ANTHROPOMETRIC MEASUREMENTS OF LIVE-BORN KENYAN INFANTS BETWEEN GESTATIONAL AGES OF 28-42 WEEKS DELIVERED AT KENYATTA NATIONAL HOSPITAL, NAIROBI, KENYA.

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D E C L A R A T I O N

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SUMMARY

Anthropometric measurements - weight, crown-heel length, head circumference, and chest circumference of 249 live-born babies between 28 and 42 weeks of gestation were taken and growth charts plotted.

The growth pattern of the Kenyan infant was found to be similar to those reported by other workers, there being a slow weight gain between 28 and 34 weeks followed by an increased intrauterine growth velocity from 34 to 38 weeks, and a decline thereafter. The growth in length and head circumference being relatively uniform, though the rate slows down from 38 weeks to term. The growth in chest circumference shows a growth spurt between 34 to 38 weeks and declines thereafter. The mean values when compared with values for caucasian infants for the same measurements, were found to be lower for all the age groups. Similar findings were obtained when comparisons were made with data for African infants from other African Countries, except Tanzania.

Aetiological factors to explain this retardation of intra-uterine growth remains at this stage largely speculative. High altitude, socio-economic status of the mothers, and environmental factors could have played a role but further studies are needed to confirm the role of each.

INTRODUCTION AND OBJECTIVES

Intra-uterine growth of the foetus is a product of the interplay of many factors when the foetus is still in utero. Such factors could be foetal, maternal, and environmental, and could be single or act in combination (1- 5). The outcome of each pregnancy will therefore depend on or the extent to which these factors have acted and this is reflected by the wide distribution of birth sizes for any given gestational age and a wide variation of the nutritional status at birth. Low birth weight is sill a major cause of infant mortality (2), but from birth weights alone, it is not possible to assess the degree of intrauterine growth retardation, for it has been found that infants of same gestational age, with same external body dimensions may differ in their birth weights by as much as 30 to 40% (7). Differences in birth weights of such magnitudes are dependent in large part on variations in amounts of soft tissue mass from one infant to another (7). When growth in weight only is affected, growth retardation is mild. If both weight and length are reduced, but there is relatively normal head size, the intrauterine growth retardation is moderately severe. If growth retardation occurs in all

three dimensions, it is severe (8).

Anthropometric measurements of intra-uterine growth would therefore provide the much needed information of how an infant has performed in utero. The infants at risk would be easily identified and appropriate immediate curative and preventive measures taken. Long term measures aimed at reducing perinatal mortality at national level would then be undertaken by proper planning of the Health services (2).

In developed countries, studies have been done on intrauterine growth of the foetus since 1950's(6,9-12.). For a long time, many third world countries have used the borrowed standards from those countries to compare the growth of their infants. It is only recently, since 1978, that some countries in Africa have initiated similar studies (13-15.). From the data so far available, notably birth weights, it is apparent that there is marked difference between infants born in developed countries compared to those born in the third world, (16-17). From the literature review, it has come out quite clearly that intrauterine foetal growth is very sensitive to environmental factors (1,3,4,5). Those factors are, however, not always static in any given population, and hence it is advisable that intra-uterine growth standards be reviewed from time to time for a given population.

In Kenya, there is so far no literature on intra-uterine foetal growth measurements except for birth weights and head circumference of full term babies (I6,I8). The standard growth charts in current use are those derived from studies on infants of Caucasian origin(I0,I9), and therefore are unlikely to be of much use on Kenyan African infants. It was therefore the purpose of this study to take anthropometric measurements of weight, crown-heel length, head circumference and chest circumference of live-born Kenyan infants delivered at Kenyatta National Hospital between gestational ages 28 - 42 and draw intra-uterine growth charts.

MATERIALS AND METHODS

This study was carried out in Kenyatta National Hospital (K.N.H.) Nairobi, which is situated at an altitude of about 5,500 feet above sea-level. This hospital is basically a referral hospital for complicated deliveries, however, routine uncomplicated deliveries are also carried out.

The author collected data from the postnatal wards and the newborn unit. Those babies who met the selection criteria listed below were examined by the author within 24 hours of birth.

Criteria for inclusion into the Study

(i) The baby must have been born to parent of Kenyan origin.

(ii) The delivery must have taken place in the labour ward of Kenyatta National Hospital.

(iii) The baby must not have been asphyxiated at birth.

(iv) The baby must have been born with no overt congenital malformations.

(v) The baby must have been a singleton.

(vi) The mother must have had no medical complication of pregnancy, e.g., nephritis, diabetes, hypertension, and chronic lung diseases.

(vii) The mother must not have suffered from toxaemias of pregnancy.

(viii) The mother must have been living in Nairobi and its environment within the last three months of pregnancy.

Gestational age assessment

Different authors who have done similar studies, have used different methods in estimating the gestational age. Some have used only the mother's menstrual history while others have combined the mother's menstrual history and the clinical method of Dubowitz et al (20).

In this study, which comprised mostly mothers from low socio-economic group, it was thought that the use of menstrual history alone would not give accurate estimations. Objective clinical assessment of gestational age was therefore carried out on all infants, and if the calculated gestational age was not compatible with that obtained by clinical assessment, the infant

was not included in the study. The Dubowitz method using both physical and neurological criteria has been applied to African infants and found to have an accuracy of prediction not significantly different from that of white infants (21). Infants delivered from 3 days before and 3 days after a completed week were considered to be that number of weeks of gestation.

Birth weight

Birth weight of each infant was taken using a beam balance scale made by Seca of West Germany. The weights were taken to the nearest 10 gms.

Crown-heel length

This measurement was taken with the infant lying supine on a measuring board with a fixed headpiece and a sliding foot-piece. With the infant's head facing the opposite side to the examiner, the opposite foot becomes reflexly extended,(7) and the sliding foot-piece is applied against it. The length was then read from a centimeter metal scale fixed to the board to the nearest 0.1 cms.

Head Circumference

Head circumference was measured around the largest occipito-frontal circumference using a plastic tape to the nearest 0.1 cms. The tape was applied at the level of the occiput, passing around the head and the same level on both sides to the frontal bones superior to the supra orbital ridges(22)

Chest circumference

Chest circumference was the smallest measurement passing through the nipple line using a plastic tape measure and taken to the nearest 0.1 cms.

RESULTS

During the study period from July 1984 to January, 1985, there were 4981 live infants born at the Kenyatta National Hospital (K.N.H.) labour ward. Most of these infants were full term and were admitted to the post-natal ward, while the preterm babies were admitted to the Newborn Unit. Of the 249 infants studied, 127 were males and 122 were females, however the data for both sexes were combined for they were too small for separate statistical analysis.

Majority of the mothers whose babies were studied 227 (91.2%) attended antenatal clinics while only 22 (8.8%), did not have any ante-natal clinic attendance. This latter group consisted of primigravidas and single mothers.

I - Actual body measurements for gestational age.

Table I presents the data for the anthropometric measurements of weight, crown-heel length, head circumference and chest circumference, while Table II shows weekly growth increaments 28 to 33 weeks, 34 to 37 weeks and 38 to 42

For the mean birthweights, Kenyan infants have the highest growth velocity between 34 and 38 weeks, followed by the period between 28 and 34 weeks, and minimal growth between 38 and 42 weeks. Growth in length and head circumference, however, take a different pattern, there being a progressive decline in growth upto 42 weeks. Chest circumference growth takes a similar pattern to that taken by growth in weight.

II Intra-uterine growth curves

Intrauterine growth curves in which the means 2SD for birth weight crown-heel length, head circumference and chest circumference are plotted against gestational age are shown in figures I-IV. The values used in the construction of these curves are presented in Table III In figure I, There is a slow increase in weight between 28-34 weeks followed by a growth spurt between 34 tO 38 weeks, thereafter, there is a decline growth velocity. In figure II, there is marked growth velocity in length betweem 28 and 34 weeks, and a progressive decline being more marked after 38 weeks. In figure III. The growth of the head has maximal velocity in the 28 to 34 week period and minimal from 38 weeks. In figure IV., the growth in chest circumference is maximal between 34 to 37 weeks, followed by the period between 28 to 34 weeks, and minimal between 38 and 42 weeks.

III Comparison of the data between Kenyan, Nigerian, Tanzanian, Ethiopian, and Lake Country, Colorado infants.

Table IV -VII and figures V - VIII show the actual measurements and the curves obtained by plotting the means of the measurements against gestational ages.

Birth weights

There is significant difference between the birth weights of Kenya infants when compared with those of Nigeria, $p < 0.001$, and Ethiopia $p < 0.001$ upto 39 weeks of gestation. The Kenyan infants being of lower births than their Nigerian and Ethiopian counterparts. However, comparison with Tanzanian and Lake Country, Colorado infants reveal no significant differences, t=-0.0000628, $t_c < t_t$ -0.0000628 < 3.499 for Kenyan and Tanzanian infants. t = -0.00049, $t_c < t_t$, -0.0009 < 3.106 for Lake County.

Crown-heel lengths.

Table V shows the data of the mean values of crown-heel lengths. There is significant difference of the means between Kenyan and Nigerian infants $p < 0.001$, while for Ethiopian infants, there is significant difference upto 37 weeks gestation when $p < 0.001$. There is no significant difference between Kenyan and Tanzanian infants t=0.0162, $t_c < t_t$, 0.0162 < 3.499. There is

also no significant difference in crown-heel lengths between Kenyan and Colorado infants t=-0.1197 $t_c < t_t$, $-0.1197 < 3.055$.

Head Circumference

The data for head circumference are presented in Table V. There is no significant difference between the head circumference of Kenyan infants, Nigerian and Tanzanian infants. $P \geq 0.50$, t=-0.1473, $t_c < t_t$, $-0.1473 < 3.499$ respectively for Nigerian and Tanzanian infants.

Chest circumference

Data for comparison were only available from the Nigerian study and are presented in Table VI. There is significant difference between chest circumferences of Kenyan and Nigerian infants. Kenyan infants had smaller chest circumference than Nigerian infants $p < 0.001$.

TABLE 1.

ACTUAL MEAN MEASUREMENTS OF WEIGHT, CROWN-HEEL LENGTH, HEAD CIRCUMFERENCE, AND CHEST CIRCUMFERENCE OF 249 KENYAN INFANTS BORN BETWEEN GESTATIONAL AGES 28-42 WEEKS.

GESTATION IN WEEKS	NUMBER OF CASES	WEIGHT (GMS). MEAN	±2SD	CROWN-HEEL LENGTH (CMS) MEAN	±2SD	HEAD CIRCUM. (CMS.) MEAN	±2SD	CHEST CIRCUM. (CMS.) MEAN	±2SD
28	7	850	136	33.5	3	25.0	5	20.0	1.0
29	12	995	310	34.6	5.14	26.1	1.78	21.0	3.4
30	11	1106	184	36.2	4.6	26.8	3.6	22.1	3.4
31	9	1164	210	38.3	3.0	28.4	1.4	22.9	6.6
32	13	1500	388	41.4	3.2	29.9	2.76	24.9	2.84
33	16	1641	414	42.4	3.78	31.0	2.74	25.6	4.0
34	10	1901	536	44.7	4.10	31.7	3.42	27.4	3.34
35	12	2115	792	45.4	4.30	32.6	3.14	28.0	7.46
36	15	2558	950	47.0	4.50	34.1	3.5	30.4	5.86
37	18	2591	788	47.3	5.0	34.6	3.16	31.2	5.0
38	20	2697	558	48.3	3.4	35.0	2.64	31.6	2.66
39	24	2826	658	48.7	2.72	35.0	1.58	31.1	3.54
40	53	3048	830	49.8	3.64	35.0	2.28	32.0	2.84
41	21	3141	836	50.4	3.08	35.1	2.68	32.8	3.38
42	8	3265	622	50.0	3.70	35.3	1.8	33.7	2.18

TABLE II: WEEKLY GROWTH RATES IN THE ANTHROPOMETRIC MEASUREMENTS BETWEEN 28 to 42 WEEKS.

GESTATION IN COMPLETED WEEKS	WEEKLY INCREASE IN THE ANTHROPOMETRIC MEASUREMENTS			
	WEIGHT (GMS)	CROWN-HEEL LENGTH (CMS)	HEAD CIRCUM. (CMS)	CHEST CIRCUM. (CMS)
28-33	150	1.58	0.98	0.98
34-37	190	0.98	0.72	1.12
38-42	113	0.34	0.06	0.42

TABLE III. - *SMOOTHED MEAN VALUES OF THE MEANS OF BIRTH WEIGHT, CROWN-HEEL LENGTH, HEAD CIRCUMFERENCE, AND CHEST CIRCUMFERENCE OF 249 KENYAN INFANTS AGED 28 TO 42 WEEKS AT BIRTH.

GESTATION IN COMPLETED WEEKS	WEIGHT (GMS)	±2SD	CROWN-HEEL LENGTH (CMS)	±2SD.	HEAD CIRCUMFERENCE (CMS)	±2SD	CHEST CIRCUMFERENCE (CMS)	±2SD.
29	983	210	34.8	4.24	25.9	3.46	21.0	2.60
30	1088	234	36.3	4.24	27.1	2.26	22.0	4.46
31	1257	337	38.6	3.60	28.4	2.58	23.3	4.28
32	1435	260	40.7	3.32	29.7	2.30	24.5	4.48
33	1680	446	42.8	3.69	30.8	2.92	25.9	3.39
34	1886	580	44.2	4.06	31.7	3.10	27.0	4.93
35	2191	759	45.7	4.30	32.8	3.26	28.6	5.55
36	2421	843	46.6	4.60	33.7	3.10	29.8	6.10
37	2615	765	47.5	4.30	34.6	2.46	31.0	4.57
38	2704	668	48.1	3.70	34.8	2.16	31.3	3.73
39	2857	682	48.9	3.25	35.0	2.46	31.5	3.01
40	3005	774	49.6	3.14	35.0	2.18	31.9	3.25
41	3151	762	50.0	3.47	35.1	2.25	32.8	2.80

*Mooving averages of the actual mean values to be used for the construction of growth curves.

FIGURE I: MEAN BIRTH WEIGHTS AGAINST GESTATIONAL AGES OF KENYAN INFANTS BETWEEN 28-42 WEEKS ±2 SD.

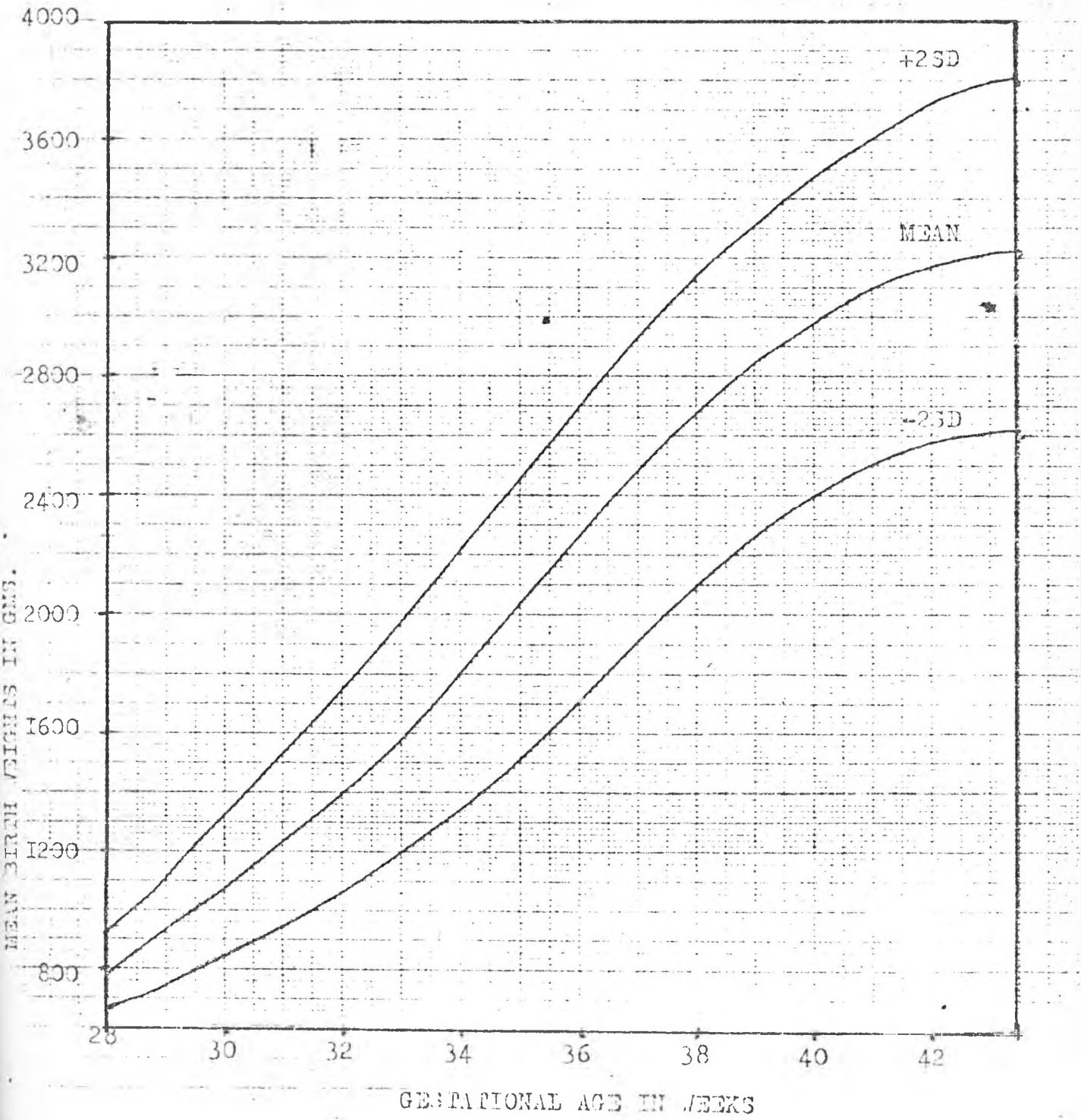


FIGURE II: MEAN CROWN-HEEL LENGTH AGAINST GESTATIONAL AGES OF KENYAN INFANTS BETWEEN 28-42 WEEKS +2SD.

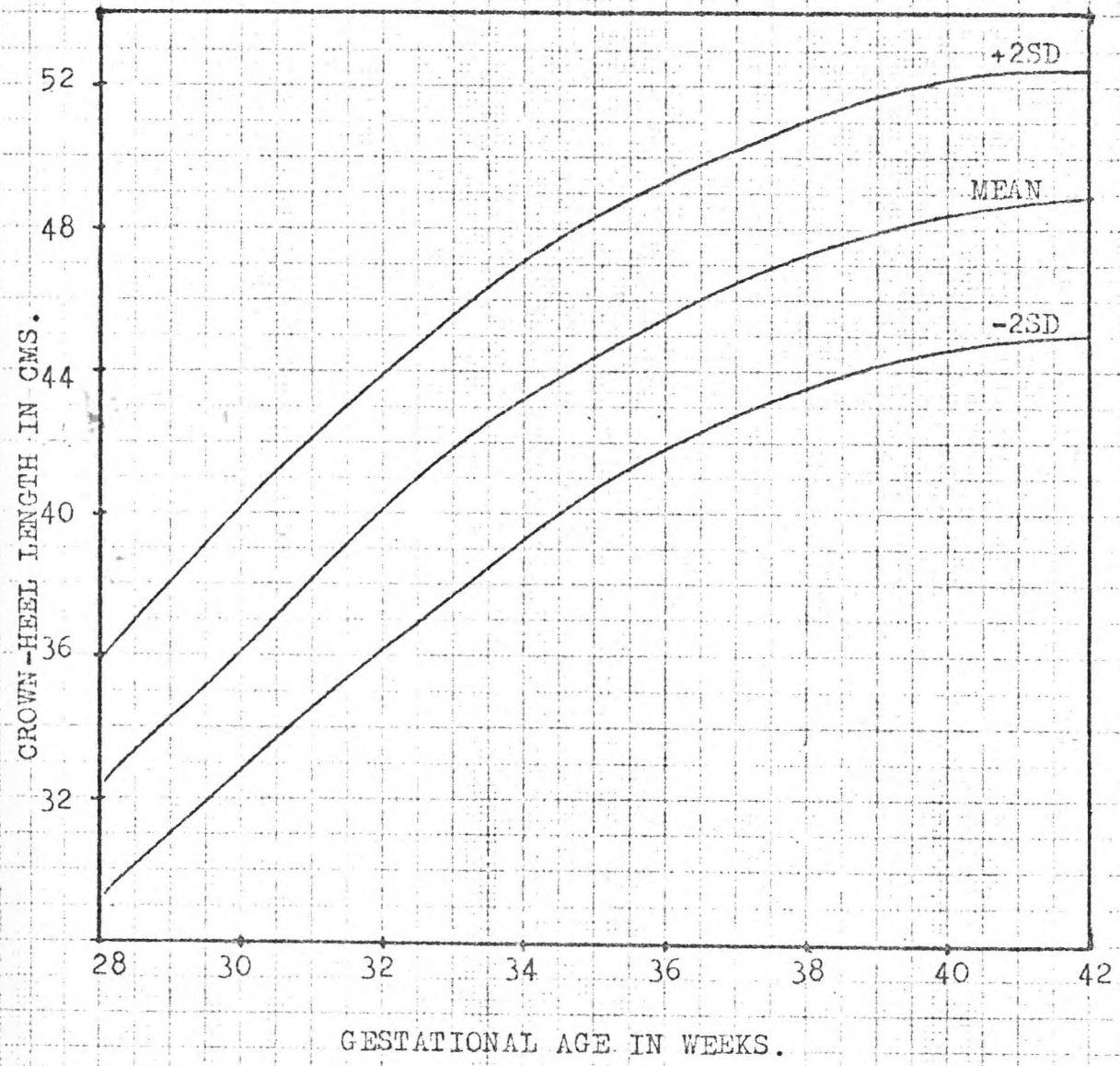


FIGURE IN. MEAN HEAD CIRCUMFERENCE IN CMS AGAINST GESTATIONAL AGE OF KENYAN INFANTS BETWEEN 28-42 WEEKS +2SD.

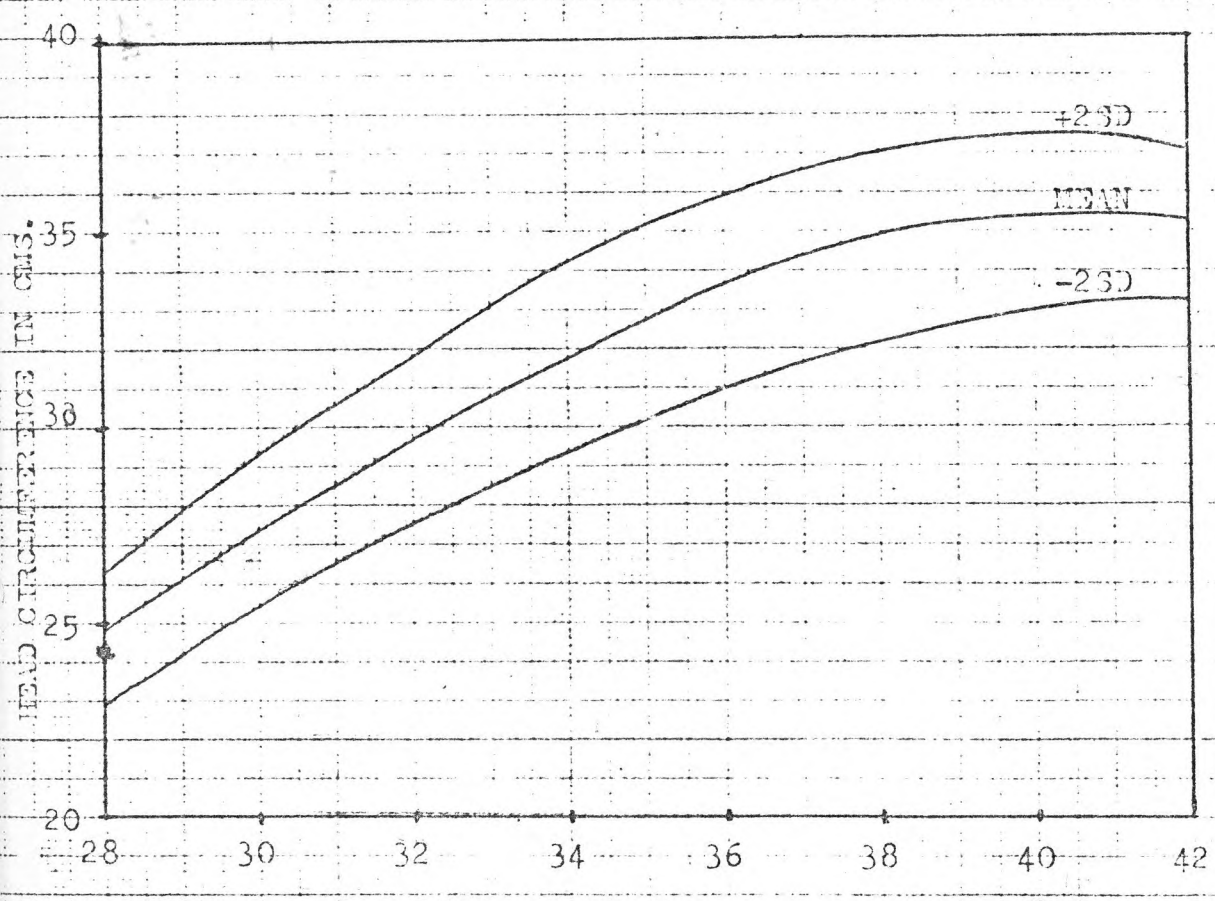


FIGURE IV. MEAN CHEST CIRCUMFERENCE (CHS) AGAINST GESTATIONAL AGES IN WEEKS +2SD FOR KENYAN INFANTS BETWEEN 28-42 WEEKS.

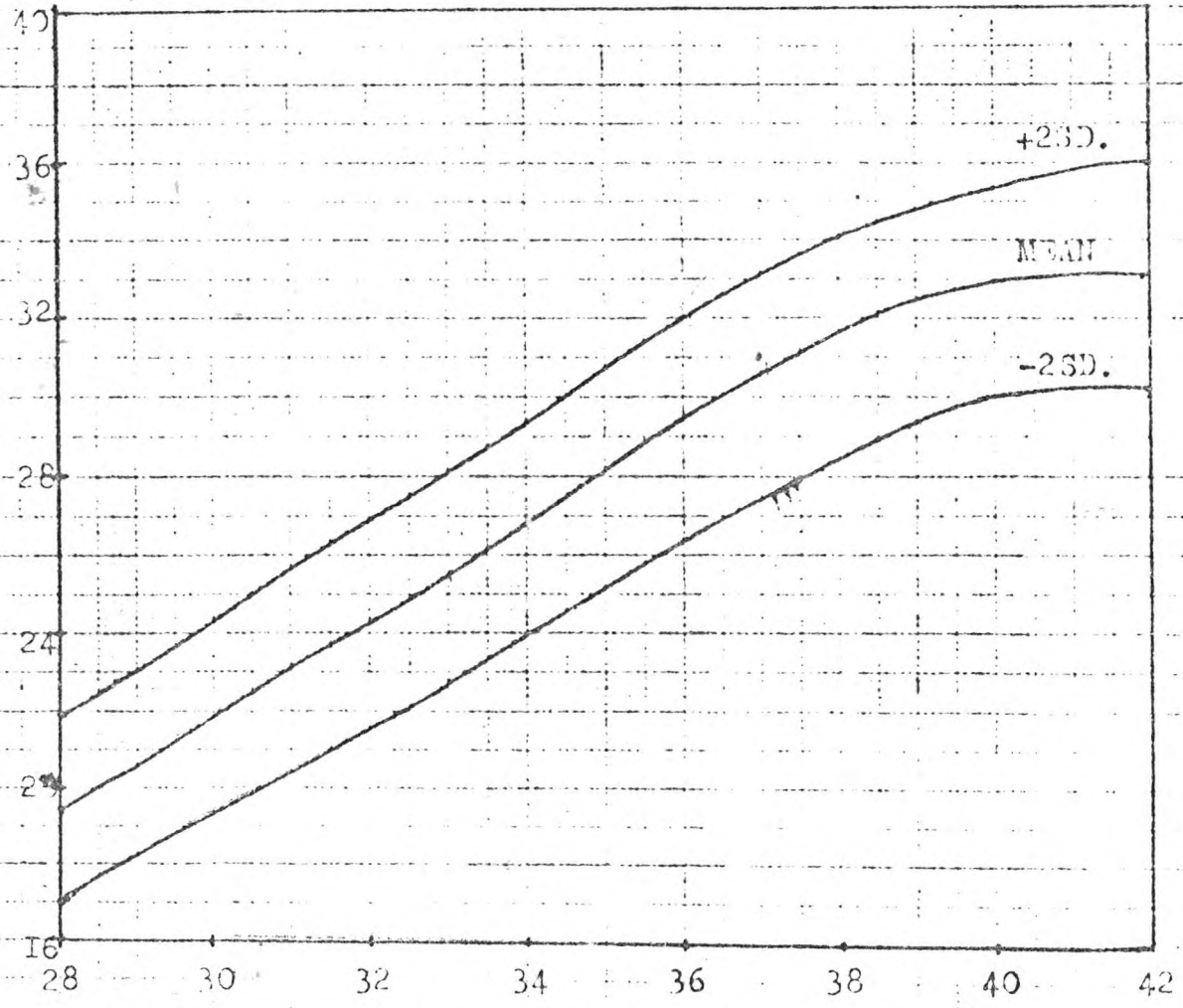


TABLE IV. MEAN VALUES OF BIRTH WEIGHTS OF KENYAN, NIGERIAN, TANZANIAN, ETHIOPIAN AND LAKE COUNTY, COLARADO INFANTS

GESTATION IN COMPLETED WEEKS	WEIGHT IN GMS				
	Kenya	Nigeria	Tanzania	Ethiopia	Lake County
28	850	1300	960		1130
29	995	1163			1250
30	1106	1556	1160		1320
31	1164	1630			1500
32	1500	2008	1370		1687
33	1641	2066			1750
34	1901	2231	1590	2900	2000
35	2115	2472		3100	2130
36	2558	2780	2120	3050	2500
37	2591	2870		3015	2375
38	2697	3084	2790	3105	2830
39	2826	3246		3175	2900
40	3048	3380	3070	3240	3166
41	3141	3583		3205	
42	3265	3604	3100	3265	

P < 0.001
The difference is significant.

δ = -0.0000628
t_t < t_c 0.0000628 < 3.499
The difference is not significant.

P < 0.001
The difference is significant

t = -0.00049
t_c < t_t -0.0009 < 3.106
The difference is not significant.

TABLE V: MEAN VALUES OF CROWN-HEEL LENGTHS OF KENYAN, NIGERIAN, TANZANIAN, ETHIOPIAN AND LAKE-COUNTY, COLORADO INFANTS

GESTATION IN COMPLETED WEEKS	MEAN CROWN-HEEL LENGTHS IN CMS				
	KENYAN	NIGERIA	TANZANIA	ETHIOPIA	LAKE COUNTY COLORADO
28	33.5	36.8	38.2		37.0
29	34.5	36.6			38.8
30	36.2	41.8	39.0		39.8
31	38.3	41.5			41.2
32	41.4	42,2	40.0		42.5
33	42.4	43.9			44.9
34	44.7	44.9	41.8	49.7	44.8
35	45.4	46.9		49.0	45.0
36	47.0	47.6	44.8	49.0	45.0
37	47.3	48.1		49.1	47.0
38	48.3	48.7	48.6	49.3	47.8
39	48.7	49.7		49.6	48.0
40	49.8	50.4	49.8	49.7	49.8
41	50.4	51.3		49.9	
42	50.0	51.5	49.7	49.9	
		P $<$ 0.001 The difference is significant.	$t = 0.0162$ $t_t < t_c$ $0.0162 < 3.499$ The difference is not significant	P $<$ 0.001 The difference is significant upto 37 weeks.	$t = -0.1197$ $t_c < t_t$ $-0.1197 < 3.055$ The difference is not significant.

TABLE VI: MEAN VALUES OF HEAD CIRCUMFERENCE OF KENYAN, NIGERIAN, TANZANIAN, AND ETHIOPIAN INFANTS

GESTATION IN COMPLETED WEEKS	HEAD CIRCUMFERENCE IN CMS			
	KENYA	NIGERIA	TANZANIA	ETHIOPIA
28	25.0	25.0	26.0	
29	26.1	25.7		
30	26.8	28.4	27.0	
31	28.4	28.9		
32	29.9	29.9	28.0	
33	31.0	31.5		
34	31.7	32.2	29.6	33.4
35	32.6	32.4		33.7
36	34.1	33.6	31.8	33.6
37	34.6	33.4		33.6
38	35.0	34.2	33.5	33.7
39	35.0	34.6		33.8
40	35.1	34.9	34.5	33.7
41	35.1	35.3		33.9
42	35.3	35.9	34.6	33.8
		$P > 0.50$ There is no significant difference.	$t = 0.1473$ $t_c < t_t$ -01473 < 3.499 There is no significant difference.	0.20 P 1.0 The difference is not significant.

TABLE VII: MEAN VALUES OF CHEST CIRCUMFERENCE OF KENYAN AND NIGERIAN INFANTS

GESTATION IN COMPLETED WEEKS	CHEST CIRCUMFERENCE IN CMS.	
	Kenyan	Nigerian
28	20.0	23.5
29	21.0	22.3
30	22.1	24.2
31	22.9	25.1
32	24.9	26.7
33	25.6	27.5
34	27.4	28.5
35	28.0	29.2
36	30.4	31.0
37	31.2	31.3
38	31.6	32.1
39	31.1	32.7
40	32.0	33.2
41	32.8	33.8
42	33.7	33.6

$P < 0.001$

There is significant difference between the chest circumferences.

FIGURE V: COMPARISION OF THE MEANS OF BIRTH WEIGHTS AGAINST GESTATIONAL AGES BETWEEN KENYAN, NIGERIAN, TANZANIAN, AND LAKE COUNTY (COLORADO INFANTS.

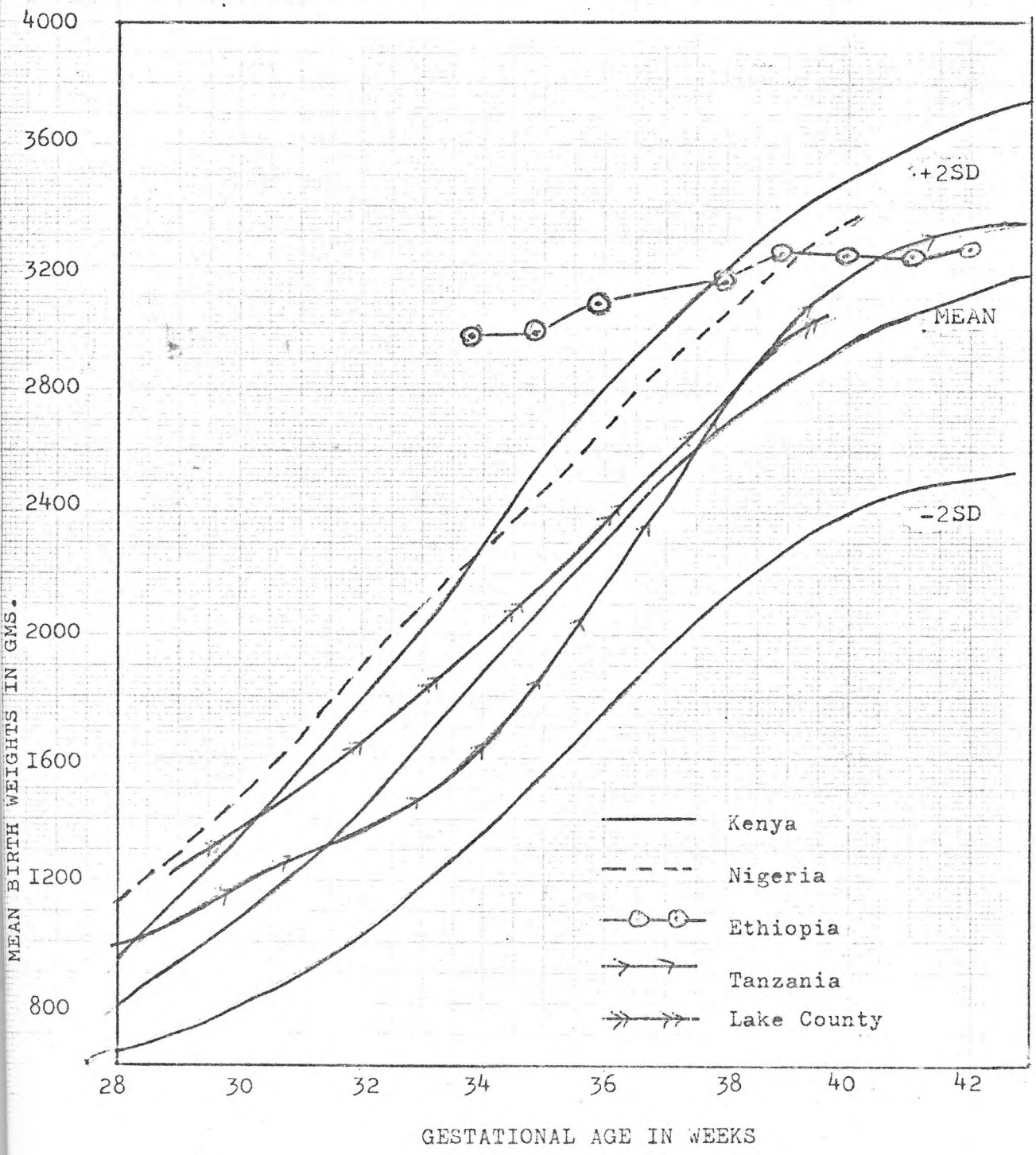


FIGURE VI: COMPARISON OF THE MEANS OF CROWN-HEEL LENGTHS AGAINST GESTATIONAL AGES BETWEEN KENYAN, NIGERIAN, TANZANIAN, AND LAKE COUNTY (COLORADO INFANTS

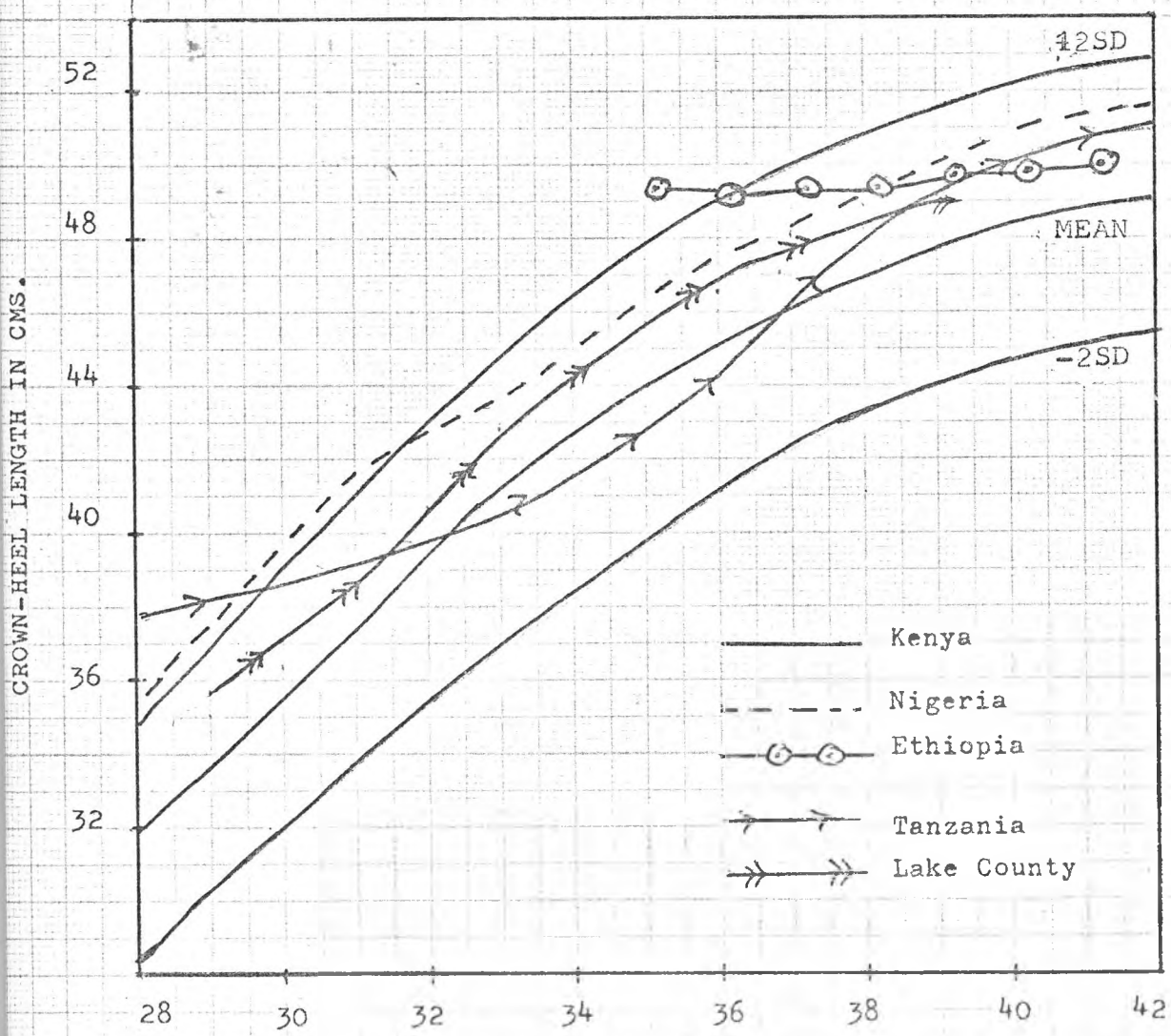


FIGURE VII: COMPARISON OF THE MEANS OF HEAD CIRCUMFERENCE AGAINST GESTATIONAL AGES BETWEEN KENYAN, NIGERIAN, TANZANIAN AND ETHIOPIAN INFANTS.

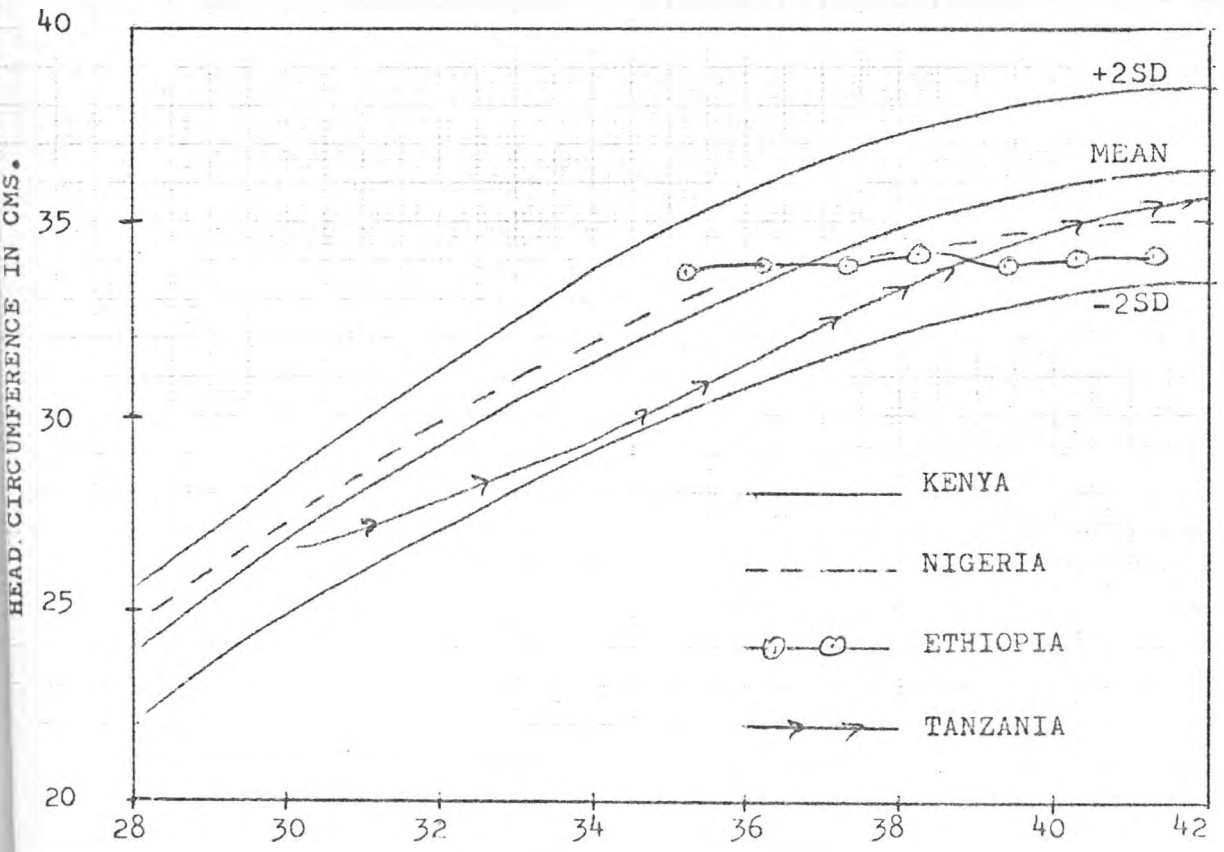
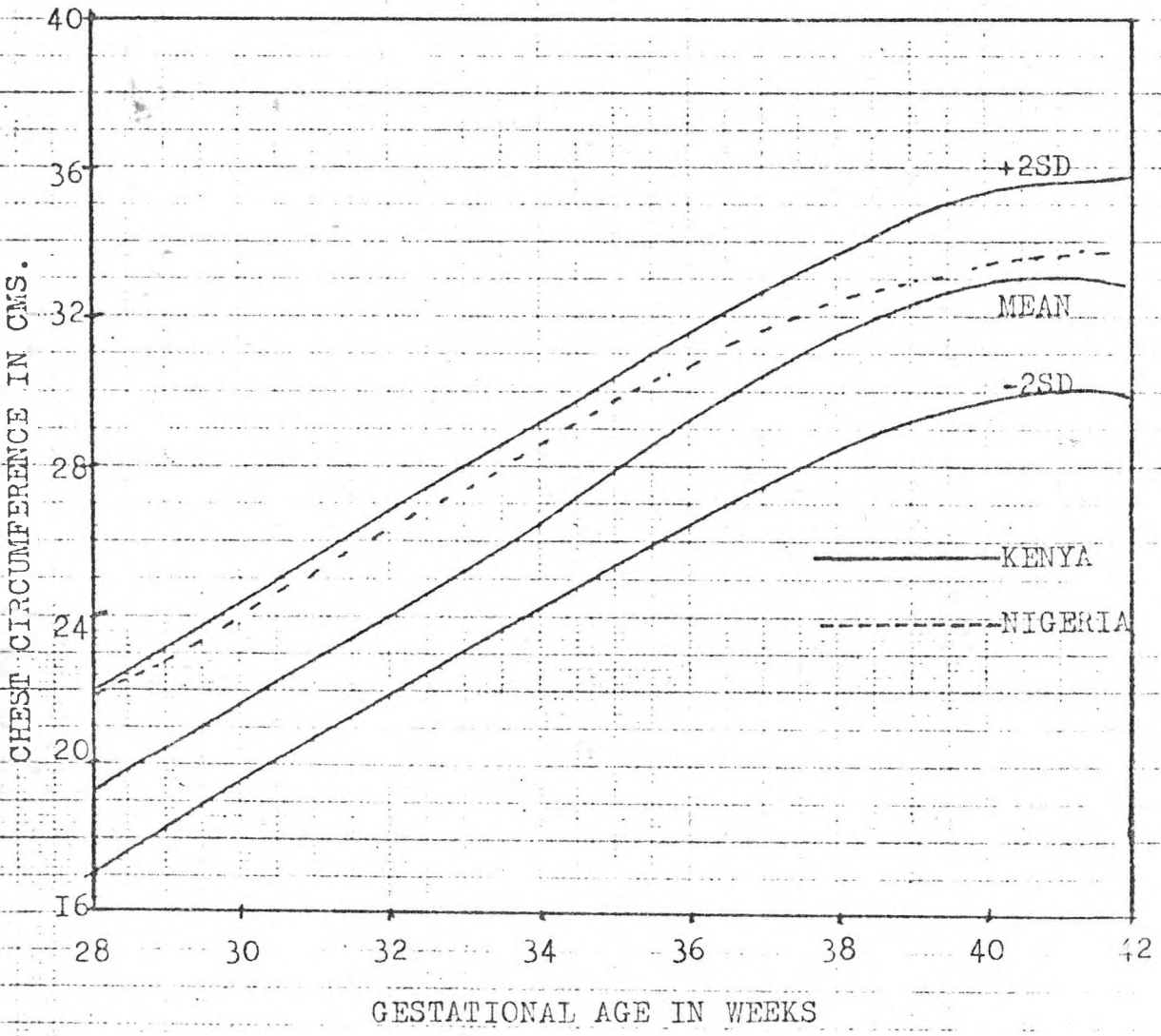


FIGURE VIII: COMPARISION OF THE MEANS OF CHEST CIRCUMFERENCE AGAINST GESTATIONAL AGES BETWEEN KENYAN AND NIGERIAN INFANTS.+ 2SD.



DISCUSSION

Perinatal mortality and morbidity in any population depends to a large extent, on the gestation and size of the infant at birth (24). It is therefore important that for a given population, there should be valid intrauterine growth charts for proper classification and management of neonates. Ideally such standards should be derived from the population for which the charts are meant to be used because important determinants of intra-uterine growth, such as race, socio-economic level, and altitude vary from one community to another.

In order to determine foetal growth, gestational age and the physical measurements must be as accurate as possible. Calculation of foetal age from menstrual history in itself has an error of about 5 days. This is contributed to by variation in the length of the menstrual cycle, in time of ovulation within the cycle and the time of conception in relation to ovulation. This is explained by the fact that duration of a menstrual cycle is taken as being 28 days ± 5 days.(23) Another source of error is the delay in ovulation which occurs during the cycle immediately following ceasation of ovulation inhibition methods of contraception (25). Errors may also arise in estimation of gestational age due to vaginal bleeding during early pregnancy (spotting) which may be considered

as having been a menstrual cycle by mothers whose previous cycles were not regular.

In the present study, large errors in estimation of gestational age were avoided by utilizing objective clinical assessment of maturity to corroborate gestational age calculated from menstrual history.

The results of this study as shown in Tables I - III, figures I, II, III and IV reveal that foetal growth of Kenyan foetus takes a similar pattern as most other studies have shown. For growth in weight, there is growth spurt from about 34 weeks to 38 weeks of intra-uterine life, while for the other measurements, there is a progressive increase thoughout from 28 weeks to 38 weeks. However, despite this growth pattern, the Kenyan infant appears smaller in all the dimensions except for head circumference when compared with infants of same age of most other studies.

The mean birthweight at term from this study is 2932 gms. This is lower than the figure of 3345 gms found by Oduori and Kaur in 1974(16). The possible explanation here would be that the Kenyan mother of the 70's was better off economically and hence nutritionally than the Kenyan mother of the 80's. Again, the present study was

carried out at a time of famine in the country from July 1984 to January 1985. This latter reason would be supported by the observations made by Clement in his study of the effect of wartime starvation in Holland upon pregnancy (4). Malaria, a common cause of low birth-weight in the tropics (26) is unlikely to have played a major role as malaria transmission in Nairobi is reported to be very low (27).

Comparison of the data between Kenyan and Nigerian infants Tables IV- -VII and figures IV - VIII, show that the anthropometric measurements of Nigerian infants except for head circumference are larger than the corresponding measurements of Kenyan infants. The Kenyan infant may have been smaller because of the effect of altitude, and possibly socio-economic status of the mother's of the babies studied.

The mothers in the Nigerian study (13), were from high socio-economic class, attended ante-natal clinic throughout the pregnancy periods and had supplements of iron, vitamins and anti-malarial prophylaxis given. These factors, in addition to living at a low altitude could explain this marked difference.

Comparison of the data between Kenyan and Tanzanian infants show that there was no significant difference between the various antropometric measurements. This

is contrary to expectation for the following reasons. Other factors apart, one would have expected the Tanzanian infants to be larger than Kenyan infants on account of the mothers having lived at sea level during the pregnancy period (1). Secondly, the majority of the mothers were from the working class and therefore were expected to be of reasonable nutritional status (3,5). However, on the other hand, two adverse factors may have influenced foetal growth of the Tanzanian infants. Dar-es-Salaam being a malaria endemic area, is likely that some of the mothers may have had malaria with placental parasitization unless anti-malarial prophylaxis was given throughout pregnancy. Parasitization of placenta is known to cause intra-uterine growth retardation and subsequent delivery of babies with low birth weights (26). Nutritional deficiencies during pregnancy is known to cause intra-uterine growth retardation (3), and Tanzanian mothers may have been victims of this factor since that Country has had food shortage for a number of years due to prolonged drought. However, without a nutritional survey of the population studies it is not possible to implicate this factor too strongly.

Comparison of the mean birthweights, crown-heel lengths and head circumference between Kenyan and Ethiopian infants shows that there are significant differences in these values. The difference in birth weights is marked between 34 - 40 weeks. This difference is difficult to account for since it is very marked and the Ethiopian infant does not follow the normal intra-uterine growth pattern as other infants do. It is possible that there was underestimation of gestational ages of term infants who therefore fell into lower age groups. Infants born in Addis-Ababa (altitude 11,000 ft) are expected to be smaller than infants born in Nairobi (altitude 5500 ft) on the basis of altitude, unless they have a genetic potential for such growth if other factors are excluded. Studies of lake County (Colorado) infants at an altitude of above 11,000 ft., show infants smaller than those born at lower altitude, but with normal growth pattern (1).

Comparison of data between Kenyan and Caucasian infants are shown in Tables IV and V ; Figures V - VII and IX. There is no significant difference between birthweights of Kenyan and Lake County, Colorado, infants and neither was there significant difference in the crown-heel length measurements in the groups of infants.

CONCLUSIONS.

1. The results of this study reveal that the intrauterine growth pattern of Kenyan infants is the same as those reported for other countries.
2. The growth of the Kenyan infant is retarded in utero.

RECOMMENDATIONS

1. A continuation of this study should be done at both Kenyatta National Hospital and Pumwani Maternity Hospitals and private hospitals so as to have large enough data representative of the population of Nairobi.
2. Similar studies should simultaneously be carried out at each of the provincial hospitals. This would reflect the various environmental, genetic, and socio-economic factors that are known to influence foetal growth.

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