

# Transverse thoracic diameter in frontal chest radiographs of an adult Nigerian population

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## Summary

**Background:** Normal standards for thoracic dimensions that are available in our environment are often based on studies conducted on Caucasians. Application of such published data to a Nigerian population may lead to erroneous conclusions in terms of clinical implication.

**Objective:** Our study aimed to establish age and sex specific transverse thoracic diameter (TD) for our environment.

**Subjects and methods:** The TD of 303 males and females aged between 20 and 93 were obtained in a cross sectional study at a tertiary hospital.

**Results:** The mean values for the 20-39, 40-59 and the 60 year-old males were 29.6, 29.0, 27.8cm respectively. The corresponding values for females were 26.3, 27.1 and 25.1cm. Males had significantly larger thoracic diameter than females. The largest mean TD in males and females were in the 20-39 and 40-59 age groups respectively. The TD had a significant positive correlation with weight, height, body mass index and body surface area. The best correlations were with body surface area and weight.

**Conclusions:** Nigerians have a smaller TD than Caucasians. Smaller TD in Nigerians is likely to be responsible for their high cardiothoracic ratios in comparison with Caucasians or Asians.

**Keywords:** Transverse thoracic diameter, Frontal chest radiographs, Adult Nigerians.

## Résumé

**Contexte:** Les mesures thoraciques standard disponibles dans notre environnement sont souvent basées sur les études menées sur des Caucasiens. L'application de telles données sur la population nigériane peut mener à des conclusions erronées en termes d'implication clinique.

**Objectif:** Notre étude a pour objectif d'établir, dans notre environnement, des diamètres thoraciques (DT) transversaux spécifiques en fonction de l'âge et du sexe.

**Patients et méthodes:** Le DT de 303 hommes et femmes âgées de 20 à 93 ans a été obtenu par le biais d'une étude statistique menée dans un hôpital universitaire à partir d'un échantillon représentatif.

**Résultats:** Les valeurs moyennes pour les hommes âgés de 20 à 39 ans, de 40 à 59 ans et de 60 ans et plus étaient

respectivement de 29.6, 29 et de 27.8cm. Les valeurs correspondantes pour les femmes étaient de 26.3, 27.1 et 25.1cm. Les hommes avaient un DT nettement supérieur à celui des femmes. La moyenne des DT la plus élevée concernait les hommes et les femmes âgés respectivement de 20 à 39 ans et de 40 à 59 ans. On a constaté une corrélation positive significative du DT avec le poids, la taille, l'indice de masse corporelle et la surface corporelle. Les corrélations les plus significatives ont été observées avec la surface corporelle et le poids.

**Conclusion:** Les Nigériens ont un diamètre thoracique plus petit que les Caucasiens. Un diamètre thoracique moindre chez les Nigériens semble être la cause de leurs plus grands ratios cardio-thoraciques en comparaison avec les Caucasiens et les Asiatiques.

## Introduction

The transverse thoracic diameter (TD) is not only invaluable in the calculation of cardiothoracic and aortothoracic ratios but also in the comparison of the physiques of different racial groups. Although newer imaging modalities like computed tomography and magnetic resonance imaging provide accurate evaluation of TD, what is affordable and available in most centers, especially in developing countries, is conventional radiography. Chest radiography therefore remains an important radiological investigative tool for the detection of cardiomegaly and the evaluation of cardiothoracic ratio<sup>1</sup>. There is paucity of studies on chest dimensions in Africans. Normal standards for thoracic dimensions that are available in our environment are often based on studies conducted on Caucasians. The possibility of racial differences does exist<sup>2</sup>. The present study was aimed at establishing age and sex specific transverse thoracic diameter for Nigerians.

## Materials and methods

The subjects studied were individuals referred to the Department of Radiation Medicine, University of Nigeria Teaching Hospital, Enugu, for pre-employment chest radiographs or for routine medical examinations. The period of study was from 1997 to 1999. The subjects were asked their ages and their heights and weights were measured using a fixed wall ruler with a spirit level as bar for the height, and a beam balance for the weight.

Posteroanterior chest radiographs were obtained in full inspiration with the subjects standing erect.

The focus film distance was constant at 2 metres. At this distance projection distortion is minimal and magnification is about 5%.<sup>3</sup> Only good quality standard posteroanterior chest radiographs were studied. The radiographs that did not meet the criteria proposed by Kabala and Wilde<sup>4</sup> and Brockington and Bohrer<sup>5</sup> were excluded from the study.

**Measurements**

The transverse thoracic diameter (TD) was measured from the internal surfaces of the ribs above the costal attachments of the diaphragm at the point where the chest diameter was greatest (see figure 1).

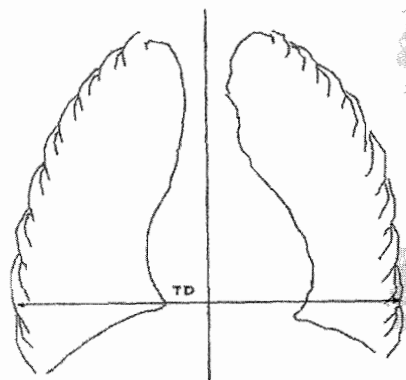
Body mass index (BMI) was calculated from the formula:  $BMI = W / H^2$  (W is the weight in kilograms while H is the height in metres)<sup>6</sup> and body surface area (BSA) was also calculated from the formula:  $BSA = W^{0.425} \times H^{0.725} \times 0.007184$  (Weight is in kilograms while height is in centimetres. BSA is in square metres)<sup>7</sup>. The TDS obtained from this study were compared with those reported by other authors<sup>2,8</sup>.

**Results**

There were 303 subjects in the study group: 157 males and 146 females. Their ages ranged from 20 to 93 years in males and 20 to 80 years in females. The mean TD of the 20-39, 40-59 and the <sup>3</sup>60 year-old males were 29.6, 29.0, 27.8cm respectively. The corresponding values

significant negative correlation of TD with age in males but not in females ( $r = -0.11$  in males and  $.0014$  in females). However, between the 40-59 and <sup>3</sup>60 age groups, there was a significant decrease in females,  $p < 0.01$ , but not in males. As shown in table 2, the TD had a significant positive correlation with height, weight, body mass index and body surface area in both sexes.

Table 3 and figure 2 show comparative data on the TD of males and females as reported by various authors. The mean TD in males and females in the present study were smaller than the values reported for the Americans and the British. The differences were statistically significant except for the British females. Overall, the mean TD in the present study was similar to the values reported for Jamaicans<sup>2</sup>.



**Figure 1** Transverse thoracic diameter (TD) was measured from the internal surfaces of the ribs above the costal attachments of the diaphragm at the point where the chest diameter was greatest.

**Table 1** Thoracic diameter (cm) of males and females by age

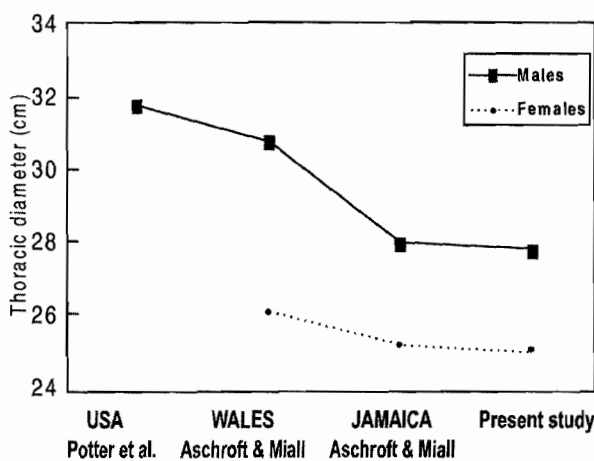
Age (yr)	Males			Females			p
	No.	Mean	SD	No.	Mean	SD	
20-39	108	29.6	1.9	108	26.3	1.5	<0.000
40-59	36	29.0	1.7	28	27.1	1.6	<0.000
<sup>3</sup> 60	13	27.8	2.7	10	25.1	1.7	<0.014

**Table 2** Correlation of thoracic diameter with weight, height body mass index and body surface area in males and females

	Height	Weight	BMI	BSA
<b>Male</b>	0.5773*	0.7275*	0.5216*	0.7488*
<b>Female</b>	0.4321*	0.6715*	0.5454*	0.6974*

\* Statistically significant at  $p < 0.001$

for females were 26.3, 27.1 and 25.1cm. The range was 23.3cm to 35cm in males and 21.7 to 30.8cm in females. As shown in table 1, the TD decreased with age in males while in females it initially increased with age and later decreased with it. At all age groups, males had significantly larger TD than females. There was a



**Figure 2** Thoracic diameters of adults in the older age group as reported by various authors.

**Discussion**

The TD correlated better with body surface area and weight than with body mass index and height. The TD decreased with advancing age in males. This is in keeping with the findings of Potter et al.<sup>8</sup> who showed

**Table 3 Comparative data on thoracic diameter (cm) of males and females as reported by various authors**

Country/ People	Authors	Year	Age (yr)	Male			Female		
				No.	Mean	SD	No.	Mean	SD
USA	Potter et al <sup>8</sup> .	1982	32-50	60	31.6				
			60-69	32	31.8				
Wales	Ashcroft & Miall <sup>2</sup>	1969	35-44	98	31.4	1.8	99	27.9	1.7
Wales	-ditto-		55-64	96	30.8	2.0	97	26.1	2.0
Jamaica	-ditto-		35-44	89	28.9	1.5	118	26.0	1.6
Jamaica	-ditto-		55-64	89	28.0	2.1	67	25.2	1.8
Nigeria	Present study	2002	20-29	108	29.6	1.9	108	26.3	1.5
			35-44	21	29.3	1.4	22	27.3	1.6
			<sup>3</sup> 60	13	27.8	2.7	10	25.1	1.7

that the TD in males, tended to decrease with advancing age. In our study, the negative correlation of TD with age was significant in males but not in females but between the 40-59 and the <sup>3</sup>60 year-old age groups there was a significant decrease with age in females but not in males. This observation indicates that the decrease of TD with advancing age was gradual in males. The decrease started later in females but was more marked.

The steep decrease of TD with age in females collaborates the findings of Edge et al.<sup>9</sup>, Cowan<sup>10</sup> and Milne and Lauder<sup>11</sup>. Edge et al.<sup>9</sup> noted a more striking reduction in TD with increasing age in women than in men. Cowan<sup>10</sup>, in a study of older people, found a significant negative correlation of TD with age in females but not in males. He indicated that this could be because women are subject to greater degrees of kyphosis than men, with a corresponding decrease in the transverse diameter. This greater degree of kyphosis in older females may be due to menopausal osteoporosis.

Although secular growth trend in height was reported in Nigerians by Obikili and Singh<sup>12</sup>, it seems unlikely that the decrease in TD with advancing age in our study could be accounted for by secular growth trend alone. Senile and postmenopausal osteoporotic changes are contributory factors. Milne and Lauder<sup>11</sup> postulated that the age differences in TD were unlikely to be the result of secular trend towards larger chest diameters. For them, it seemed more likely, particularly in older women, that the development of kyphosis increased the anteroposterior chest diameter with a resultant change in the thoracic shape and reduction in the transverse diameter.

The mean values of TD of males and females in the present study were smaller than those reported for Caucasians. This finding corroborates the report of Nickol and Wade<sup>13</sup> and Munro-Faure et al.<sup>14</sup> They showed that Africans have narrower chests at all ages than Caucasians or Asians. The smaller TD in Nigerians is likely to be responsible for their larger cardiothoracic ratios in comparison with Caucasians or Asians.

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