted in their study.

Aortic arch diameter correlated positively and significantly for both sexes. The males showed larger values of aortic arch diameter than the female groups of same age group. This is in agreement with some earlier researches<sup>3,5</sup> but Stuart<sup>9</sup> made a different observation when he recorded a larger value of aortic arch diameter for females than males of same age group. This he attributed to the higher blood pressure levels found in women.

A study on the differences of aortic arch diameter between the age categories shows that for movements from one decade of age category to the next, the aortic arch diameter increases by an average of 3% of the aortic arch diameter length. This shows that the aortic arch diameter length increases with a mean length of about 0.15cm from each decade of age to the other. Variations in the rate of these differences were also noted which were highest between age groups 11 to 20 and 20 to 30 and least and irregular from ages 60 and above. As a result, this study suggests an increment in the aortic arch diameter of 0.25cm in transitions between the 1<sup>st</sup> and 2<sup>nd</sup> age decades and 0.15cm for the 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> decades. The slight increments noted in the later age groups (6<sup>th</sup> and 7<sup>th</sup>) though irregular shows that even in normal individuals, (as is with the case in this study) that some levels of aortic unfolding accompany aging.

Similar observations made on the difference in the lengths of aortic arch diameter of males and females of same age groups showed that the aortic arch diameters of the males were about 6.7% longer than those of the females. This shows that for each age group, the standard of aortic arch diameter for the females can be obtained by reducing the aortic arch diameter of the males by 0.34cm

**Table 1: Relationship of Aortic Arch Diameter (AD) with Age.**

| Age   | Males    |     | Females  |     | Both     |      |
|-------|----------|-----|----------|-----|----------|------|
|       | Mean AD  | N   | Mean AD  | N   | Mean AD  | N    |
| 4-10  | 3.57±0.5 | 20  | 3.45±0.3 | 25  | 3.50±0.4 | 45   |
| 11-20 | 4.45±0.4 | 81  | 4.30±0.4 | 79  | 4.38±0.4 | 160  |
| 21-30 | 4.80±0.4 | 146 | 4.47±0.4 | 186 | 4.62±0.5 | 332  |
| 31-40 | 4.97±0.4 | 100 | 4.68±0.5 | 100 | 4.83±0.5 | 200  |
| 41-50 | 5.13±0.5 | 70  | 4.71±0.4 | 69  | 4.99±0.5 | 139  |
| 51-60 | 5.24±0.5 | 62  | 4.92±0.5 | 33  | 5.13±0.5 | 95   |
| 61-70 | 5.49±0.6 | 20  | 4.76±0.5 | 14  | 5.19±0.5 | 34   |
| 71-80 | 5.35±0.5 | 11  | 5.00±0.5 | 2   | 5.30±0.5 | 13   |
| Mean  | 4.96±0.5 | 510 | 4.52±0.5 | 508 | 4.74±0.5 | 1018 |

**Table 2: Differences in length of AD between the various age groups.**

| Age            | Change in AD | Change in % | Age   | Change in AD | Change in % |
|----------------|--------------|-------------|-------|--------------|-------------|
| 11-20 to 21-30 | 0.24         | 5.19        | 4-10  | 0.12         | 3.36        |
| 21-30 to 31-40 | 0.21         | 4.35        | 11-20 | 0.15         | 3.37        |
| 31-40 to 41-50 | 0.16         | 3.21        | 21-30 | 0.33         | 6.88        |
| 41-50 to 51-60 | 0.14         | 2.73        | 31-40 | 0.29         | 5.83        |
| 51-60 to 61-70 | 0.06         | 1.16        | 41-50 | 0.42         | 8.19        |
| 61-70 to 71-80 | 0.11         | 2.08        | 51-60 | 0.33         | 6.11        |
| Mean           | 0.15         | 3.12        | 61-70 | 0.73         | 13.30       |
|                |              |             | 71-80 | 0.35         | 6.54        |
|                |              |             | Mean  | 0.34         | 6.70        |

**Table 3: Differences in length of AD between both sexes of same age group**

## REFERENCES

- Kerwin AJ, 1943, Observations on the Heart size of Natives living At High Altitudes. Am Heart J. 69-80.
- Nickol K, and Wade AJ, 1982; Radiographic Heart size and cardiothoracic ratio in three ethnic groups; a basis for a simple screening test for cardiac enlargement in men. BJR; 55 (654): 399.
- Obikili EN and Okoye IJ, 2004. Aortic Arch diameter in frontal chest radiographs of a normal Nigerian population. Nig. J. Med 2 (13) 171-74.
- Ashcroft M. T. Miall W.E 1969: Cardiothoracic ratio in two Jamaican communities AM J Epidemiol 89 (2):166-7
- Ikeme A. C., Ogakwu MN, Nwakonobi FA, 1976; The significance of the enlargement of the aortic shadow in adult Nigerians. Afr. J. Med. Sc. 5: 1995-99.
- Umerah BC, 1982; Unfolding of the aorta (Aortitis) associated with pulmonary tuberculosis Br J Radiol. 55:201-203.
- Kabala J.E, Wide P 1987: The measurement of the heart size in the anteroposterior chest radiograph Br. J. Radiol; 60: 981-986.
- Rose GR & Black Burn H; 1966: Cardiovascular population study methods. Geneva WHO monographs
- Stuart KL, Miall WF, Tulloch JA, et al 1962; Dilation and Unfolding of the aorta in a Jamaican population Br Heart J 24: 455-463.