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--THORACIC INDEX IN THE NEGRO--

by

Charles Bradford Rodes, Jr.

Thesis

Offered to the Graduate Committee of the University of  
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of Master of Arts.





## --THE THORACIC INDEX IN THE NEGRO--

by

Charles Bradford Rodes, Jr.

The following investigations were undertaken in order to determine the thoracic index, (i. e. the ratio of the antero-posterior to the transverse diameter) according to age and sex in the Negro, by means of a series of measurements made upon the living body. In addition, a number of observations were made to determine the character of the thoracic index in the embryo and foetus, (independent of race.). The investigations were conducted under the direction of Dr. C. M. Jackson, Professor of Anatomy in the University of Missouri, whom I wish to thank for his kind assistance and valuable suggestions. In addition, I desire to thank Miss Sophie Bodenheimer, Assistant in Womens' Gymnasium of the University of Missouri, for a series of observations upon fifty women students.

Before stating the results of the present investigations, however, a brief review of the somewhat scanty literature upon the subject of the thoracic index in general will be given.

Chomel (1) as far back as 1829 noted the utility of transverse and antero-posterior measurements on the human thorax. He pointed out the necessity of having the subject in as nearly the same position as possible during the time all measurements are being made.

Wintrich (14) presents a table containing averages made



from observations upon the chests of 435 individuals of various ages. His measurements were taken at three different levels on the thorax; first, an upper just beneath the axilla; second, a middle at the level of the nipple or just below the shoulder blade, and a third over the xiphoid process. A brief discussion of Wintrich's table will be made later.

Rüdinger (11) states that thoracic measurements should be made during quiet respiration in order to assure constant results.

Fourmentin (3) was the next to publish an article along this line. He took the ratio of the transverse to the antero-posterior diameter as the thoracic index. His method of calculating the thoracic index was as follows:

$$\frac{\text{Transverse diameter} \times 100}{\text{Antero-posterior diameter}} = \text{Thoracic index.}$$

According to this method of calculation, he found the thoracic index to vary, in apparently normal individuals, between 120 and 140, (expressed according to the ratio of antero-posterior to the transverse diameter, these would be 83.3 and 71.4 respectively).

Poirier (10) states that Broca (#) gave the term thoracic index to the ratio of horizontal diameters of the thorax. He also states that the index has been studied by Dr. Weisgerber on 127 human skeletons and on a very large number of skeletons belonging to various orders of mammals. The measurements were made at a level of a line from the inferior part of the body of the sternum to

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(#) I was not able to obtain Broca's article which Poirier says contains the application of the term thoracic index to the ratio of the horizontal diameters of the thorax.



the summit of the vertebral spine situated on the same horizontal plane. He found that the index for adult man, living and healthy, was 150, (or  $66 \frac{2}{3}$  according to the inverse ratio used in the present paper), and for the human skeleton 118 (84.7). In woman the thorax is more rounded than in man. The thoracic index in the foetus is about equal to or less than 100 (over 100), while it increases (decreases) up to full grown adult life, and decreases (increases) in old age. On the skeleton of the Negro the index has been found to be more than 118 (less than 84.7), but not enough measurements have been made on the Negro, however, to draw definite conclusions. In different types of mammals the index varies from 56 (178) in the ruminants to 112 (89.3) in the anthropoid apes. Weisgerber found in general that the thorax is flatter (in the antero-posterior direction) in animals with well developed clavicles.

Symington (12) states that the thoracic cavity undergoes several distinct alterations in its shape between foetal and adult life, and one of the most remarkable changes is due to its transverse diameter increasing more rapidly than its antero-posterior. The shape of the thorax is so liable to vary, that it is very unsafe to draw conclusions from individual specimens, but it is very probable that the thorax does not acquire its permanent shape until adult life.

Maurel (7) in a discussion of the methods of taking thoracic measurements mentions the one in which the antero-posterior and transverse diameters at the widest point of the thorax are used.



In general, four points have been chosen in taking measurements from the thorax; at the level of the suprasternal notch, at the level of the nipples or gladiolo-manubrial junction, at the gladiolo-xiphoid junction, and at the tip of the sternum. All things being considered, he thinks the third point is the best for taking accurate measurements from the thorax, for it more nearly represents the thorax free from muscular and abdominal influences. Maurel states that one M. Jousset, who made measurements in the Antilles, India, Indo-China, on the Negro of the Congo States, the Chinese and the Cochin-Chinese, found that people of color had chests tending to a barrel shape rather than the flat type.

According to Hutchinson (5), the process of thoracic development in man corresponds to the series of differences displayed in the chests of mammals from the lower to the higher types. In both cases the antero-posterior diameter of the thorax decreases at the expense of the transverse. Hutchinson was the first to express the thoracic index by means of the ratio of the antero-posterior to the transverse diameter (instead of the inverse ratio used by earlier writers). This method has been adopted by subsequent investigators and is used in the present paper. His measurements used in determining the thoracic index were taken at the level of the nipples. In a series of four fetuses varying in age from three to seven months, he found the thoracic index to average 103. From measurements of seven children between five months and three years of age he found the index to average 87. In a series of





fifty measurements on soldiers he found the average index to be 73.6. In a later paper (5a) Hutchinson states that Dr. Seaver, from measurements of 2300 students in the Yale gymnasium, found the thoracic index to be 70. In a series of measurements on foetuses, newborn, children under two years, children between three and seven years, and boys from fourteen to eighteen, he found the thoracic indices to be, respectively, for foetuses, 105-115, for newborn, 101, for children under two years, 94, for children from three to seven years, 85, and for boys from fourteen to eighteen years, 80.

Malone (6) published a series of measurements taken upon 119 male medical students. He does not state the ages of the individuals or the level at which the measurements were made, but the average thoracic index calculated from the two thoracic diameters measured at the end of forced expiration is 74.6.

Mehnert (8), Mettenheimer (9), Dwight (2) and Henke (4) all noted that the thorax in the newborn was more round in character than that of the adult.

From the preceding review of the literature it will be seen that comparatively little work has been done upon the subject of the thoracic index, (especially is this true in the case of the Negro), and practically nothing conclusive concerning the variations according to age, sex and race.

The instruments used in taking the measurements included a large pair of calipers (Martin's pelvimeter), a steel tape measure, and a narrow band of black elastic.



The mode of procedure was as follows: the individuals were measured standing, with the arms hanging naturally at the sides. The plane of measurement was indicated by the elastic band placed around the chest at the level of the gladiolo-xiphoid articulation. This point is considered the most favorable from which measurements may be taken. In the first place, it is a point easily determined in most cases, and not so variable in position as the nipples. The index at the nipple level usually varies only slightly however, from that measured at the end of the gladiolus. In the second place, the shape of the chest in cross section is most typical in this region, being less influenced by the external musculature of the upper extremity on the one hand and by the abdominal ~~viscera~~<sup>viscera</sup> on the other. The circumference of the chest was measured with the tape at the level determined. Then, with the calipers, the antero-posterior diameter was measured in the mid-sagittal plane, and the transverse diameter at the widest point on the thorax at this level (the prominence caused by the latissimus dorsi being ignored). In all cases the measurements were made at the end of quiet expiration and were taken over the clothing. In order to determine whether the thoracic index is appreciably different when measured over the clothing, a number of observations were made on the same individuals both when wearing the ordinary amount of clothing and when stripped. It was found that the effect of the clothing is merely to increase each diameter from .5 cm to 1 cm. and that the effect on the thoracic index is to increase it very slightly



The average amount of the increase in ~~the~~ cases observed was .7%, an amount probably within the limits of the errors of observation.

For the purpose of studying the thoracic index in the Negro, observations and measurements were made upon 506 healthy, living negroes of both sexes. Of this number 212 were on males between the ages of six months and eighty-five years. The remaining 294 were on females between the ages of four days and eighty-six years. Negroes <sup>in this country</sup> are rarely absolutely pure blooded, but there are only a very few in the entire list of measurements in which white blood was evidently predominant. In addition to the measurements on the thorax, the age, sex, weight, height and physique were obtained if possible. The data of most importance are age, sex and the thoracic diameters. In order to study the character of the chest during embryonal and foetal life (independent of race), eleven measurements were made upon embryos and foetuses from 26 days' development to 5 days after birth, ~~practically~~ <sup>most</sup> all of which were white. <sup>Nine</sup> ~~Ten~~ out of the eleven measurements were from specimens in the Anatomical Museum of the University of Missouri ~~and the eleventh was from a plate in Mittenheimer.~~

Immediately following is a table (Table I) of the thoracic indices of both male and female negroes grouped according to years. The highest and lowest index in each group is given and also the average for the entire group.









--TABLE I.--(Continued.)

--FEMALE--				--MALE--			
No. of Obs.	Lowest Index	Highest Index	Average	No. of Obs.	Lowest Index	Highest Index	Average.
3	75.00	78.43	73.66	—	—	—	—
5	64.80	71.70	71.41	2	71.50	75.00	73.25
1	—	—	71.10	1	—	—	73.20
2	71.15	75.40	73.27	3	71.90	76.30	73.24
2	74.20	83.33	78.76	2	72.13	78.43	75.28
2	70.83	76.90	73.86	1	—	—	67.27
7	65.09	85.92	75.37	1	—	—	70.04
2	68.80	79.60	74.20	2	77.50	80.30	78.90
2	71.18	82.19	76.63	—	—	—	—
—	—	—	—	2	72.13	74.60	73.26
1	—	—	64.00	—	—	—	—
6	66.66	82.14	76.18	2	59.00	76.50	67.75
—	—	—	—	1	—	—	72.40
1	—	—	85.93	—	—	—	—
2	59.00	73.40	66.40	—	—	—	—
1	—	—	80.00	1	—	—	66.00
2	73.07	80.30	76.68	3	67.85	89.20	79.18
1	—	—	76.50	—	—	—	—
—	—	—	—	1	—	—	73.21
—	—	—	—	1	—	—	67.10
2	72.90	76.00	74.45	1	—	—	73.00
—	—	—	—	1	—	—	71.00
1	—	—	78.94	1	—	—	71.40
2	73.07	73.90	73.48	—	—	—	—
—	—	—	—	1	—	—	72.72
1	—	—	76.92	—	—	—	—
1	—	—	77.30	1	—	—	73.77
2	70.83	88.46	79.64	—	—	—	—
1	—	—	74.10	1	—	—	72.30
<u>294</u>				<i>total</i> <u>212</u>			



If Table I be studied it will be seen that absolute dependence can not be placed upon the results for each year, because scarcity of observations at certain of the ages makes the factor of individual variation enter too largely and the results obtained can not be taken as typical for that year. When the results shown in Table I. are grouped in larger periods, however, the changes in the thoracic index are brought out more clearly and the factor of individual variation more nearly eliminated.

In discussing the results of the observations made above, it is our intention to mention first, the variation according to age in the Negro, secondly, the variation according to sex in the Negro, third, the variation according to race, (a comparison between the Negro and the White race) and lastly, the changes in the thoracic index in the embryo and foetus.

In Table II., which follows, the observations shown in Table I. (under female) have been grouped in 5 and 10 year periods. This table contains the lowest and highest thoracic indices found in each group and also the average for each group.

--TABLE II.--

Thoracic Index in-Female-Negro. (Grouped in 5 & 10 yr. periods.)						
Age	Av. Age	No./of Obs.	Lowest Index	Highest Index	Average	
1-11mo.	5.5mo.	10	80.00	94.11	85.83	
1-5yr.	3.30 yrs	39	68.00	88.88	76.84	
6-10 "	7.50 "	33	57.77	80.00	72.98	
11-15 "	13.30 "	19	63.04	78.26	68.75	
16-20 "	18.00 "	16	65.21	79.16	70.35	
21-25 "	23.20 "	32	65.30	81.63	71.57	
26-30 "	28.20 "	26	65.20	82.00	71.60	
31-40 "	35.60 "	38	65.70	82.90	72.48	
41-50 "	45.80 "	39	64.80	80.04	74.46	
57-60 "	55.90 "	25	64.00	85.70	74.93	
61-70 "	65.30 "	9	59.40	85.93	75.27	
er 70 "	78.20 "	8	70.83	88.46	76.68	



From the averages in Table II, a curve (Female in Fig. I.) has been drawn to show the age variations in the female more at a glance than they can be seen in Table II. This curve shows two main features; first, a rapid decrease in the thoracic index from about birth (average age 5.5 months, average index 85.6) to the age of puberty (average age 13.3, average index 68.75), and second, a more gradual rise from puberty through the remainder of life (average age 78.2, average index 76.68). The ~~first~~ <sup>descending portion of the curve</sup> again shows two periods, one of which consists of a <sup>more</sup> rapid decrease in the first few years immediately following birth (~~average age 3.3, average index 76.84~~) and another which is a more gradual decrease from about the third year to the age of puberty. The <sup>ascending limb of the curve</sup> ~~second~~ shows three periods; one, a rapid (average age 23.2, average index 71.57); increase in the index from puberty to early womanhood; ~~another~~, <sup>second</sup> a more gradual increase from early womanhood to about the time of the climacteric <sup>vi</sup> (average age 45.8, average index 74.46); and ~~still another~~, <sup>third still</sup> a more gradual increase through the remainder of life (average age 78.2, average index 76.68).

Table III, which follows below, contains, like Table II above, the grouping of the average indices of the male negroes in Table I into 5 and 10 year periods.



--TABLE III.--

--Thoracic Index in Negro Male.  
(Grouped in 5 & 10 year periods.)

Age	Av. Age	No. of Obs.	Lowest Index	Highest Index	Average
1-5	3.2	26	66.66	86.00	75.51
6-10	8.3	45	60.86	87.00	72.59
11-15	12.8	46	61.90	85.00	71.33
16-20	18.0	12	62.50	78.00	71.24
21-25	23.0	16	63.40	76.60	70.17
26-30	28.3	10	64.51	74.07	69.71
31-40	36.7	18	63.01	85.40	71.79
41-50	45.0	12	58.06	81.40	72.77
51-60	55.0	14	59.00	80.30	73.06
61-70	65.9	8	66.00	89.20	73.66
over70	77.0	5	71.20	73.77	72.28

Figure I shows a curve drawn from the averages of the thoracic indices in the above table. From this curve two general periods in the male are seen; first, one in which there is a ~~gradual~~ decrease in the thoracic index from early childhood (average age 3.2, average index 75.5) to early manhood (average age 28.3, average index 69.71), and secondly, one in which there is a ~~gradual~~ increase from early manhood through the remainder of life. The first period in the male may be subdivided into two, one a rather rapid decrease from early childhood to puberty (average age 12.8, average index 71.33), and the other a more gradual decrease between the age of puberty and early manhood. The second period may be subdivided also into two, one a gradual increase in the index from early manhood to forty-five years of age (average index 72.77), and another,





a gradual rise, slower than the one just mentioned, from forty-five to the age of sixty-six (average age 65.9, average index 73.66). From here there is a slight decrease, which is probably caused by individual variation due to an insufficient number of observations at that period.

If Table I be referred to, it will be seen that the most rapid decrease in the thoracic index in both male and female takes place between birth and about three years of age.

From a combination of Tables II and III, Table IV is constructed. It will be easily understood from a comparison with the two tables mentioned.

--TABLE IV.--

--Thoracic Index in Negro. (mixed)  
(Grouped in 5 & 10 year periods.)

Age	Av. Age.	No. of Obs.	Lowest Index	Highest Index	Average
1-11mo.	5.5mo.	10	80.00	94.11	85.83
1-5yr.	3.3yr.	65	66.66	88.88	76.31
6-10 "	7.9 "	78	57.77	87.00	72.75
11-15 "	12.9 "	65	61.90	85.00	70.58
16-20 "	18.0 "	28	62.50	79.16	70.73
21-25 "	23.0 "	48	63.40	81.63	71.10
25-30 "	28.3 "	36	63.20	82.00	71.07
31-40 "	35.9 "	56	63.01	85.40	72.00
41-50 "	45.6 "	51	58.06	81.40	72.10
51-60 "	55.6 "	39	59.00	85.71	74.26
61-70 "	65.5 "	17	59.40	89.20	74.51
Over 70 "	77.7 "	13	70.83	88.46	74.20

In order to show the variation of the Negro race as a whole according to age, a curve (Negro (mixed)) was planned from the averages in Table IV. (see Figure II, The curve shows the characters in general displayed by



both the curves in Figure I. There are two general periods. One extends from birth (average age 5.5 months, average index 85.73) to puberty (average age 12.9, average index 70.58), where the decrease in the thoracic index is rather rapid. The other extends from puberty to old age, (average age 77.7, average index 74.12), during which period there is a gradual increase in the index.

If Tables I. and II. together with Figure I. be compared, the variations of the thoracic index in the two sexes may be seen. Lack of measurements upon the male under one year of age accounts for the incompleteness of the male curve at its beginning. The indices of the two sexes correspond in that in each there are two general periods indicated. The first is an early decrease in the index, rather rapid and ending at puberty in the female, more gradual and ending at early manhood in the male. The second is an increase in the index in both cases, beginning rapidly at first, but becoming more gradual during the later periods of life. In general it may be said that, except for a period extending from a few years before puberty to a few years after puberty, the thoracic index in the female is from one to two per cent. higher than in the male. That is to say, then, that the thorax in the female is of a <sup>slightly</sup> rounder type than that in the male. Physique seemed to have no particular effect upon variation in the



thoracic index in either male or female.

If the curves of Figure II. are now compared with each other the variations of age in the Negro and White races may be seen. The curve for the Negro has been explained. The curve in Figure II. showing the variations in the thoracic index of the White race was ~~calculated~~ planned from Wintrich's table. The averages were made from his measurements taken at the level of the nipple. ~~A~~ The thoracic index of the White, as the curve shows, decreases from about ten years of age (index 74.5), (with two variations at the ages of 11.2 and 12.9) to the age of 14.3 (index 72.2). From this period the index increases gradually throughout early adult and adult life and continues to the age of 86.5 (index 77.38). The table shows no measurements below the age of 9.94.\* In addition, there is a period from 24.7 to 63 years during which he has no measurements recorded. The interesting point to note in a comparison of the two races is that the thoracic index in the White averages from two to three per cent. high<sup>er</sup> than<sup>in</sup> the Negro. This means, then, that the Negro has a flatter type of chest than the White race.

Wintrich's table offers only one age <sup>from which</sup> ~~where~~ a comparison of the sexes according to race may be made. The <sup>white</sup> thoracic index in the female (from Wintrich's table) calculated from measurements of fifty individuals (average

\* Hutchinson's observations, ~~on the thorax of the~~ however, would seem to indicate that, <sup>also</sup> in infancy & early childhood the thoracic index in the white is somewhat higher than that shown by my observations on negro children at corresponding ages. He also finds that the index drops rapidly during this period.



*These two sets of observations upon young white women therefore agree closely.*

age 24.8) is 74.6. From an average of fifty measurements, made upon women students at the Missouri University (average age 20.8 years) the index was found to be 73.14. In about an equal number (48) of negro women (average age 21), *on the contrary,* the thoracic index is 70.9 (see Table II). It is seen from this that the thoracic index in the negro woman is from about two to four per cent lower than the white woman, thus indicating a flatter type of chest in <sup>the female</sup> negro <sup>^</sup> than in the white.

(5) Hutchinson <sup>^</sup> found the thoracic index in fifty soldiers of the white race (average age 31 years) to be

73.6. Malone <sup>(6)</sup> <sup>^</sup> found the index in 119 male medical students to average 74.6. From Table III, it will be seen that, in males of the Negro race at about the ages corresponding to the ages which would be included in the measurements just quoted ~~from Malone and Hutchinson~~, the thoracic index is

about 70.7. ~~Again~~ <sup>Therefore</sup> in the males of the Negro we see the <sup>same</sup> tendency to flat-chestedness, ~~for~~ the thoracic index at the age indicated appear <sup>ing</sup> <sup>^</sup> to be from three to four per cent

lower than in white males of corresponding age. If Hutch-

inson's quotation of Dr. Seaver's measurements <sup>be correct,</sup> ~~can be re-~~ <sup>lower</sup> ~~lied upon~~ <sup>^</sup>, there would seem to be some doubt <sup>concerning</sup> ~~about~~ the above

conclusion ~~and the types of chest in the males of both races would more nearly correspond,~~ for Seaver's average thoracic

index from 2300 observations on Yale students <sup>(male)</sup> <sup>^</sup> was 70.

*Mintick's measurements upon 50 males (white) averaging 24.6 years <sup>indicate</sup> <sup>^</sup> the thoracic index to be 73.45.*





From the series of measurements taken upon the embryos and foetuses, Table V., which follows, was constructed.

--TABLE V.--

--Thoracic Index in Embryos, Foetuses, and Newborn.--

	Specimen	Length	Age	A.P. Diam.	Trv. Diam.	Index.
1	—	6.8mm	26 days	245mm	135.6mm	181.48
2	H 97	14.0 "	5.5wks.	5.4 "	3.6 "	150.00
3	H 56	24.0 "	7.0 "	9.0 "	7.0 "	128.50
4	H 32	50.0 "	10.0 "	19.0 "	20.0 "	95.00
5	H 55	65.0 "	12.0 "	18.8 "	20.6 "	91.20
6	H 33	120.0 "	16.0 "	37.0 "	39.0 "	94.90
7	H 54	150.0 "	21.0 "	38.0 "	40.0 "	95.00
8	H 106	40.0cm	8 mo.	67.5 "	75.0 "	90.00
9	H 32	50.0 "	full term	88.0 "	110.0 "	88.00
10	H 84	50.0 "	5 days	68.0 "	77.5 "	87.72
11	—	48.5 "	36 hrs.	81.0 "	90.3 "	87.09

In the first seven specimens, the length given is the crown-rump length. In the other four, the total length is given. The ages refer to intrauterine life, excepting the last two. *The specimens are mostly from the white race.* The table needs no further explanation except to say that in the column marked "Specimen", the figures refer to the number of the specimen in the collection of embryos and foetuses in the Anatomical Museum <sup>of the University of Missouri,</sup> The measurements for No. 1, however, was taken from Piper's wax model (Ziegler) and those for No. 11 from Fig. 6 in Mettenheimer's dissertation. From the thoracic indices in this table (averaging numbers 5 & 6 and numbers 10 & 11) along with the average indices for the first five groups in Table I., a curve was drawn to show the changes in the thoracic index during prenatal and early postnatal life (regardless of race). The thoracic index in the embryo (as shown from the curve in Figure III.) decreases very rapidly from 26 days of age, where the antero-posterior diameter is nearly twice that of



the transverse (index 181.48), to about the beginning of the early foetal life (10 weeks of age) where the antero-posterior is slightly less than the transverse (index 95). From this period the index decreases ~~very~~ gradually till birth (about  $9 \frac{1}{2}$  <sup>calendar</sup> months) where it is 88. <sup>In the Negro, at least,</sup> the decrease continues at about the same rate during the years of infancy and early childhood. It appears therefore that the <sup>respiratory</sup> changes taking place in the thorax at birth have no marked effect upon the thoracic index.

The question which we have now reached is that of the significance of the variations taking place in the thoracic index at the different ages. What is said of these variations in the Negro might be said in general of the White race as well, for it appears that they both follow the same general changes. It was seen that from early embryonal to early foetal life there was an exceedingly rapid change in the thoracic index from 181.48 to 95. The large index in the early embryo is unquestionably due to the great size of the heart. The rapid change from the exceedingly high to the lower index during this period is due to the receding of the heart, <sup>to</sup> and the growth of the lungs which begin to ~~push around~~ <sup>enlarge at</sup> the sides of the heart. These ~~two~~ factors, then, <sup>cause</sup> ~~allow~~ the anterior wall of the thorax to recede and ~~cause~~ the sides to spread out, thus decreasing the antero-posterior diameter and by <sup>this</sup> means of and to the growth of the liver, which presses up from below.



~~that~~ the thoracic index. The more gradual decrease in the thoracic index from early foetal life to birth may be due to the gradual ~~continued~~ <sup>size and</sup> change in the <sup>^</sup> position of the heart and the growth of the lungs ~~around~~ <sup>at</sup> the sides of the heart. Among other things which may influence the change in the index is the descent of the diaphragm, for any thing that tends to pull the anterior wall of the thorax down, causes a decrease in the index. On the other hand, the rate of the decrease might be retarded by the pushing up of the liver from below\* and the growth of the thymus into the thoracic cavity. After birth, however, ~~the~~ other factors assist in bringing about the changes in the thoracic index, yet the changes in the shape, size and position of some of the organs, as an important factor, must not be lost sight of. Vierordt (13) shows that the large heart and liver both actually decrease in size for a short time after birth and that when they do begin to grow, their development is relatively slower than <sup>that of</sup> <sup>^</sup> the other organs of the body. Thus the decrease in the size of the heart and liver tends to decrease the thoracic index. On the other hand, the large size of the heart and liver together with the growth of the thymus up to the second year of life may be factors in retaining the relatively large thoracic index in the period of infancy and early childhood. ~~Of the other factors to be considered, one is the effect of gravity both~~

\* The tendency of the pressure of the liver is to cause the lower part of the thorax to assume that form giving the maximum capacity, i.e. circular in outline. It tends, therefore to accelerate the reduction in the thoracic index until this reaches 100, ~~and~~ but to retard any further decrease.



~~upon the body wall itself, in front, and the weight of the organs attached to it. This would be true especially after the assumption of the upright position of the body.~~

Henke<sup>(4)</sup> advances the theory that this progressive antero-posterior flattening of the chest from birth to adult life is due to the manner of growth of the bony skeleton of the thorax. He thinks that the ribs in growing forward have to advance against the elasticity of the costal cartilages in front and that the outward and backward pressure, exerted upon the growing ribs (only true of course in the cases of the ribs attached by cartilages to the sternum) by the cartilages, tends to bow the ribs outward and, at the same time, to press the transverse processes of the vertebra to which the ribs are attached, backward. Both the outward bowing of the ribs and the change in direction of the transverse process ~~from transverse to more nearly oblique (from the body of the vertebra backward)~~ would tend to decrease the thoracic index. It is certain that the decrease in the index due to antero-posterior flattening does take place, but whether or not it is due solely, as Henke thinks, to the process of growth is ~~the~~ questionable. ~~Though the process of growth may be a factor, it seems that the more plausible theory would be one which would account for the greater part of the flattening as being due to a lowering and a receding of the ribs in order to relatively~~





~~decrease the size of the cavity in proportion to the decrease in size of the heart and thymus in the cavity and the liver below.~~

Mehnert,<sup>(8)</sup> who shows that the ribs undergo a progressive downward inclination with varying degrees of rapidity, from early foetal life to advanced age (which results in an antero-posterior flattening of the thorax. He thinks that the constant decrease of the thoracic index is due to the *sinking of the anterior thoracic wall caused by the* weight of the thoracic organs, together with the weight of the abdominal viscera attached to the diaphragm. Mehnert's theory applies well enough for the early years of life, though it ought not to be argued that gravity acting on the above mentioned organs is the only factor in producing the changes. If any dependence can be placed <sup>upon</sup> ~~in~~ Wintrich's tables, the statements of ~~Dr.~~ Weisgerber's results by Poirier, and the results of the measurements produced in this article, Mehnert is wrong in his assertion that there is a progressive antero-posterior flattening of the thorax from early foetal period through the remainder of life; for the <sup>evidence</sup> ~~three articles~~ above mentioned show that the progressive flattening takes place only to early adult life, and is then <sup>undoubtedly</sup> followed by a progressive antero-posterior widening of the thorax, which results in an increase of the thoracic index. ~~As to the significance of the increase in the thoracic index from early adult through the remainder of life, nothing can be said.~~



It seems therefore that the progressive decrease in the thoracic index up to early adult life may be due to a number of causes among which the <sup>characteristic</sup> process of growth in the thoracic wall (Henke), the factor of gravity (Mehnert), and the change in the relative size and position of the viscera are important. The progressive increase in the thoracic index from early adult life onward, however, can hardly be due to the above factors, and still awaits a satisfactory explanation.

--SUMMARY--

I. The thoracic index in the Negro as a race during the entire life undergoes an almost continuous change. This change consists of a decrease from birth to the age of puberty, most rapid in infancy and early childhood, followed by a rather gradual rise from puberty to the end of life.

II. The thoracic index in the female Negro shows about the same characters as the race in general. In the male Negro the decrease in the thoracic index continues to early manhood, followed by a gradual increase to the end of life.

III. In general, the thoracic index in the female Negro is from  $1 \frac{1}{2}\%$  to  $2\%$  higher than in the male except at a period of a few years just before and after puberty. Thus the thorax of the female is rounder than the male, except near



the age of puberty.

IV. From a comparison of the thoracic index of the Negro with that of the White race, the index in the Negro is found to be <sup>2% to 3%</sup> less than in the White, though <sup>the</sup> variations according to age appear to be about the same in character <sup>in both races</sup>. The thorax of the Negro is, therefore, flatter than that of the White race.

V. The thoracic index in the early embryo is very high (nearly 200), but it decreases, at first rapidly, then more slowly, throughout foetal life, being a little less than 90 at birth. From a comparison of the thoracic index during the latter part of the prenatal life with that of early postnatal life it seems that birth does not have a very pronounced effect on the thoracic index.



Index

90

85

80

75

70

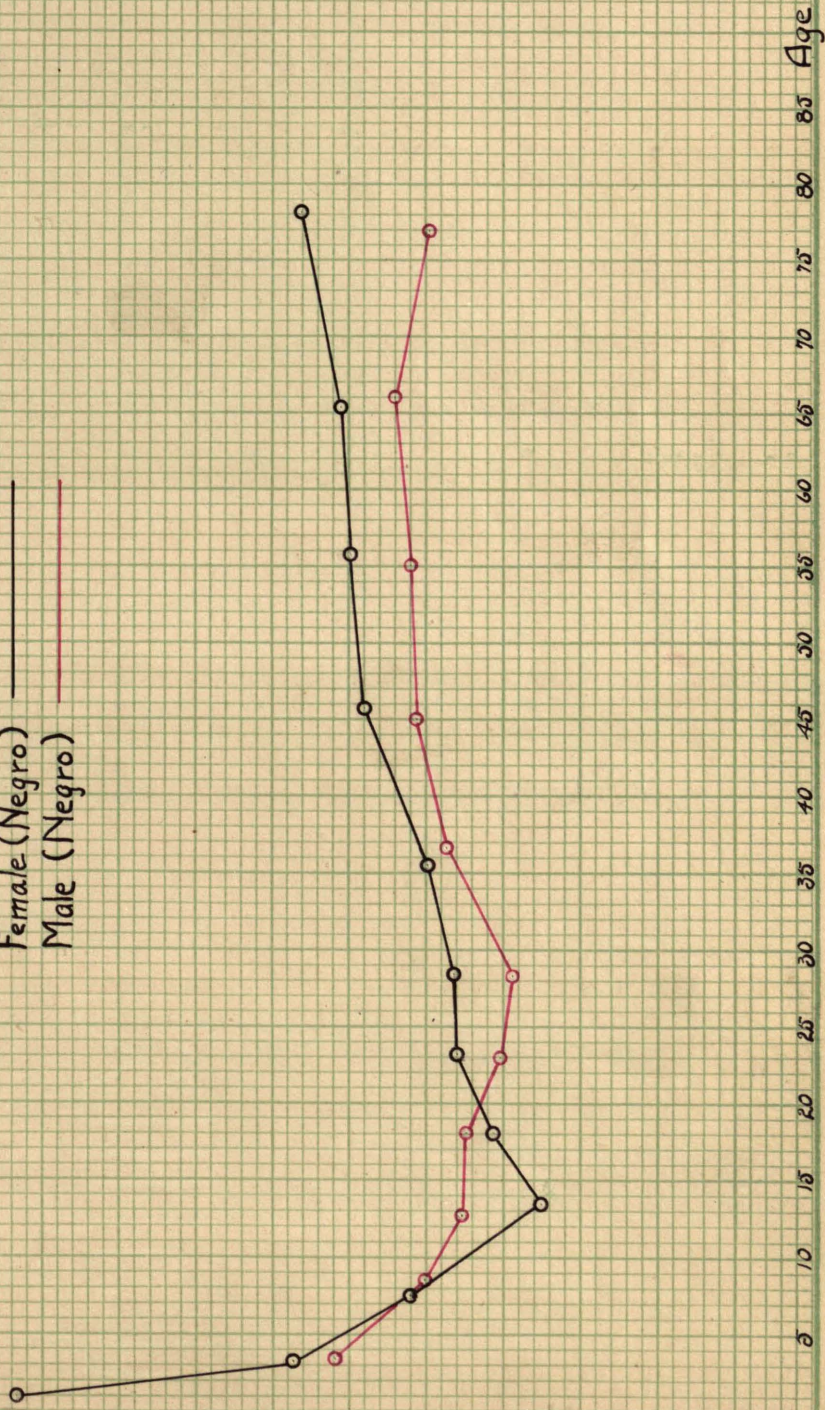
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Fig. I.

Age Variation According to Sex.

Female (Negro)

Male (Negro)



Age

85

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75

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35

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5





Index 90

85

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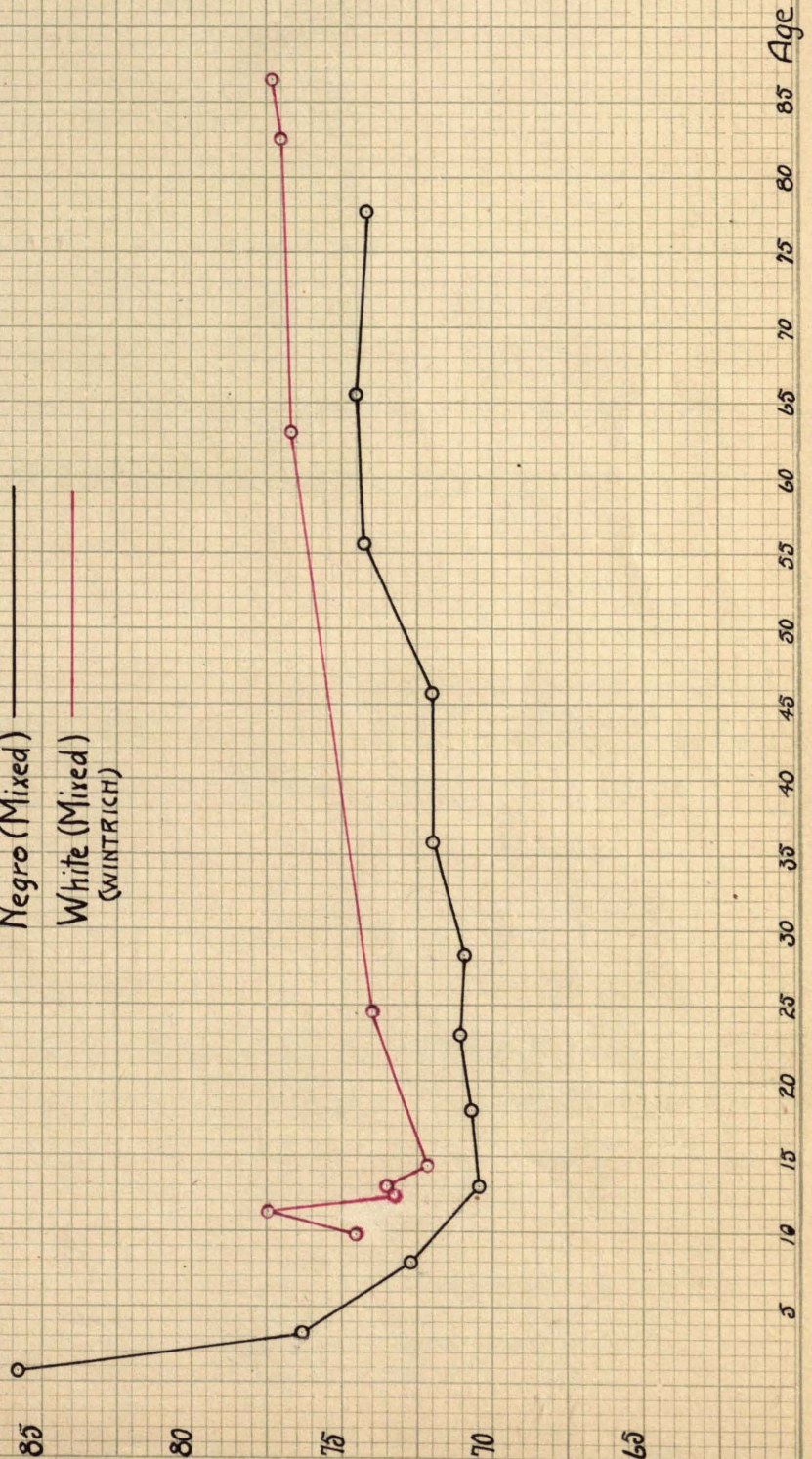
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Fig. II.

Age Variation According to Race

Negro (Mixed) —

White (Mixed)  
(WINTRICH) —

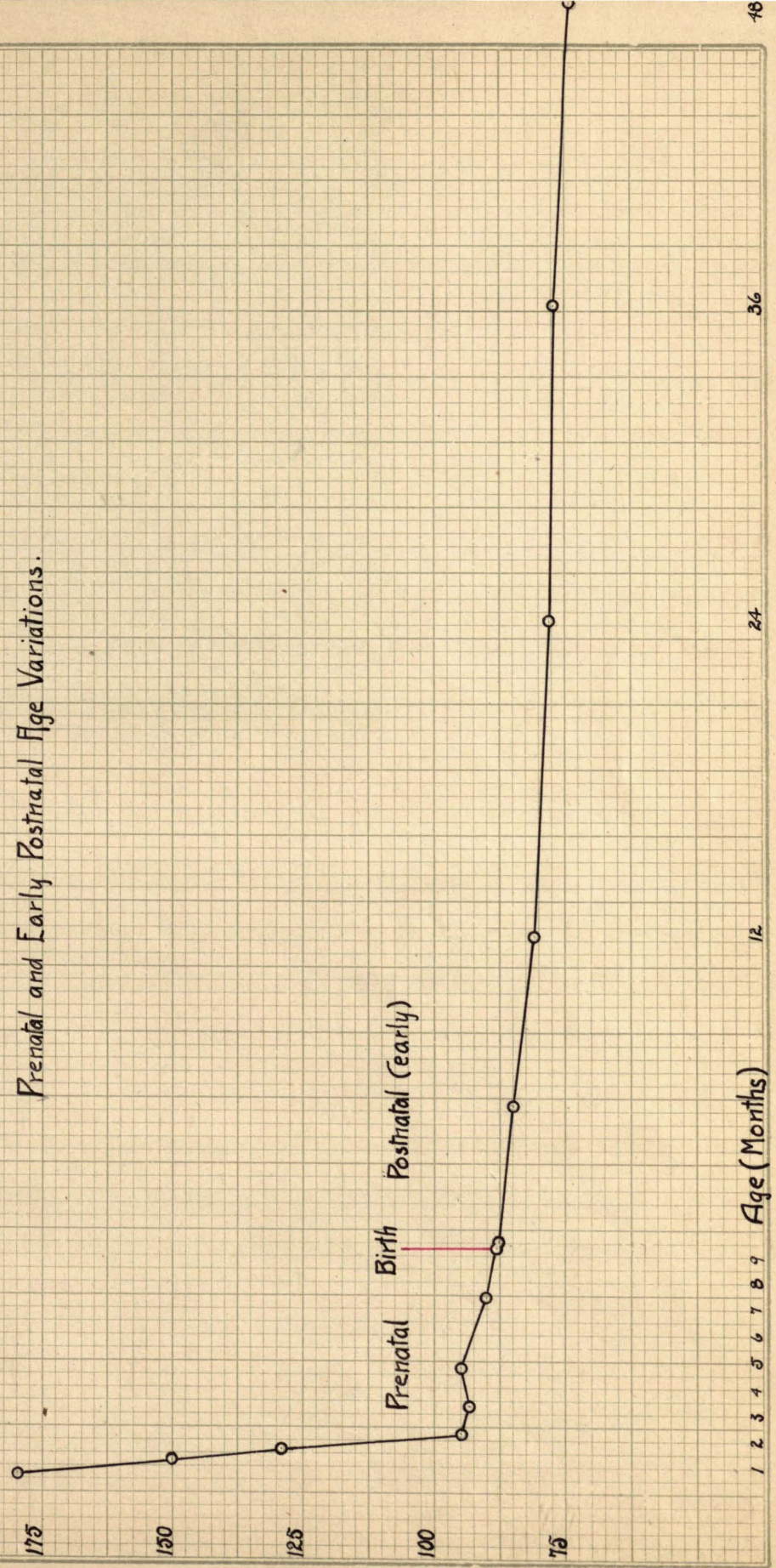


Age



Index  
200

Fig. III.  
Prenatal and Early Postnatal Age Variations.







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