# Assessment of Normal Diameter of Thoracic Aorta Using Computed Tomography Angiography

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## ABSTRACT

**Objective**

This retrospective study aimed to asses normal diameter of the thoracic aorta in the healthy Sudanese population using Computed Tomography Angiography

**Material and Method**

A total of 50 chest were retrospective investigated in the period spanning from March 2021to May 2021. (160 – 16)slice CT units (Toshiba aquilion Medical Systems) were used to examine patients at two hospitals in Khartoum State, Sudan. The diameters of the thoracic aorta were calculated manually at five points by using the standard clinical Method

The average thoracic aorta diameters of the all population at five points Sino tubular Junction, Mid-Ascending Aorta, Transverse aorta, Mid Descending aorta, and Diaphragmatic Hiatus.

**Result**

were Sino tubular Junction sagittal was 1.80 to 5.50Sino tubular Junction axial was1.41 to 4.44 Mid-Ascending Aorta sagittal was 2.20 to 3.90 Mid-Ascending Aorta axial was 2.02 to 3.88 Transverse aorta sagittal was 2.00 to2.90 Transverse aorta axial was2.03 to 3.72 Mid-Descending aorta sagittal was 1.23 to 3.11 Mid-Descending aorta axial was 1.20 to 3.50 Diaphragmatic Hiatus sagittal was 1.34 to 3.50 Diaphragmatic Hiatus axial was1.07to2.99respectively.

**Conclusion**

that These results provide normative data for evaluating a patient's thoracic aorta enlargement. Furthermore, computed tomography is playing a great role in the measurement of the diameter of the thoracic aorta

## INTRODUCTION

The aorta is the main artery in the human body and distributes oxygenated blood to all part of the body through the systemic circulation. It extends from the heart to about the fourth lumber vertebra and it divided into thoracic and abdominal sections. The thoracic section divided into four segments: aortic bulb (root), ascending aorta, aortic arch and descending aorta. The bulb or root portion is at the proximal end of the aorta and is the area from which the coronary arteries originate. Extending from the bulb is ascending portion of the aorta, which terminates at approximately second sternocostal joint and becomes the arch. The arch is unique from the other segments of the thoracic aorta because three arterial branches arise from it: the brachiocephalic artery, the left common carotid artery, and the left subclavian artery. The distal end of arch becomes descending aorta, which extends from the isthmus to the level of twelfth dorsal vertebra.

Numerous intercostals, bronchial, esophageal, and superior phrenic branches arise from the descending aorta. Then continues downward as the abdominal aorta which extends from diaphragm to the aortic bifurcation. It gives rise to lumbar and musculophrenic arteries, renal and middle suprarenal arteries, and visceral arteries (celiac trunk, the superior mesenteric artery and the inferior mesenteric artery). It

ends in a bifurcation into the left and right common iliac arteries (1). Echocardiography better in measure aortic root diameter, which provides prognostic information in aortic regurgitation and the Marfan syndrome (2). Computed tomography angiography uses an injection of iodine-rich contrast material and CT scanning to help diagnose and evaluate blood vessels disease or related condition such as aneurysm or blockage (3). Aortography is performed by x-ray with catheters, magnetic resonance

imaging, and computed tomography, which is usually the most useful technique in imagining of aorta, and produce detailed image of vessels (3)

## 1. Material and Method

### 1.1 Machine and Study design

Computed tomography (CT) examinations were done by using CT machines Toshiba aquilion 160 and 16 slices. The technical parameters were 120 kvp, 200 mAs, and 5 mm slice ,The study was retrospective cross sectional , where the patient selected randomly

### 1.2 Area of study and Sample and study population

This was descriptive analytical study. It was done in radiology department of two hospitals; i )Al Muallem Medical city ii) Al-Zaytona specialized hospital in Khartoum, Sudan.Because the number of cases was small, thus it was convenient sample, Size is 50 patient (male and female) which referred to radiology department for CTA.

### 1.3 Technique

**1.4 Sudanese subject who were scanned for chest CT and were diagnosed as 50normal mediastenium and had no history of vascular diseases. Axial images were obtained CT scans were obtained with the patient in supine position during full inspiration. The scan range was from 1 cm above lung apices to the diaphragm. The exposure parameters were 120 kVp, 50- 300 mA and 5 mm slice. Patient preparation for contrast media (renal profile-patient fasting from 6 to 8 hrs ) volume of contrast(80100-ml) flow rate (2.5-3 ml/s) concentration(300 mg/ml).**

Thoracic Aorta MeasurementMeasurements from outer wall to outer wall of thoracic aortic diameter should be taken perpendicular to the axis of blood flow on axial images and from sagittal oblique reformatted

images Aortic diameters should be measure at five levelsSinotubular junction,Mid- ascending aorta, halfway between the sinotubular junction and aortic arch, at the level of the right pulmonary artery,

Transverse aortic arch,Mid-descending aorta (at the same level as the sinotubular junction measurementDistal descending thoracic aorta at the diaphragmatic hiatus Measurements ofthoracic aortic diameter were collected from each participant's CT scan

### 1.5 Data analysis

The data collected in master data sheet and were analyzed using Microsoft Excel; version 2007. Data were presented as mean and standard deviation (SD) for all of variables.

### 1.6 Ethical considerations

Special consideration was given to the right of the confidentiality and anonymity for all participants. Anonymity was achieved by using number for each participant to provide link between the collected information and the participants. Justice and human dignity was considered by teaching the selected participant equally when offering them an opportunity to participate in the research. Permission for conducting the study was obtained from head of the radiology department at Khartoum hospitals

## 2. Result

**Table 4.1 show statistical variables for all patients:**

| Variables | Mea | Std. Dev | Minimum | Maximum |
|---|---|---|---|---|
| Age | 57.44 | 15.889 | 25 | 88 |
| STJ Sagittal | 2.874 | .66668 | 1.80 | 5.50 |
| STJ Axial | 2.4652 | .64022 | 1.41 | 4.44 |
| M A A Sagittal | 2.7124 | .46066 | 2.20 | 3.90 |
| M A A Axial | 2.9298 | .52093 | 2.02 | 3.88 |
| T A Sagittal | 2.4208 | .28323 | 2.00 | 2.90 |
| T A Axial | 2.4662 | .35958 | 2.03 | 3.72 |
| M D A Sagittal | 2.2932 | .41249 | 1.23 | 3.11 |
| M D A Axial | 2.4664 | .37777 | 1.20 | 3.50 |
| D H Sagittal | 2.2404 | .43907 | 1.34 | 3.50 |
| D H Axial | 2.2622 | .40367 | 1.07 | 2.99 |

**Table 4.2 show group statistic for all patients according to their gender:**

| | Gender | N | Mean | Std. Deviation | Error Mean |
|---|---|---|---|---|---|
| Age | Female | 20 | 52.75 | 15.193 | 3.397 |
| | Male | 30 | 60.57 | 15.813 | 2.887 |
| STJ Sagittal | Female | 20 | 2.8095 | .75285 | .16834 |
| | Male | 30 | 2.9183 | .61217 | .11177 |
| STJ Axial | Female | 20 | 2.2660 | .52407 | .11718 |
| | Male | 30 | 2.5980 | .68338 | .12477 |
| M A A Sagittal | Female | 20 | 2.5890 | .39836 | .08908 |
| | Male | 30 | 2.7947 | .48692 | .08890 |
| M A A Axial | Female | 20 | 2.8895 | .46201 | .10331 |
| | Male | 30 | 2.9567 | .56285 | .10276 |
| T A Sagittal | Female | 20 | 2.2740 | .24237 | .05419 |
| | Male | 30 | 2.5187 | .26886 | .04909 |
| T A Axial | Female | 20 | 2.3915 | .19228 | .04299 |
| | Male | 30 | 2.5160 | .43340 | .07913 |
| M D A Sagittal | Female | 20 | 2.1620 | .46042 | .10295 |
| | Male | 30 | 2.3807 | .35892 | .06553 |
| M D A Axial | Female | 20 | 2.4430 | .29241 | .06539 |
| | Male | 30 | 2.4820 | .42952 | .07842 |
| D H Sagittal | Female | 20 | 2.0965 | .40575 | .09073 |
| | Male | 30 | 2.3363 | .44054 | .08043 |
| D H Axial | Female | 20 | 2.1435 | .38070 | .08513 |
| | Male | 30 | 2.3413 | .40520 | .07398 |

**Table 4.4 show analysis of variance for all variables:**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| STJ Sagittal | Between Groups | 16.521 | 30 | .551 | 1.990 | .060 |
| | Within Groups | 5.258 | 19 | .277 | | |
| | Total | 21.779 | 49 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| STJ Axial | Between Groups | 11.049 | 30 | .368 | .775 | .741 |
| | Within Groups | 9.035 | 19 | .476 | | |
| | Total | 20.084 | 49 | | | |
| M A A Sagittal | Between Groups | 5.061 | 30 | .169 | .601 | .897 |
| | Within Groups | 5.337 | 19 | .281 | | |
| | Total | 10.398 | 49 | | | |
| M A A Axial | Between Groups | 8.756 | 30 | .292 | 1.221 | .329 |
| | Within Groups | 4.540 | 19 | .239 | | |
| | Total | 13.297 | 49 | | | |
| T A Sagittal | Between Groups | 2.453 | 30 | .082 | 1.052 | .465 |
| | Within Groups | 1.477 | 19 | .078 | | |
| | Total | 3.931 | 49 | | | |
| T A Axial | Between Groups | 3.980 | 30 | .133 | 1.070 | .448 |
| | Within Groups | 2.355 | 19 | .124 | | |
| | Total | 6.336 | 49 | | | |
| M D A Sagittal | Between Groups | 5.653 | 30 | .188 | 1.334 | .258 |
| | Within Groups | 2.684 | 19 | .141 | | |
| | Total | 8.337 | 49 | | | |
| M D A Axial | Between Groups | 4.463 | 30 | .149 | 1.118 | .408 |
| | Within Groups | 2.530 | 19 | .133 | | |
| | Total | 6.993 | 49 | | | |
| D H Sagittal | Between Groups | 6.989 | 30 | .233 | 1.801 | .091 |
| | Within Groups | 2.457 | 19 | .129 | | |
| | Total | 9.446 | 49 | | | |
| D H Axial | Between Groups | 5.133 | 30 | .171 | 1.140 | .390 |
| | Within Groups | 2.852 | 19 | .150 | | |
| | Total | 7.985 | 49 | | | |

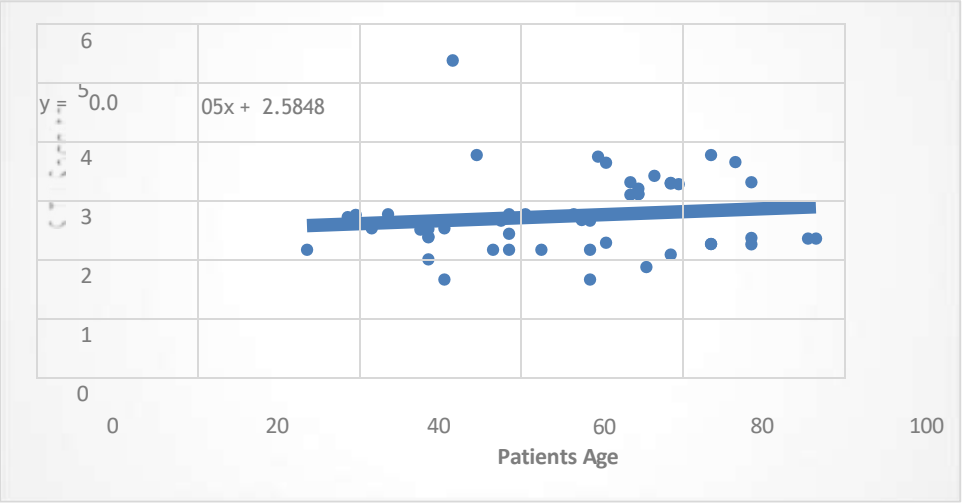


**Figure 4.2 show Sino tubular Junction for sagittal oblique section with patient age**

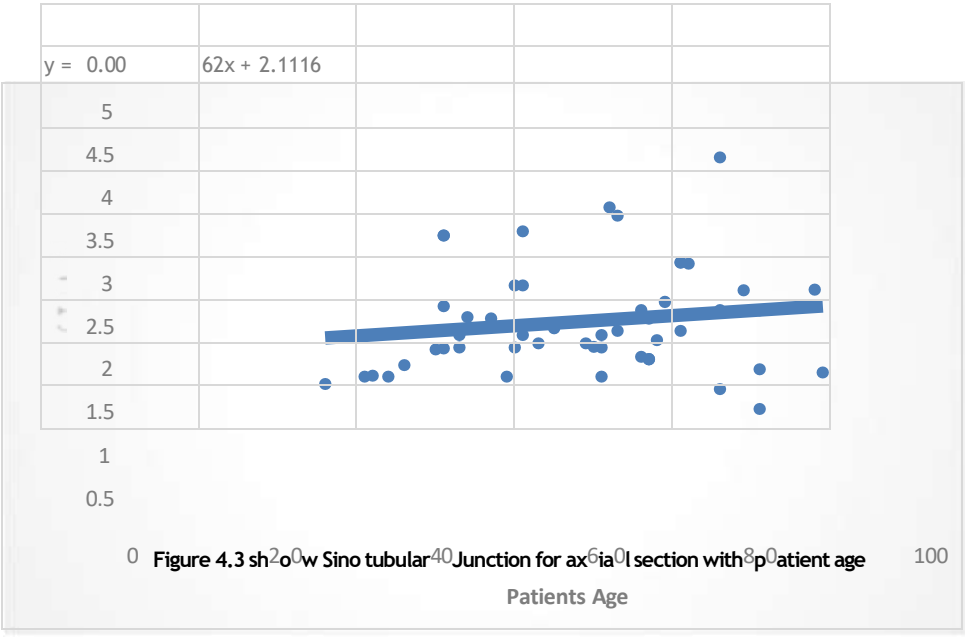


**Figure 4.3 show Sino tubular Junction for axial section with patient age**

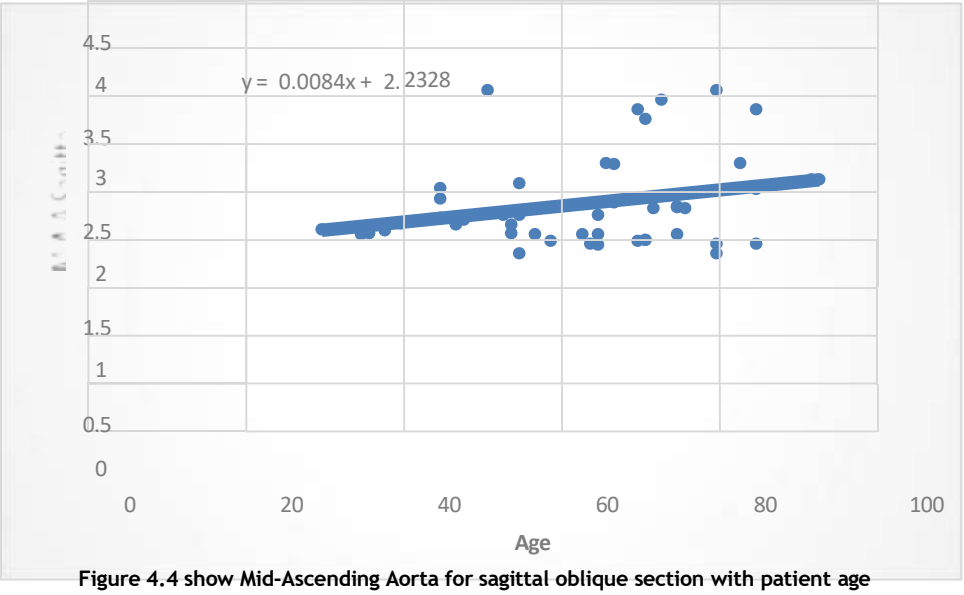


**Figure 4.4 show Mid-Ascending Aorta for sagittal oblique section with patient age**

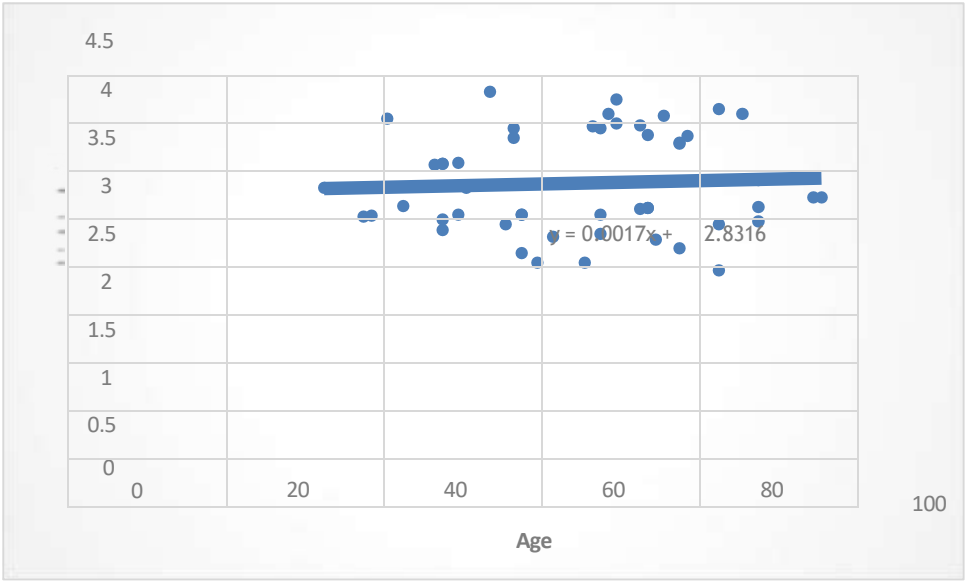


**Figure 4.5 show Mid-Ascending Aorta for axial section with patient age**

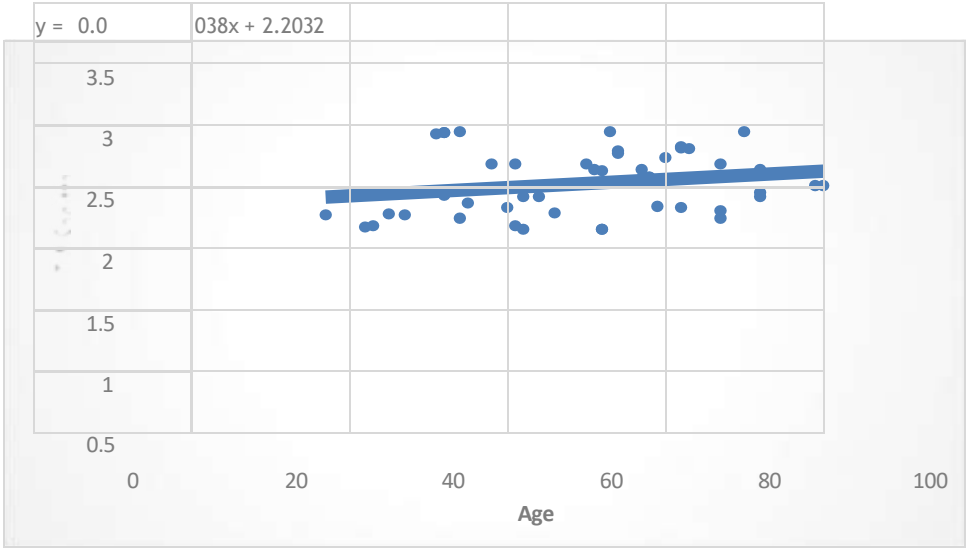


**Figure 4.6 show Transverse aorta for sagittal oblique section with patient age**

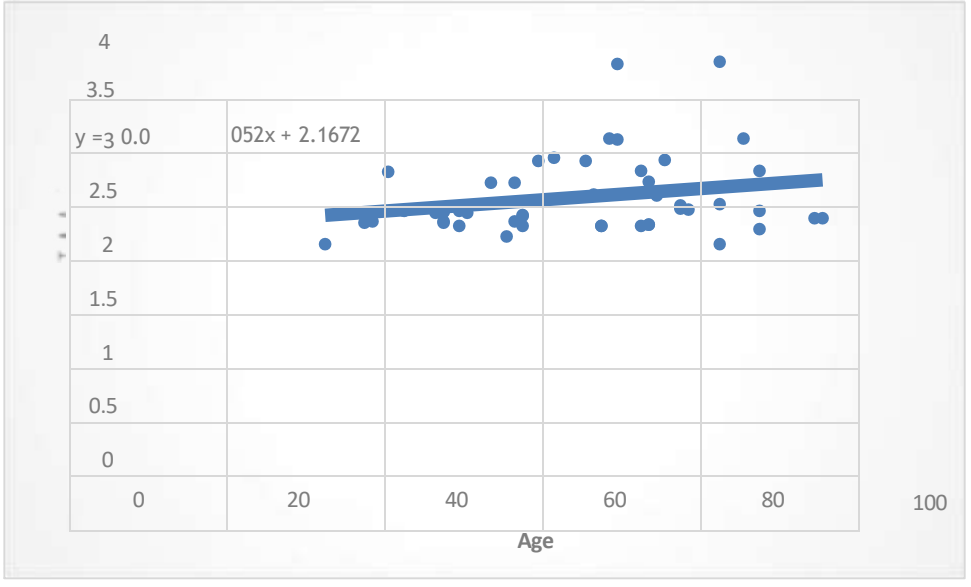


Figure 4.7 show Transverse aortafoe axial section with patient age

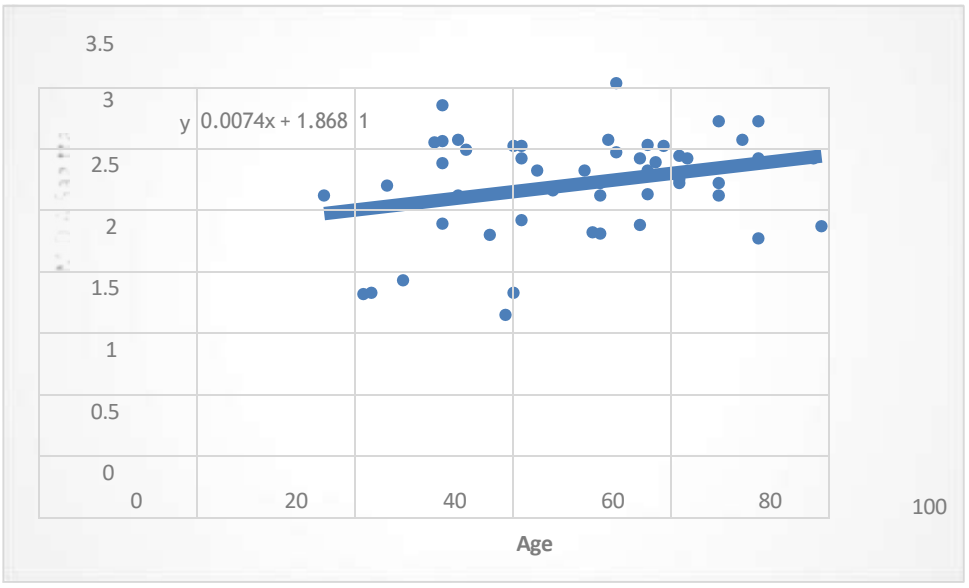


**Figure 4.8 show Mid-Descending aortafor sagittal oblique section with patient age**

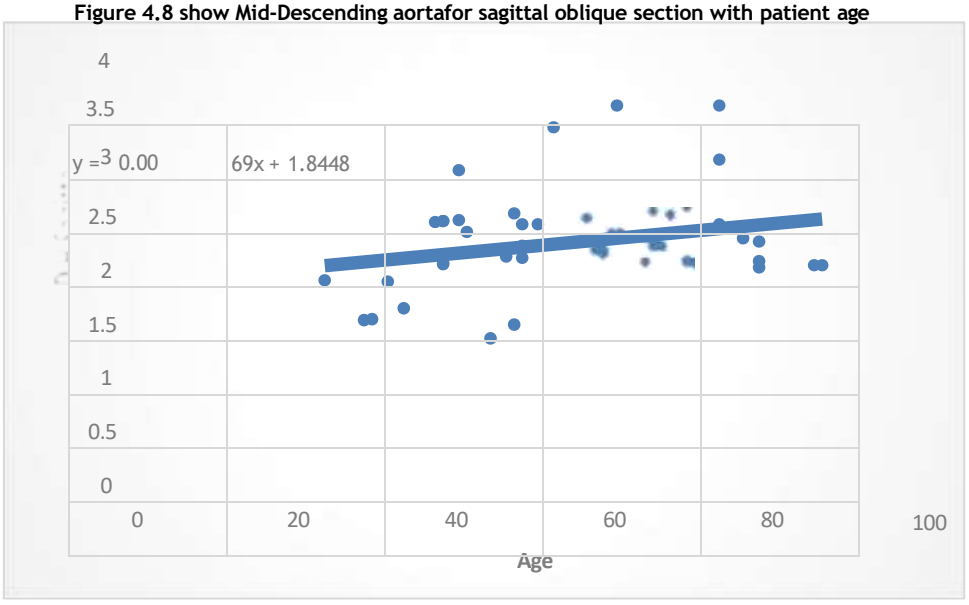


**Figure 4.10 show Diaphragmatic Hiatusfor sagittal oblique section with patient age**

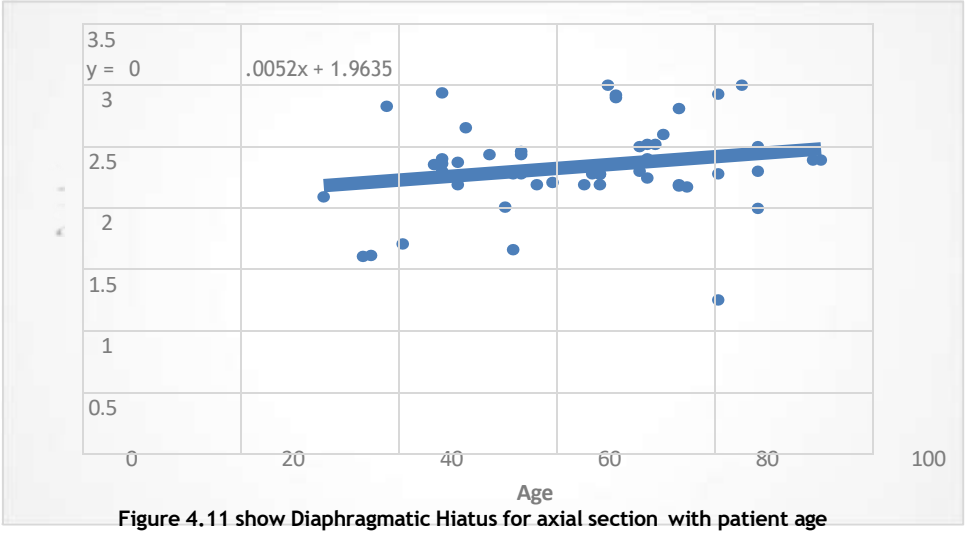


**Figure 4.11 show Diaphragmatic Hiatus for axial section with patient age**

## DISCUSSION

This descriptive study's aimed to measure the thoracic aorta diameter in the Sudanese population by using a CTA scan.Various studies were analyzed, and their data compared with our research .In the current study, of the 50 subjects examined, Table (4.1) show statistical variables for all patients were data presented as mean,stander Deviation , Minimum and Maximum . were the mean57.44 ± 15.889 std for age, for STJ sagittal was 2.87 ± .66668 , for STJ axial was 2.47± .640 ,for M A A Sagittal was 2.7124 ±.46066 , for M A A axial was 2.9298 ± .52093, for T A Sagittal was 2.4208±.28323, for T A Axial was 2.4662±.35958,for M D A Sagittal was2.2932± .41249,for M D A axial was 2.4664±.37777 ,for D H Sagittal was 2.2404± .43907,for D H axial was 2.2622±.40367.

Table( 4.2 ) show gender frequency for all patients were the number of female was 20 with percent 40.0l% and male number was 30 with percent 60.0% as shown in figure number one . Table (4.3) show group statistic for all patients according to their gender. for age were the mean 52.75±15.193 for female and for male was60.57±15.81,for STJ sagittal the mean for female was2.81±.75285,for male was 2.92±.61217,for STJ axial the mean for female was2.27±.52407 and for male was2.59±.68338,for M A A Sagittal Female was2.5890±39836and for male was2.7947±.48692, for M A A axial female was 2.8895±.46201and for male was2.9567±56285,for T A Sagittal female was 2.2740±.24237 and for male was 2.5187±26886, for T A axial for female was2.3915±.19228 and for male was 2.5160±.43340, M D A Sagittal for female was2.1620±.46042 and for male was2.3807±.35892, M D A axial for female was 2.4430±.29241and for male was 2.4820±.42952,for D H sagittal for female was2.0965±.40575and for male was 2.3363±.44054, for D H axial for female was2.1435±.38070 and for male was2.3413±.40520. Table (4.4 )show analysis of variance for all variables with patient age were the p. value shown there is no significant difference between the patient age with all measurement value were p value for STJ sagittal was (.060), STJ axial was( .741),MAA sagittal(.897) M A A axial(.329),TA sagittal (.465 )TA axial (.448) M DA sagittal(.258) MDA axial(.408),D H sagittal (.091) D H axial(.390).

Figure( 4.2) show correlation Sino tubular Junction for sagittal oblique section with patient age were the rate of change for STJ was 0.005 for each years of the patient . Figure (4.3) show correlation Sino tubular Junction for axial section with patient age were the rate change for STJ was0.006 for each years of the patient . Figure( 4.4) show correlation Mid-Ascending Aorta for sagittal oblique section with patient age were the rate change for MAA was0.008 for each years of the patient. Figure (4.5) show correlation Mid-Ascending Aorta for axial section with patient age were the rate of change for MAA was 0.001 for each years of the patient. Figure (4.6 )show correlation Transverse aorta for sagittal oblique section with patient age were the rate of change for TA was 0.003 for each years of the patient. Figure (4.7) show correlation Transverse aorta for axial section with patient age were the rate of change for TA was0.005 for each years of the patient. Figure( 4.8 )show correlation MidDescending aortafor sagittal oblique section with patient age were the rate of change for MDA was0.007 for each years of the patient. Figure (4.9) show correlation MidDescending aorta for axial section with patient age were the rate of change for MDA was0.001 for each years of the patient.

## CONCLUSION

In conclusion, there is no significant difference between the patient age with all measurement value were p value for Sino tubular Junction sagittal was (.060), Sino tubular Junction axial was( .741), Mid-Ascending Aorta sagittal(.897) MidAscending Aorta axial(.329), Transverse aorta sagittal (.465 ) Transverse aorta axial ( .448 ) Mid-Descending aorta sagittal(.258) Mid-Descending aorta axial(.408), Diaphragmatic Hiatus sagittal (.091) Diaphragmatic Hiatus axial(.390). with patient age were the rate of change for Sino tubular Junction was 0.005 for each years of the patient . correlation with patient age were the rate change for Sino tubular Junction was0.006 for each years of the patient . correlation with patient age were the rate change for Mid-Ascending Aorta r was0.008 for each years of the patient. correlation with patient age were the rate of change for Mid-Ascending Aorta was 0.001 for each years of the patient. correlation patient age were the rate of change for Transverse aorta was 0.003 for each years of the patient. correlation patient age were the rate of change for Transverse aorta was0.005 for each years of the patient. correlation with patient age were the rate of change for Mid-Descending aorta was0.007 for each years of the patient. correlation with patient age were the rate of change for Mid-Descending aorta was0.001 for each years of the patient. correlation with patient age were the rate of change for Diaphragmatic Hiatus was 0.006 for each years of the patient. correlation patient age were the rate of change for Diaphragmatic Hiatuswas0.005 for each years of the patient.

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