MATERNAL AND NEWBORN NUTRITION STUDIES AT PHILADELPHIA LYING-IN HOSPITAL*

NEWBORN STUDIES. V. SIZE AND GROWTH OF BABIES DURING THE FIRST YEAR OF LIFE

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DURING the course of the Nutrition Study at the Pennsylvania Hospital, physical examinations were routinely done on the infants in the study population. These examinations were performed on the newborn infants within a few days of birth and, subsequently, at ages one, two, three, six, and twelve months. The examination procedure included determination of weight and measurement of the baby's chest circumference, crown-sole length, crown-rump length, hip breadth, head circumference, and calf circumference. The analysis of the data on weight, crown-sole length, and chest circumference for the examinations up to three months of age have been presented in another paper in this series of Newborn Studies (1), and this paper will report on all measurements made at birth and at three, six, and twelve months of age.

The analysis is based on the records of 1,391 singleton infants, weighing more than 5.5 lbs. at birth, whose mothers attended the Nutrition Clinic during the years 1947–1952. Babies of mothers with syphilis or a serious chronic disease have not been included.[4] Three hundred and fifty-four of the

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[4] Patients with chronic disease or syphilis referred to the Nutrition Research Clinic were carried but have been excluded from tabulations in this report. Chronic diseases excluded are essential hypertension, chronic heart classified II-a or higher, chronic nephritis, and chronic pyelitis.

babies were Negro, and the remaining 1,037 were white, of whom about 75 per cent had one or both parents of Italian ancestry. All infants were on the same regimen in the Hospital, and the mothers were given uniform diet instructions and vitamin supplements for their babies. The condition of the infants was generally appraised as favorable by the pediatricians, only 3 per cent being rated as poor at birth.

The babies were not always returned to the Clinic for each scheduled examination and the number for whom observations are available decreases considerably after the birth examination. This attrition is especially heavy among the group of white infants. Weight was determined on almost all of the individual examinations, but it was not always possible to make all of the other measurements so that there are differences in the numbers on which the analysis of each measurement is based. Measurement of calf circumference was not included in the examination until the later part of the program, and there are fewer observations of this dimension than there are of the other measurements.

In most cases, the examinations were not done at exactly three, six, and twelve months of age. The observations were adjusted to these ages by plotting the measurements for each baby and making a linear interpolation or extrapolation from the date of examination to the date on which it should have been done. This method was not used to estimate missing observations when no examination had been performed.

During much of the study the measurements were made by one pediatrician (A.R.).[5] The procedure for each measurement is as follows:

Weight: The infants were weighed nude on a scale measuring in pounds and ounces, and the weight was read to the nearest ounce.

Chest Circumference: Measured with a steel tape in centimeters

[5] Measurements not done by Alexander Randall, IV, M.D., were done by Josephine Perlingiero Randall, M.D., and Thomas R. Boggs, M.D.

to the nearest tenth at the level of the xiphoid normal to the body axis.

Crown-Sole Length: With the baby placed flat and straight on a board, the measurement was made from the plane tangent to the top of the head to the bottom of the heels, and read in centimeters to the nearest tenth.

Crown-Rump Length: Measured between the planes tangent to the top of the head and the bottom of the buttocks when the infant was lying on his back on the measuring board with the legs flexed on the abdomen.

Rump-Sole Length: Computed by subtracting the crown-rump length from the crown-sole length.

Hip Breadth: Measured with sliding steel calipers, graduated in millimeters, at the maximum breadth between the iliac crests.

Head Circumference: Measured approximately around the crown at the greatest circumference in this area with a steel tape and read to the nearest tenth of a centimeter.

Calf Circumference: Measured with a steel tape at the maximum circumference of the calf, and read to the nearest tenth of a centimeter.

The purpose of the Nutrition Study was to assess the effect of nutrient supplements in the diets of pregnant women upon the outcome of pregnancy and the physical status of the infant. The latter question has been reported upon in earlier papers in this series (2) (3), based upon the examination of the infants at birth and one month of age. It was concluded that the effect of the supplements upon the physical condition of the infant was slight. It was believed that if no action of the supplements was apparent during the first month of life, none would appear later. However, the observations at the later ages during the first year of life were analyzed to see whether the supplements seemed to influence the size and growth of the infants, but no such association was found. In view of these negative results, the extensive data for this analysis will not be presented in this report.

Table 1. Mean and quartile values of weight by age and by race and sex.

Race and Sex	Mean (lbs.)				Standard Deviation				Number			
Section A	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months
White Males	7.53	13.45	18.05	23.47	.96	1.58	2.00	2.77	569	265	238	134
White Females	7.26	12.42	16.72	21.68	.89	1.29	1.86	2.59	468	248	212	122
Negro Males	7.38	13.49	17.67	22.76	1.02	1.41	2.05	2.77	185	151	141	92
Negro Females	7.15	12.43	16.46	21.42	.95	1.60	2.08	2.87	169	130	120	84

	Difference in Means				Ratio of Means			
Section B	Male Minus Female				$\left(\frac{\text{Male}}{\text{Female}}\right) \cdot 100$			
	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months
White	.27	1.03	1.33	1.79	103.7	108.3	108.0	108.3
Negro	.23	1.06	1.21	1.34	103.2	108.5	107.4	106.3
	White Minus Negro				$\left(\frac{\text{White}}{\text{Negro}}\right) \cdot 100$			
Male	.15	−.04	.38	.71	102.0	99.7	102.2	103.1
Female	.11	−.01	.26	.26	101.5	99.9	101.6	101.2

	Quartile Values (lbs.)											
Section C	Birth			3 Months			6 Months			12 Months		
	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile
White Males	6.87	7.59	8.26	12.38	13.46	14.51	16.61	17.90	19.41	21.65	23.52	25.25
White Females	6.67	7.30	7.93	11.49	12.33	13.22	15.40	16.54	17.78	20.01	20.89	23.32
Negro Males	6.67	7.39	8.22	12.49	13.41	14.39	16.27	17.58	18.91	21.00	22.41	24.29
Negro Females	6.47	7.11	7.86	11.20	12.44	13.60	14.93	16.44	17.68	19.36	21.40	23.00

Measurements at Each Age

The observations at birth and three, six, and twelve months of age are summarized in Tables 1–8 and Figures 1–8. One table and figure is devoted to each measurement and each table is divided into three sections. In Section A are given the means and standard deviations for each of the four race-sex groups; Section B shows the differences in the means by race and by sex and the ratios of the means of male infants to those for females and the ratios of the means for whites to those for Negroes; in Section C are the quartile values for each distribution of the observations by race and sex.

Weight (Table I and Figure 1). The average birth weights

Fig. 1. Mean and quartile values of weight by age and by race and sex.

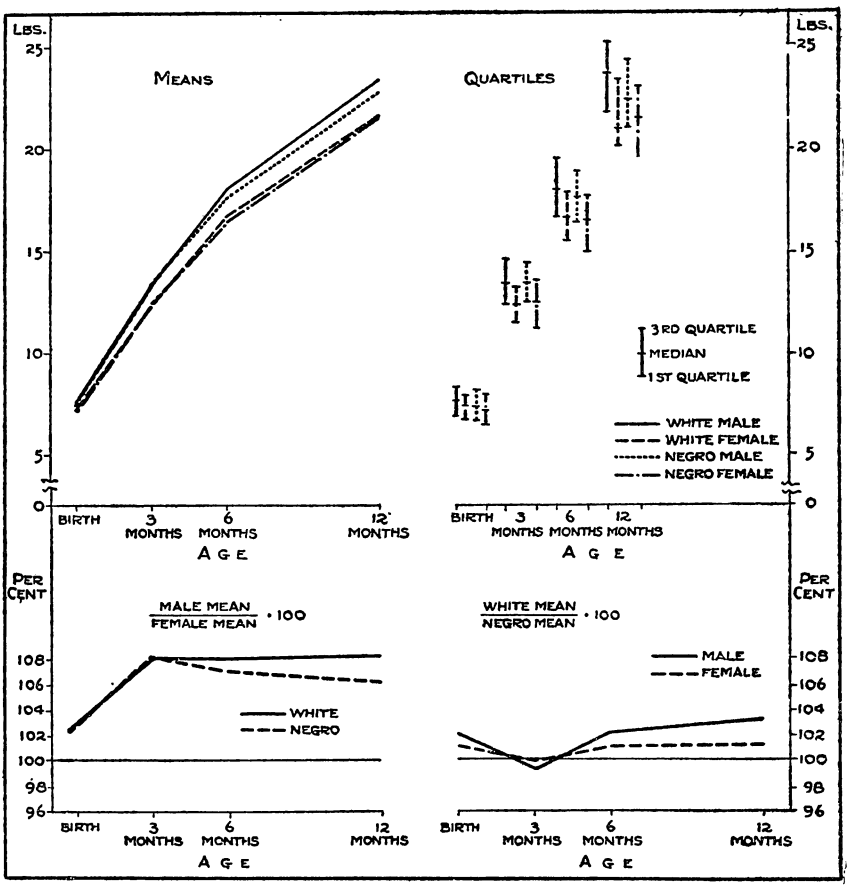

Table 2. Mean and quartile values of chest circumference by age and by race and sex.

Race and Sex	Mean (cms.)				Standard Deviation				Number			
Section A	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months
White Males	32.60	41.01	44.73	48.71	1.67	1.78	1.84	2.21	508	265	232	130
White Females	32.25	39.78	43.50	46.86	1.55	1.63	1.82	2.12	406	247	211	121
Negro Males	32.01	40.67	44.14	47.51	1.85	1.71	1.88	2.14	161	151	137	91
Negro Females	31.89	39.45	42.93	46.21	1.68	1.79	2.05	2.30	148	129	115	82

	Difference in Means				Ratio of Means			
Section B	Male Minus Female				$\left(\frac{\text{Male}}{\text{Female}}\right) \cdot 100$			
	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months
White	.35	1.23	1.23	1.85	101.1	103.1	102.8	103.9
Negro	.12	1.22	1.21	1.30	100.4	103.1	102.8	102.8
	White Minus Negro				$\left(\frac{\text{White}}{\text{Negro}}\right) \cdot 100$			
Male	.59	.34	.59	1.20	101.8	100.8	101.3	102.5
Female	.36	.33	.57	.65	101.1	100.8	101.3	101.4

	Quartile Values (cms.)											
Section C	Birth			3 Months			6 Months			12 Months		
	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile
White Males	31.36	32.59	33.83	39.74	40.91	42.21	43.43	44.76	45.84	47.20	48.70	50.26
White Females	31.16	32.18	33.34	38.70	39.79	40.89	42.22	43.40	44.65	45.22	46.86	48.59
Negro Males	30.64	31.92	33.34	39.57	40.62	41.82	42.77	43.86	45.51	46.04	47.21	49.13
Negro Females	30.82	31.79	33.19	38.29	39.46	40.63	41.31	43.27	44.41	44.61	46.18	48.04

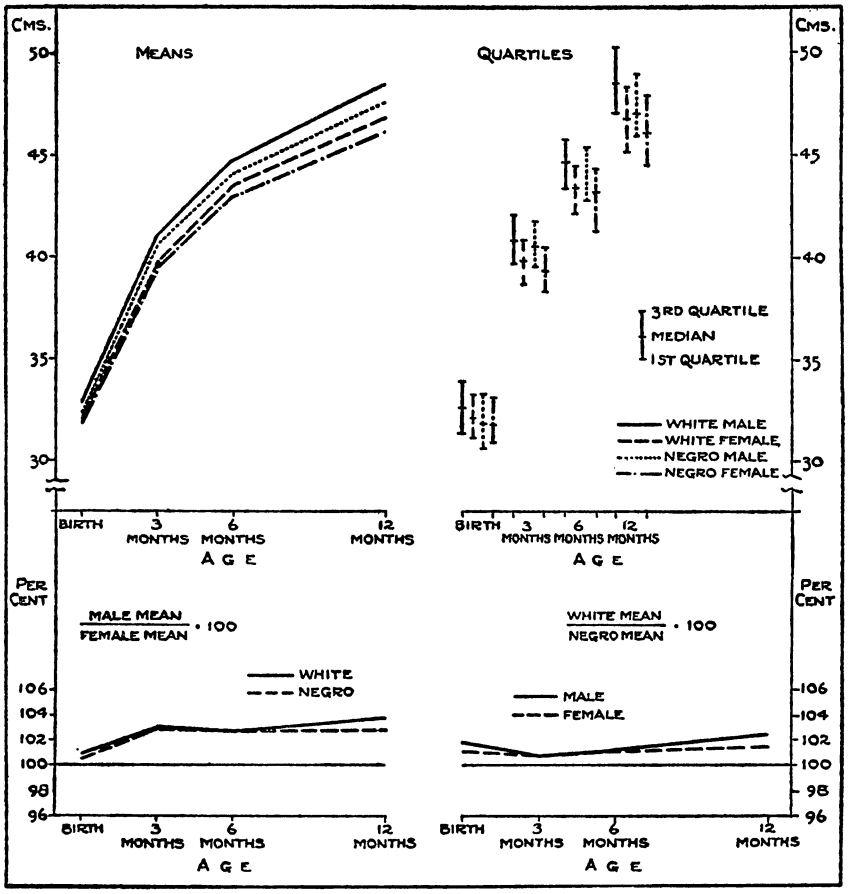

Fig. 2. Mean and quartile values of chest circumference by age and by race and sex.

for the four groups of babies range from 7.15 lbs. for Negro females to 7.53 for white males. At three months of age the means fall between 12.4 and 13.5 lbs., at six months between approximately 16.5 and 18.0 lbs., and at twelve months between 21.4 and 23.5 lbs. The average weight of male infants is greater than that of females at all four observations during the first year of life. At birth the means for the male groups are about .25 lbs. above those for females; at three months the difference is over 1 lb. and at twelve months of age it is 1.79 lbs. for the white babies and 1.34 lbs for the Negroes. In relative terms, the mean weight for males is about 3 per cent

greater than that for females at birth, the differential increasing to 8 per cent at three months and remaining between 6 and 8 per cent for the subsequent observations. The mean weight for white infants tends to be slightly larger than the mean for Negro infants of the same sex at each age except three months. This difference at birth is under .2 lbs. and at twelve months is almost .75 lbs. for males and .26 for females. At three months there is practically no difference between the average weight of white and Negro babies of the same sex. The corresponding differences expressed as a per cent of the means for Negroes are 2–3 per cent for males and 1–2 per cent for females. Study of the quartile values, illustrate the tendency of heavier weights in male infants and the relatively smaller differences in weight by race. At each of the four points of observation the quartile values for males are larger than the corresponding values for females of the same race. These differences are small at birth but emerge clearly at the later ages.

Chest Circumference (Table 2 and Figure 2). At birth the means of chest circumference in the four groups of babies are between 31.9 and 32.6 cms. and at twelve months they vary between 46.21 cms. for Negro females and 48.71 cms. for white males. The means for males are larger than those for females except at birth when the mean for white females (32.25 cms.) exceeds that for Negro males (32.01 cms.). At the examinations at three months and after, the average chest circumference for males is well over 1 cm. above that for females of the same race, corresponding to a percentage difference of about 3 per cent. The means for white babies are consistently larger than those for Negro infants of the same sex, but, except for males at twelve months the differences lie between .3 and .7 cms. The quartile values indicate that at birth the white males tend toward a larger chest circumference, with little difference among the other three groups. At the later observation periods, the occurrence of larger measurements among the males is evident.

Crown-Sole Length (Table 3 and Figure 3). Crown-sole

length of male infants averages about 50.2 cms. at birth, slightly above 61 cms. at three months, 67.9 cms, at six months, and about 76.8 cms. at twelve months. The corresponding values for females are around 49.5 cms. at birth, just under 60 cms. at three months, 66.2 cms. at six months and 74.8 cms. for white females and 75.6 cms. for Negro females at twelve months. Thus at birth the mean length of males is .7 cms. greater than that for females, and at the later periods this difference ranges from 1.2 cms. to 1.9 cms. These represent differences of between 1.5 and 2.7 per cent of the means for females. The differences in the mean crown-sole lengths by race are generally small and inconsistent with respect to sign. From birth onward, the differences by sex in the distributions of the measurements of length and the negligible variation by race are reflected in the quartile values.

Crown-Rump Length (Table 4 and Figure 4). The pattern of the distributions of this segment of crown-sole length, resembles that noted for the latter measurement with respect to the differences by sex but not by race. As was also found for crown-sole length, the mean crown-rump length for males is consistently greater than that for females of the same race, although in relative terms the differences for crown-rump length are not as large. At birth, the means for males exceed those for females by less than 1 per cent, and for the Negro group the difference never exceeds 2 per cent, while it rises to 2.5 per cent for the white infants. The white babies have average crown-rump lengths which are always higher than those for Negroes of the same sex, but the difference is never as large as 1 cm. These are equivalent to percentage differences of between .4 and 1.8 per cent. Thus, while there appears to be no difference in crown-sole length by race, the white babies tend toward a slightly larger crown-rump length than do the Negroes. This may also be seen in the graph of the quartile values.

Rump-Sole Length (Table 5 and Figure 5). The factors of race and sex evidently influence this segment of the total body length to a greater extent than they do the crown-rump length.

Table 3. Mean and quartile values of crown-sole length by age and by race and sex.

Race and Sex	Mean (cms.)				Standard Deviation				Number			
Section A	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months
White Males	50.30	61.03	67.89	76.75	2.08	2.22	2.48	2.71	513	264	234	131
White Females	49.61	59.88	66.26	74.83	1.92	2.15	2.28	2.55	403	247	212	124
Negro Males	50.12	61.19	67.90	76.87	2.15	2.07	2.33	2.57	162	152	138	91
Negro Females	49.40	59.98	66.14	75.60	1.87	2.27	2.39	2.82	149	129	119	82

	Difference in Means				Ratio of Means			
Section B	Male Minus Female				$\left(\frac{\text{Male}}{\text{Female}}\right) \cdot 100$			
	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months
White	.69	1.15	1.63	1.92	101.4	101.9	102.5	102.6
Negro	.72	1.21	1.76	1.27	101.5	102.0	102.7	101.7
	White Minus Negro				$\left(\frac{\text{White}}{\text{Negro}}\right) \cdot 100$			
Male	.18	−.16	−.01	−.12	100.4	99.7	100.0	99.8
Female	.21	−.10	.12	−.77	100.4	99.8	100.2	99.0

	Quartile Values (cms.)											
Section C	Birth			3 Months			6 Months			12 Months		
	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile
White Males	48.93	50.28	51.66	59.60	60.79	62.63	66.17	67.70	69.58	74.92	76.78	78.45
White Females	48.36	49.59	50.85	58.40	59.74	61.34	64.57	66.18	67.83	73.05	74.71	76.58
Negro Males	48.66	50.25	51.59	59.69	61.39	62.61	66.16	67.76	69.58	75.28	77.09	78.69
Negro Females	48.09	49.17	50.68	58.49	60.08	61.20	64.73	66.09	67.40	73.72	75.54	77.35

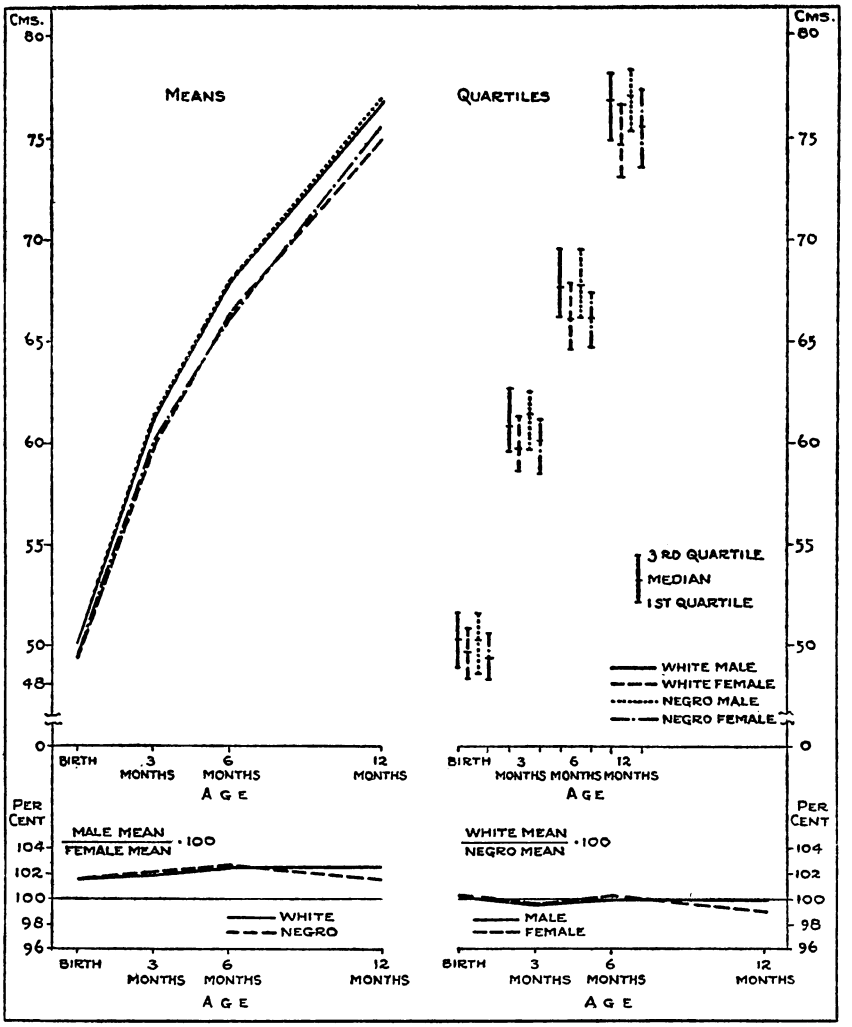

Fig. 3. Mean and quartile values of crown-sole length by age and by race and sex.

The means of this dimension for males are greater than those for females by about 2 per cent among white infants and between 2 and 3.5 per cent among Negroes. Rump-sole length is one of the measurements for which the means for Negro babies are greater than those for the white infants of the same sex. At birth, the average rump-sole length for Negroes is greater than that for whites by .25 cms. for males and .18 cms. for females and this differential steadily increases until at

Table 4. Mean and quartile values of crown-rump length by age and by race and sex.

Race and Sex	Mean (cms.)				Standard Deviation				Number			
Section A	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months
White Males	34.01	41.12	45.23	49.48	1.48	1.57	1.63	1.84	411	238	215	124
White Females	33.68	40.39	44.31	48.28	1.32	1.42	1.57	1.77	327	203	181	111
Negro Males	33.44	40.73	44.66	48.60	1.47	1.40	1.71	1.87	142	126	123	82
Negro Females	33.32	40.21	43.86	47.88	1.46	1.63	1.74	2.08	130	108	102	74

	Difference in Means				Ratio of Means			
Section B	Male Minus Female				$\left(\frac{\text{Male}}{\text{Female}}\right) \cdot 100$			
	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months
White	.33	.73	.92	1.20	101.0	101.8	102.1	102.5
Negro	.12	.52	.80	.72	100.4	101.3	101.8	101.5
	White Minus Negro				$\left(\frac{\text{White}}{\text{Negro}}\right) \cdot 100$			
Male	.57	.39	.57	.88	101.7	101.0	101.3	101.8
Female	.36	.18	.45	.40	101.1	100.4	101.0	100.8

	Quartile Values (cms.)											
Section C	Birth			3 Months			6 Months			12 Months		
	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile
White Males	32.95	33.99	35.04	40.09	41.08	42.16	44.14	45.14	46.39	48.18	49.61	50.74
White Females	32.79	33.68	34.61	39.43	40.37	41.30	43.30	44.28	45.28	47.11	48.21	49.51
Negro Males	32.43	33.53	34.53	39.67	40.58	41.69	43.36	44.62	45.85	47.26	48.53	49.84
Negro Females	32.23	33.23	34.25	39.12	40.17	41.33	42.78	43.73	45.04	46.37	47.64	49.31

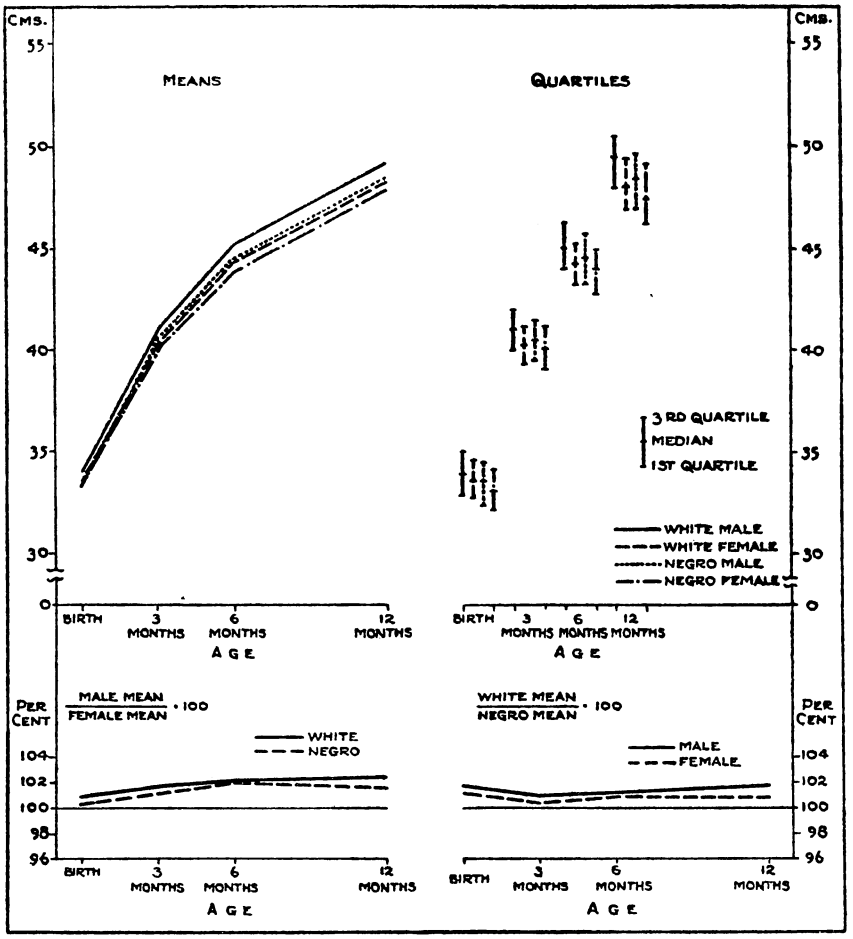

Fig. 4. Mean and quartile values of crown-rump length by age and by race and sex.

twelve months the difference is about 1.1 cms. At birth, the mean for white babies is less than 99 per cent of the corresponding mean for Negroes and at the end of the first year it is only 96 per cent of the average among the Negro infants. The largest quartile values are observed for Negro males, and at birth, three and six months, these values are about equal among the white males and the Negro females. At twelve months of age the quartile values for both Negro populations are larger than those for the white babies.

The longer rump-sole length and shorter crown-rump length

Table 5. Mean and quartile values of rump-sole length by age and by race and sex.

Race and Sex	Mean (cms.)				Standard Deviation				Number			
Section A	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months
White Males	16.37	20.00	22.73	27.30	.98	1.20	1.34	1.64	411	237	215	124
White Females	16.03	19.63	22.19	26.79	1.02	1.21	1.31	1.51	327	203	181	111
Negro Males	16.62	20.59	23.39	28.41	.94	1.14	1.49	1.53	142	126	123	82
Negro Females	16.21	19.97	22.60	27.86	.99	1.06	1.39	1.44	130	108	102	74

	Difference in Means				Ratio of Means			
Section B	Male Minus Female				$\left(\frac{\text{Male}}{\text{Female}}\right) \cdot 100$			
	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months
White	.34	.37	.54	.51	102.1	101.9	102.4	101.9
Negro	.41	.62	.79	.55	102.5	103.1	103.5	102.0
	White Minus Negro				$\left(\frac{\text{White}}{\text{Negro}}\right) \cdot 100$			
Male	−.25	−.59	−.66	−1.11	98.5	97.1	97.2	96.1
Female	−.18	−.34	−.41	−1.07	98.9	98.3	98.2	96.2

	Quartile Values (cms.)											
Section C	Birth			3 Months			6 Months			12 Months		
	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile
White Males	15.72	16.34	16.98	19.10	19.92	20.79	21.89	22.65	23.47	26.17	27.23	28.36
White Females	15.42	16.06	16.67	18.80	19.56	20.37	21.20	22.20	23.09	25.87	26.82	27.77
Negro Males	15.92	16.65	17.30	19.85	20.61	21.33	22.42	23.29	24.32	27.34	28.45	29.45
Negro Females	15.61	16.20	16.93	19.25	19.97	20.65	21.57	22.50	23.49	26.82	27.89	28.79

Table 5a. Means of the ratio $\left(\frac{\text{crown-rump length}}{\text{crown-sole length}} .100\right)$ by age and by race and sex.

Race and Sex	Mean				Standard Deviation				Number			
	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months
White Males	67.5	67.4	66.6	64.5	1.4	1.4	1.3	1.4	411	238	215	124
White Females	67.8	67.4	66.7	64.5	1.4	1.3	1.4	1.4	327	203	181	111
Negro Males	66.9	66.4	65.7	63.2	1.3	1.2	1.6	1.4	142	126	123	82
Negro Females	67.3	66.8	66.0	63.3	1.4	1.3	1.6	1.3	130	108	102	74

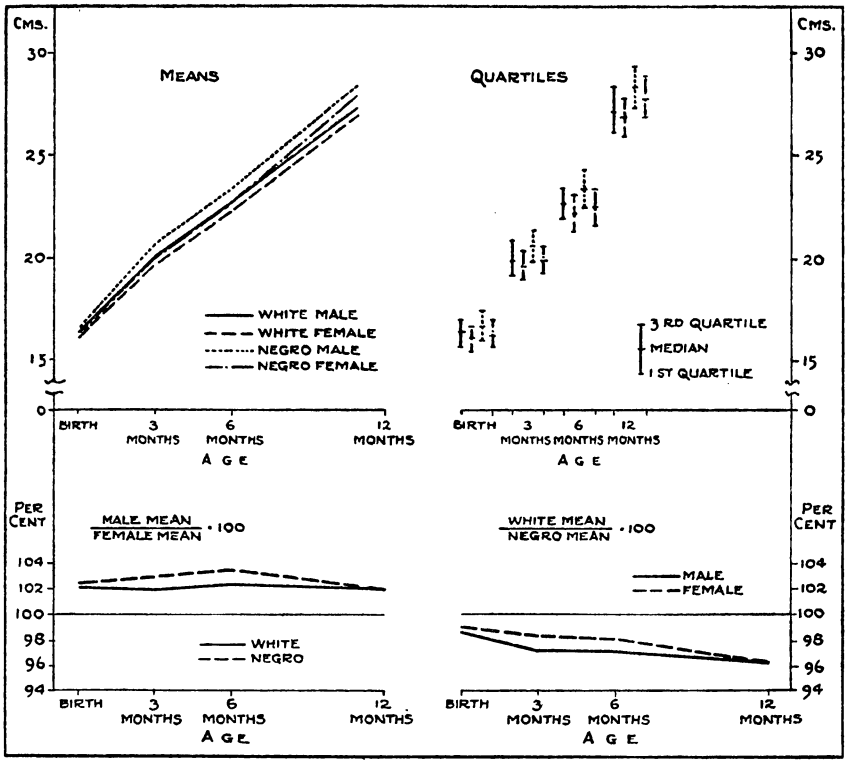

Fig. 5. Mean and quartile values of rump-sole length by age and by race and sex.

in Negro infants compared with the white babies is reflected in the means of the ratio $\frac{\text{(crown-rump length)}}{\text{(crown-sole length)}} \cdot 100$ at each age for each race-sex group (Table 5a). At each age, crown-rump length, on the average, constitutes a higher proportion of the total length among white infants than it does among Negroes, although the differences in the mean ratios are small. Among both races, the average proportion decreases during the first year of life from around 67.6 per cent for white infants and 67.0 per cent for Negroes at birth to 64.5 and 63.2 per cent for the two race groups at twelve months of age.

Hip Breadth (Table 6 and Figure 6). The means and quartile values of the distributions of this measurement fall into a pattern that differs from that of most of the other measure-

Table 6. Mean and quartile values of hip breadth by age and by race and sex.

Race and Sex	Mean (cms.)				Standard Deviation				Number			
Section A	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months
White Males	8.18	10.72	11.87	13.06	.52	.55	.61	.71	387	229	213	122
White Females	7.96	10.32	11.42	12.66	.48	.50	.64	.81	318	199	172	110
Negro Males	7.85	10.27	11.30	12.25	.55	.54	.68	.77	135	123	121	79
Negro Females	7.72	9.90	10.90	11.97	.49	.59	.71	.77	122	108	103	71

	Difference in Means				Ratio of Means			
Section B	Male Minus Female				$\left(\frac{\text{Male}}{\text{Female}}\right) \cdot 100$			
	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months
White	.22	.40	.45	.40	102.8	103.9	103.9	103.2
Negro	.13	.37	.40	.28	101.7	103.7	103.7	102.3
	White Minus Negro				$\left(\frac{\text{White}}{\text{Negro}}\right) \cdot 100$			
Male	.33	.45	.57	.81	104.2	104.4	105.0	106.6
Female	.24	.42	.52	.69	103.1	104.2	104.8	105.8

	Quartile Values (cms.)											
Section C	Birth			3 Months			6 Months			12 Months		
	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile
White Males	7.82	8.20	8.53	10.33	10.71	11.08	11.42	11.84	12.30	12.59	13.05	13.48
White Females	7.64	7.95	8.30	9.99	10.31	10.68	11.01	11.39	11.85	12.14	12.56	13.13
Negro Males	7.45	7.84	8.28	9.90	10.25	10.62	10.85	11.28	11.77	11.74	12.21	12.69
Negro Females	7.33	7.70	8.07	9.55	9.85	10.33	10.53	10.90	11.38	11.42	11.96	12.55

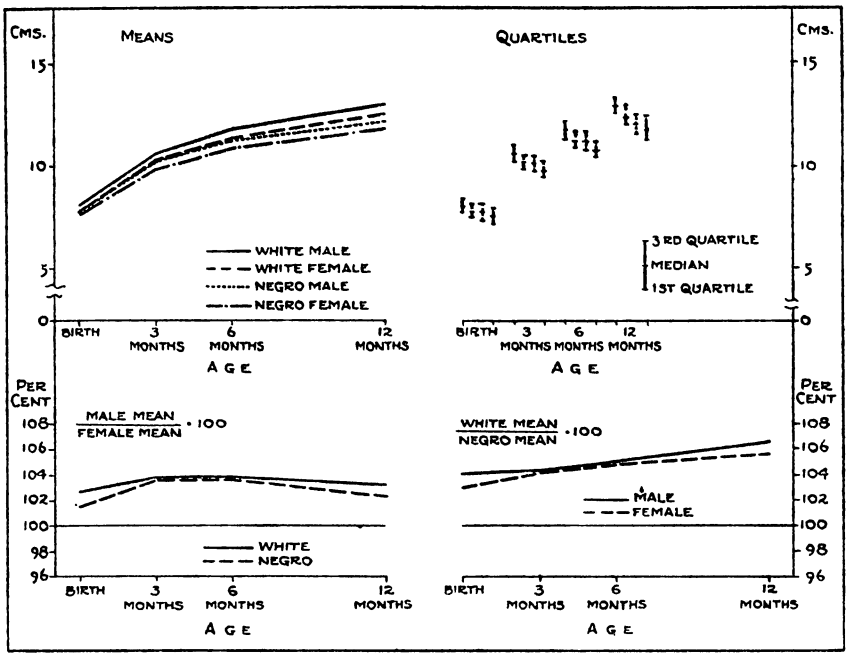

Fig. 6. Mean and quartile values of hip breadth by age and by race and sex.

ments. At each age both the means and quartiles fall in descending order of magnitude from the value for white males, followed by those for white females, Negro males, and Negro females. For example, at twelve months the means for hip breadth for these four groups are, respectively, 13.06 cms., 12.66 cms., 12.25 cms., and 11.97 cms. This pattern contrasts to that noted for most of the other measurements for which the values for males are usually greater than those for females regardless of race. The means for males, though always larger than those for females of the same race, never exceed the latter values by more than .5 cms. In relative terms those differences are between 2 and 4 per cent and are slightly greater than those found for most of the other dimensions. The percentage difference between the means for white and Negro babies of the same sex increases steadily during the year of observation from 3 and 4 per cent at birth to almost 7 per cent for males and almost 6 per cent for females at twelve months.

Head Circumference (Table 7 and Figure 7). In this popu-

Table 7. Mean and quartile values of head circumference by age and by race and sex.

Race and Sex	Mean (cms.)				Standard Deviation				Number			
Section A	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months
White Males	34.56	40.55	43.69	46.94	1.35	1.23	1.16	1.37	506	265	234	131
White Females	33.79	39.60	42.49	45.49	1.24	1.11	1.23	1.33	405	246	212	124
Negro Males	34.44	40.94	44.08	47.09	1.33	1.19	1.23	1.33	161	151	138	92
Negro Females	33.78	39.97	42.97	46.17	1.21	1.15	1.21	1.58	149	129	118	82

Section B	Difference in Means: Male Minus Female				Ratio of Means: $\left(\frac{\text{Male}}{\text{Female}}\right) \cdot 100$			
	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months
White	.77	.95	1.20	1.45	102.3	102.4	102.8	103.2
Negro	.66	.97	1.11	.92	102.0	102.4	102.6	102.0
	White Minus Negro				$\left(\frac{\text{White}}{\text{Negro}}\right) \cdot 100$			
Male	.12	−.39	−.39	−.15	100.3	99.0	99.1	99.7
Female	.01	−.37	−.48	−.68	100.0	99.1	98.9	98.5

Section C	Quartile Values (cms.)											
	Birth			3 Months			6 Months			12 Months		
	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile
White Males	33.69	34.58	35.50	39.72	40.56	41.41	42.84	43.66	44.47	45.95	46.93	47.86
White Females	33.10	33.87	34.62	38.95	39.56	40.28	41.62	42.46	43.32	44.59	45.43	46.28
Negro Males	33.57	34.52	35.42	40.09	41.03	41.74	43.20	44.12	44.92	46.20	47.23	48.00
Negro Females	33.08	33.74	34.63	39.18	39.99	40.74	42.12	43.07	43.74	45.03	46.19	46.98

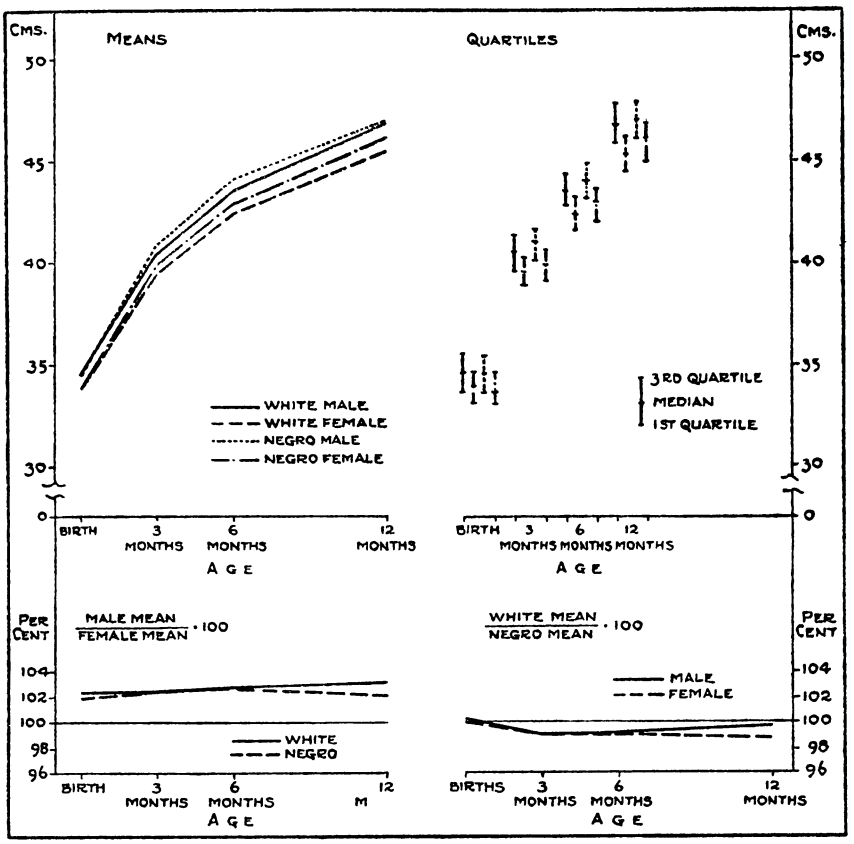

Fig. 7. Mean and quartile values of head circumference by age and by race and sex.

lation the average head circumference at birth is about 34.5 cms. for males and 33.8 cms. for females. At twelve months the largest mean is that for Negro males (47.09 cms.) and the smallest that for white females (45.49 cms.). The mean of head circumference for males is always larger than the corresponding mean for females by between 2 and 3 per cent. Except at birth, where no difference by race is found, the means for the Negro babies are larger than the means for white babies of the same sex, although the differences are relatively small, being less than 2 per cent of the means for Negroes. The quartile values also show this tendency toward a larger head circumference among Negroes at the three-month observation

Table 8. Mean and quartile values of calf circumference by age and by race and sex.

Race and Sex	Mean (cms.)				Standard Deviation				Number			
Section A	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months
White Males	11.51	16.19	18.66	20.26	.93	1.27	1.33	1.39	145	78	87	58
White Females	11.39	15.50	18.15	19.95	.99	1.06	1.31	1.58	115	64	65	40
Negro Males	11.13	15.95	18.27	19.72	1.04	1.07	1.28	1.36	71	64	64	37
Negro Females	11.28	15.61	17.85	19.37	1.03	1.27	1.55	1.59	69	56	54	38

	Difference in Means				Ratio of Means			
Section B	Male Minus Female				$\left(\frac{\text{Male}}{\text{Female}}\right) \cdot 100$			
	Birth	3 Months	6 Months	12 Months	Birth	3 Months	6 Months	12 Months
White	.12	.69	.51	.31	101.1	104.5	102.8	101.6
Negro	−.15	.34	.42	.35	98.7	102.2	102.4	101.8
	White Minus Negro				$\left(\frac{\text{White}}{\text{Negro}}\right) \cdot 100$			
Male	.38	.24	.39	.54	103.4	101.5	102.1	102.7
Female	.11	−.11	.30	.58	101.1	99.3	101.7	103.0

	Quartile Values (cms.)											
Section C	Birth			3 Months			6 Months			12 Months		
	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile
White Males	10.90	11.49	12.19	15.26	16.18	17.11	17.88	18.79	19.63	19.30	20.29	21.30
White Females	10.73	11.33	12.09	14.73	15.50	16.25	17.28	18.23	18.91	18.83	19.90	20.82
Negro Males	10.45	11.09	11.79	15.17	15.83	16.67	17.33	18.35	19.29	18.78	19.54	20.55
Negro Females	10.60	11.32	11.96	14.67	15.69	16.56	16.79	17.92	18.89	18.39	19.33	20.21

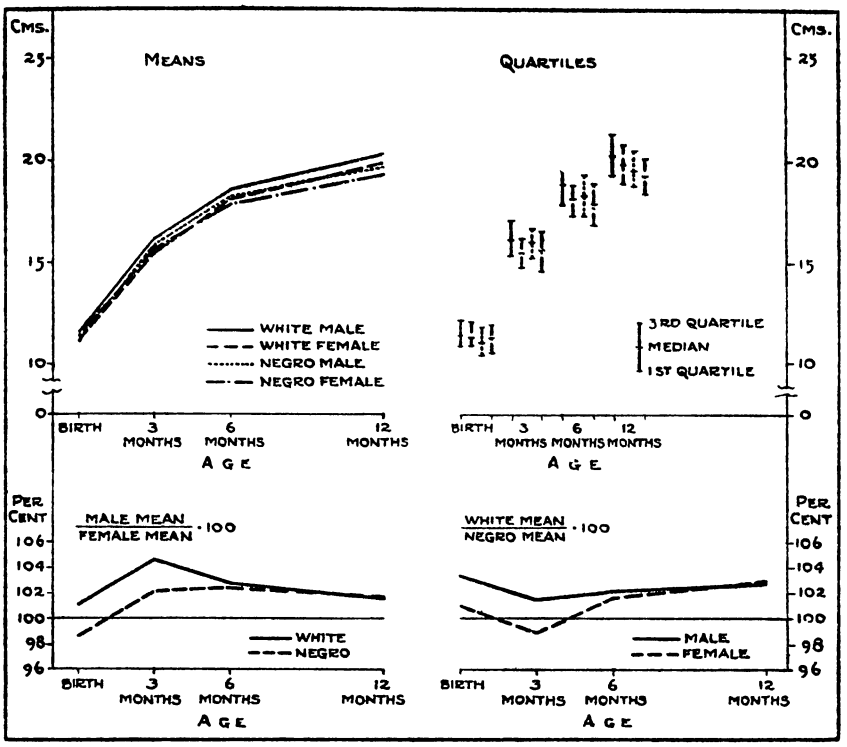

Fig. 8. Mean and quartile values of calf circumference by age and by race and sex.

and after. All three quartile measurements are larger for Negroes than the corresponding value for white babies at each age except birth. The quartile values also demonstrate the even larger differences in this measurement by sex.

Calf Circumference (Table 8 and Figure 8). The means and quartiles of this measurement present a more irregular picture than was found for the other measurements, possibly because they are based on a smaller number of observations. The average values for males are larger than those for females of the same race except for Negroes at birth. This difference is as great as 4.5 per cent for white infants at three months, but usually is about 2 per cent. The means for white babies are at most periods between 1 and 3 per cent greater than the corresponding value for Negroes. The quartile values also are in no consistent pattern. At twelve months they fall in descend-

ing order from white male, to white female, to Negro male, to Negro female, as was observed for hip breadth, but the number of cases from which they were calculated is small.

For each of these eight measurements, the mean values for the male babies are almost always greater than the means for females of the same race. The greatest relative difference in the means by sex is found for weight at three months of age and after. This differential is between 6 and 8 per cent. For most of the other measurements the relative differences are of the order of 2 to 4 per cent, and in most cases tend to be slightly lower at birth than at the subsequent observations.

Comparison of the means by race indicates that the white babies in this population tend to be larger than the Negroes of the same sex in weight, chest circumference, crown-rump length, hip breadth, and calf circumference. Negro babies have larger average values for rump-sole length, and head circumference, while no racial difference is found for crown-sole length. The most pronounced differences between the race groups are observed for rump-sole length and hip breadth.

The average per cent gain from birth to three, six, and twelve months of age is given for five of the measurements in Table 9. The largest relative increases are observed for weight. Between birth and three months of age the average per cent gain in weight for males is over 80 per cent and for females it is almost 75 per cent. During the first year of life the mean per cent increase is over 200 per cent, indicating that, on the average, these babies tripled their weight within this period. The mean per cent gain for males is about 10 per cent greater than that for females during each of these three intervals. In the periods, birth to three months and birth to six months, the average relative increases for the Negro babies are slightly above those for white infants of the same sex, but over the twelve-month interval, the larger means are found for the white population.

The average increase in chest circumference between birth and three months of age is above 27 per cent for males and 24

per cent for females and during the first year is between 45 and 52 per cent. The males have a mean per cent gain about 3 per cent above that for females during each period and there is almost no difference in the means by race, except over the one year period, when the means for white babies are about 2 per cent above those for Negroes.

The mean per cent gain in crown-sole length is slightly more than 20 per cent during the first three months of life and over 50 per cent by the end of the first twelve months. The means for males are a little larger than those for females, and, although the differences by race are small, there may be some tendency for the relative increase in crown-sole length to be larger in the Negro infants. The standard deviations of per cent gain in length are smaller than any of the others shown in Table 9, indicating that there is less variation among the infants in gain in this dimension.

The average increase in hip breadth during the first three months is between 29 and 32 per cent. During the first year the mean per cent gain ranges from 56 per cent to 61 per cent. The means for the male babies are larger than those for females of the same race, and the means for the white babies are always greater than those for Negroes of the same sex. During the twelve-month period, the average relative increases for both white groups are larger than those for the Negro infants.

The mean per cent gain in calf circumference in the first three months of life is between 36 and 46 per cent and in the first year between 73 and 86 per cent. The averages for males are consistently greater than those for females. The differences by race are inconsistent within the two sex groups.

Of the five measurements considered here, the greatest average relative gain during the first year of life is found for weight. Among the measurements of body dimensions, the largest mean per cent increases are found for calf circumference, followed by hip breadth, crown-sole length, and chest circumference. Relative growth for all these measurements is usually greater for males than for females, but differences

Race and Sex	Mean Per Cent Gain from Birth to:			Standard Deviation of Per Cent Gain from Birth to:			Number: Birth to:		
	3 Months	6 Months	12 Months	3 Months	6 Months	12 Months	3 Months	6 Months	12 Months
	WEIGHT								
White Males	80.4	141.8	215.0	19.9	30.2	41.1	265	238	134
White Females	72.0	129.4	204.2	18.9	29.5	43.8	247	212	122
Negro Males	83.7	142.4	212.3	22.4	34.4	48.9	151	141	92
Negro Females	74.4	130.9	201.6	22.3	32.1	44.1	130	120	84
	CHEST CIRCUMFERENCE								
White Males	27.3	38.2	51.4	6.2	6.7	7.6	241	215	121
White Females	24.1	35.6	47.3	6.0	6.7	7.7	207	174	100
Negro Males	27.4	38.5	48.9	7.2	8.6	8.7	131	122	80
Negro Females	24.5	35.0	45.2	6.8	7.9	9.0	113	103	72
	CROWN-SOLE LENGTH								
White Males	21.6	35.0	53.0	3.0	4.0	4.4	244	218	125
White Females	20.7	33.5	51.6	3.2	4.0	5.3	206	173	103
Negro Males	22.2	35.9	53.6	3.9	5.3	6.6	132	124	81
Negro Females	21.7	34.2	53.5	3.6	4.7	5.7	114	106	73
	HIP BREADTH								
White Males	32.1	46.3	61.0	8.1	10.6	10.6	191	175	98
White Females	30.0	44.2	60.0	7.8	10.6	11.4	167	137	80
Negro Males	31.5	45.2	57.7	8.0	10.2	9.9	106	98	61
Negro Females	28.7	42.0	55.8	7.6	10.8	11.2	94	87	58
	CALF CIRCUMFERENCE								
White Males	45.0	65.4	79.1	10.8	17.3	14.4	51	59	25
White Females	35.9	56.5	76.3	11.2	13.1	18.9	41	39	17
Negro Males	45.3	68.0	85.4	13.0	16.7	16.5	52	51	24
Negro Females	39.9	60.8	73.5	13.9	20.6	16.4	49	47	26

Table 9. Mean per cent gain in selected measurements between birth and three, six, and twelve months of age by race and sex.

among the means by race are less consistent than those by sex.

An estimate of the amount and direction of the association between the size of the measurements at each age is furnished by the coefficients of correlation between each pair of measurements (Table 10). Each coefficient is the weighted combination of the set of four coefficients, one for each race-sex group,

computed for each pair of measurements. Before they were combined, the four correlations were tested for homogeneity,[6] and the 15 of the 104 sets of coefficients found not to be homogeneous are given in Table 11, and their weighted combination shown in italics in Table 10. Each correlation coefficient is shown twice in Table 10, once under each of the two measurements being correlated. To avoid correlating a whole with its parts, the correlation between crown-sole length, and both crown-rump and rump-sole length, are not shown in the table.

At birth, the highest correlations are those between weight and each of the other measurements, except rump-sole length. All of these coefficients are above .60 and four of them exceed .70. Also above .60 are the coefficients of correlation between chest circumference and crown-sole length, crown-rump length, and calf circumference. The lowest correlations are those between rump-sole length and the other five body dimensions (.23 to .38). The coefficients of correlation among the other measurements are between .40 and .59.

The correlations among the measurements from the examination at three months are, in general, slightly smaller than the corresponding values at birth. The correlations between weight and chest circumference, crown-rump length and calf circumference are over .70 and those between weight and crown-sole length and hip breadth are above .60. The coefficients for rump-sole length and all other measurements are under .31. All the remaining coefficients are between .30 and .59.

[6] The procedure for testing homogeneity and combining the coefficients of the four race-sex groups was as follows:

$$\bar{z} = \frac{\Sigma(n_i - 3)z_i}{\Sigma(n_i - 3)}$$

$$\bar{r} = \tanh \bar{z}$$

$$\chi^2 = \Sigma(n_i - 3)z_i^2 - \frac{[\Sigma(n_i - 3)z_i]^2}{\Sigma(n_i - 3)}$$

where

z_i = Fisher transformation of the correlation coefficients, r_i, of the race-sex groups,

n_i = number of observations from which r_i was computed,

$\bar{r}$ = estimate of the combined r_i.

If with 3 degrees of freedom, one less than the number of correlations being tested, $P(\chi^2) < .05$ then the four coefficients were considered non-homogeneous. *Cf.* Weatherburn (3).

Measurement	Birth	Three Months	Six Months	Twelve Months	Birth	Three Months	Six Months	Twel Mont
	WEIGHT				CHEST CIRCUMFERENCE			
Weight	—	—	—	—	*.76*	.74	.75	.75
Chest Circumference	*.76*	.74	.75	.75	—	—	—	—
Crown-Sole Length	.77	.65	.65	.68	*.62*	.52	.49	.49
Crown-Rump Length	.76	.71	.72	.75	.65	.56	.54	.56
Rump-Sole Length	.45	.31	.25	.29	.38	.25	.18	*.23*
Hip Breadth	*.64*	.67	.67	*.69*	*.56*	.57	.55	*.58*
Head Circumference	.64	.56	.50	.50	.54	.47	.42	.40
Calf Circumference	.74	.75	*.75*	.78	.64	*.48*	.51	*.53*
	RUMP-SOLE LENGTH				HIP BREADTH			
Weight	.45	.31	.25	.29	*.64*	.67	.67	*.69*
Chest Circumference	.38	.25	.18	.23	*.56*	.57	.55	*.58*
Crown-Sole Length	—	—	—	—	*.54*	.48	.48	*.52*
Crown-Rump Length	.27	.29	.21	.22	*.50*	.53	.52	*.58*
Rump-Sole Length	—	—	—	—	.31	.20	.19	.21
Hip Breadth	.31	.20	.19	.21	—	—	—	—
Head Circumference	.32	.25	.17	.15	.44	.33	.29	*.28*
Calf Circumference	.23	.14	.12	.00	.57	*.43*	.46	.46

	Number							
	Birth							
	Wt.	Ch.	C-S	C-R	R-S	Hip	Head	Calf
Weight		1,223	1,227	1,010	1,010	962	1,222	400
Chest Circumference	784		1,212	1,009	1,009	962	1,219	400
Crown-Sole Length	784	790		—	—	960	1,209	398
Crown-Rump Length	667	673	—		1,010	957	1,009	397
Rump-Sole Length	667	674	—	674		957	1,009	397
Hip Breadth	651	658	658	653	653		962	378
Head Circumference	783	790	789	674	674	658		400
Calf Circumference	257	261	261	259	259	261	261	
	3 Months							

Note: Coefficients in italics are based on coefficients by race and sex which are not homogeneous.

Table 10. Correlations between measurements by age.

The coefficients at six months and twelve months of age are about equal to or slightly smaller than those for the three month examination. As at the two earlier periods, the highest correlations are those involving weight, all but two of which

Birth	Three Months	Six Months	Twelve Months	Birth	Three Months	Six Months	Twelve Months
crown-sole length				crown-rump length			
.77	.65	.65	.68	.76	.71	.72	.75
.62	.52	.49	.49	.65	.56	.54	.56
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	.27	.29	.21	.22
.54	.48	.48	*.52*	*.50*	.53	.52	*.58*
.57	.45	.41	.40	.59	.51	.45	.46
.54	.36	.38	.35	.54	.40	.37	.51
head circumference				calf circumference			
.64	.56	.50	.50	.74	.75	*.75*	.78
.54	.47	.42	.40	.64	*.48*	.51	*.53*
.57	.45	.41	.40	.54	.36	.38	.35
.59	.51	.45	.46	.54	.40	.37	.51
.32	.25	.17	.15	.23	.14	.12	.00
.44	.33	.29	*.28*	.57	*.43*	.46	.46
—	—	—	—	.51	.38	.24	.34
.51	.38	.24	.34	—	—	—	—

Number

6 months							
Wt.	Ch.	C-S	C-R	R-S	Hip	Head	Calf
	691	699	617	617	605	698	268
418		695	616	616	605	695	265
422	423		—	—	609	702	270
385	386	—		621	605	621	268
385	386	—	391		605	621	268
376	377	382	378	378		609	264
423	424	428	391	391	382		270
171	171	173	172	173	172	173	
12 Months							

at each age are above .60. Coefficients under .25 are observed for rump-sole length with the other dimensions and for head circumference with hip breadth and, at six months, with calf circumference.

At all four ages, each of the seven body dimensions is more highly correlated with weight than with any of the other dimen-

sions. Weight is most highly correlated (above .70) with chest circumference, crown-rump length, and calf circumference, and the measurement with the least association with weight is rump-sole length (.29 to .45). The minimum correlations for each of the other measurements are also with rump-sole length.

The correlations between the dimensions, chest circumference, crown-sole length, crown-rump length, and calf circumference are all at approximately the same level. Hip breadth could also be included in this group, but it should be noted that most of the coefficients involving this measurement at

Table 11. Correlations between measurements by race and sex which are not homogeneous by race and sex.

Measurements	Age	Correlation Coefficient				Number			
		White Male	White Female	Negro Male	Negro Female	White Male	White Female	Negro Male	Negro Female
Weight and Chest Circumference	Birth	.77	.71	.86	.75	508	406	161	148
Chest Circumference and Crown-Sole Length	Birth	.61	.56	.75	.60	504	400	161	147
Hip Breadth and Weight	Birth	.61	.59	.75	.70	387	318	135	122
Hip Breadth and Chest Circumference	Birth	.55	.50	.67	.64	387	318	135	122
Hip Breadth and Crown-Sole Length	Birth	.50	.50	.68	.57	385	318	135	122
Hip Breadth and Crown-Rump Length	Birth	.44	.47	.64	.60	384	316	135	122
Chest Circumference and Calf Circumference	3 Months	.47	.48	.28	.68	78	63	64	56
Hip Breadth and Calf Circumference	3 Months	.46	.41	.19	.62	78	63	64	56
Weight and Calf Circumference	6 Months	.68	.78	.66	.87	85	65	64	54
Chest Circumference and Calf Circumference	12 Months	.35	.67	.72	.37	58	38	37	38
Hip Breadth and Weight	12 Months	.57	.69	.70	.81	121	106	78	71
Hip Breadth and Chest Circumference	12 Months	.46	.63	.52	.74	121	107	78	71
Hip Breadth and Crown-Sole Length	12 Months	.49	.40	.55	.70	122	110	79	71
Hip Breadth and Crown-Rump Length	12 Months	.52	.44	.68	.74	120	109	78	71
Hip Breadth and Head Circumference	12 Months	.16	.24	.53	.24	122	110	79	71

birth and twelve months are derived from non-homogeneous sets of coefficients. At birth the coefficients of correlation between these measurements are between .54 and .65 and at the later ages, are, with a few exceptions, between .45 and .55. The correlations between head circumference and these measurements are slightly smaller.

The correlation coefficients for each race-sex group for the fifteen sets of coefficients which were found to be non-homogeneous are given in Table 11. Ten of the fifteen involve the measurement of hip breadth. At birth, in the four sets of correlations with hip breadth the coefficients for Negroes are consistently larger than those for white infants, and, thus, the combined coefficient understates the correlation among Negroes and slightly overstates it for the white groups. At twelve months the same four sets of correlations with hip breadth are in a similar pattern, except that in addition, hip breadth is more highly correlated with weight and chest circumference among females than among males. The variation by race and sex for most of the other non-homogeneous sets of correlations is erratic.

The correlation between the size of each measurement at one examination with the size of the same measurement at a later period (Table 12) affords an estimate of the accuracy of the prediction of size at one period from an earlier observation and also indicates the consistency of growth.

The coefficients for each of the four race-sex groups have been combined to give the coefficients shown here and all such sets are homogeneous. The observations from each examination are most highly correlated with the observations at an adjacent period, as follows: birth with three months, three months with six months, six months with both three months and twelve months, and twelve months with six months. Most measurements at three, six, and twelve months show the least correlation with the observations at birth, while the birth measurements are generally most poorly correlated with the observations at twelve months.

Table 12. Coefficients of correlation between measurements at each age.

Age	Three Months	Six Months	Twelve Months	Three Months	Six Months	Twelve Months	Three Months	Six Months	Twelve Months	Three Months	Six Months	Twelve Months
	CORRELATION COEFFICIENT											
	Weight			Chest Circumference			Crown-Sole Length			Crown-Rump Length		
Birth	.56	.43	.38	.46	.40	.38	.77	.66	.59	.68	.58	.48
3 Months		.81	.68		.74	.57		.82	.76		.78	.69
6 Months			.86			.74			.83			.80
	Rump-Sole Length			Hip Breadth			Head Circumference			Calf Circumference		
Birth	.63	.51	.48	.43	.33	.33	.66	.56	.51	.40	.22	.29
3 Months		.67	.58		.73	.64		.82	.74		.70	.54
6 Months			.65			.79			.80			.73
	NUMBER											
	Weight			Chest Circumference			Crown-Sole Length			Crown-Rump Length		
Birth	794	711	432	693	614	373	697	620	382	587	531	315
3 Months		666	424		651	418		658	422		559	345
6 Months			428			413			417			358
	Rump-Sole Length			Hip Breadth			Head Circumference			Calf Circumference		
Birth	587	531	315	557	493	297	691	617	377	193	196	92
3 Months		559	345		542	335		658	423		209	118
6 Months			357			347			418			133

The highest correlations between the birth measurements and those at the later periods are found for crown-sole length, for which the birth and three-month correlation is .77 and the birth and six-month and birth and twelve-months values are .66 and .59, respectively. Slightly lower coefficients for these same periods are observed for the other two length segments and head circumference. The lowest of this set of correlations are those for calf circumference (.40, .22, and .29). This suggests that potential length and head circumference are established to a greater extent at birth than are the other dimensions and that possibly they are less affected by external influences during infancy. Consistently higher values are seen for the correlations between the observations at three and six months and six and twelve months. These coefficients are near .80 or above for weight, crown-sole length, crown-rump length, and head circumference, and the lowest of this set, those for rump-sole length, are .65. These higher correlations, compared with those with the birth observations, indicate that the measurements at three and six months are a better index of later size than are those made at birth.

Increments of Growth between Examinations

The mean increments for each measurement in each interval between examinations are presented in Table 13 and Figure 9 and the quartile values of the distributions of the increments in Table 14 and Figure 10. In addition, the means and quartile values for the periods, birth to six months and birth to twelve months, are shown in the two tables. The means and quartiles are based on the number of babies measured at both the beginning and end of each interval.

Weight. The mean increase in weight during the first three month period was slightly over 6.0 lbs. for males and about 5.2 lbs. for females. In the next three months the average weight gain varied between 4.0 lbs. for Negro females and 4.6 lbs. for white males. The increase in weight in this interval tended to be larger both for males than for females and for

Period	Mean Gain				Standard Deviation				Number			
	White Male	White Female	Negro Male	Negro Female	White Male	White Female	Negro Male	Negro Female	White Male	White Female	Negro Male	Neg Fem
	WEIGHT (lbs.)											
Birth to 3 Months	6.01	5.19	6.11	5.24	1.24	1.10	1.22	1.41	264	248	151	13(
3 Months to 6 Months	4.61	4.24	4.24	4.01	1.10	1.14	1.28	1.10	212	204	134	11(
6 Months to 12 Months	5.31	5.12	5.34	5.11	1.50	1.37	1.44	1.28	132	120	91	8
Birth to 6 Months	10.56	9.37	10.34	9.23	1.75	1.73	2.01	1.98	238	212	141	12(
Birth to 12 Months	15.96	14.47	15.36	14.25	2.46	2.49	2.67	2.64	134	122	92	8
	CHEST CIRCUMFERENCE (cms.)											
Birth to 3 Months	8.74	7.71	8.71	7.74	1.74	1.70	1.96	1.87	241	208	131	11
3 Months to 6 Months	3.76	3.68	3.52	3.49	1.32	1.20	1.33	1.25	207	202	131	11
6 Months to 12 Months	3.83	3.62	3.42	3.30	1.56	1.44	1.37	1.36	126	119	87	8
Birth to 6 Months	12.37	11.42	12.18	11.15	1.75	1.88	2.25	2.13	215	174	122	10
Birth to 12 Months	16.49	15.05	15.51	14.43	2.08	2.15	2.18	2.47	121	100	80	7
	CROWN-SOLE LENGTH (cms.)											
Birth to 3 Months	10.80	10.30	11.08	10.73	1.31	1.43	1.55	1.56	243	207	132	11
3 Months to 6 Months	6.89	6.42	6.89	6.28	1.34	1.32	1.29	1.34	209	203	132	11
6 Months to 12 Months	9.03	8.89	9.12	9.59	1.47	1.50	1.67	1.36	127	122	87	8
Birth to 6 Months	17.61	16.67	17.91	16.84	1.69	1.74	2.19	1.94	217	173	124	10
Birth to 12 Months	26.52	25.36	26.66	26.16	1.92	2.26	2.52	2.44	124	103	81	7
	CROWN-RUMP LENGTH (cms.)											
Birth to 3 Months	7.22	6.82	7.17	6.87	1.13	1.09	.97	1.11	205	172	111	9
3 Months to 6 Months	4.21	3.95	4.09	3.63	.96	1.02	1.03	1.06	188	164	112	9
6 Months to 12 Months	4.26	4.08	3.89	4.28	1.00	1.18	1.25	1.19	116	100	72	6
Birth to 6 Months	11.24	10.77	11.26	10.38	1.36	1.33	1.45	1.55	190	146	104	9
Birth to 12 Months	15.57	14.79	15.04	14.52	1.45	1.75	1.60	1.82	105	84	65	6
	RUMP-SOLE LENGTH (cms.)											
Birth to 3 Months	3.69	3.52	3.96	3.82	1.03	.91	1.00	.91	205	172	111	9
3 Months to 6 Months	2.76	2.62	2.95	2.59	1.02	1.07	1.13	1.11	188	164	112	9
6 Months to 12 Months	4.71	4.76	4.97	5.49	1.25	1.34	1.18	1.14	116	100	72	6
Birth to 6 Months	6.44	6.03	6.79	6.40	1.17	1.12	1.48	1.31	190	146	104	9
Birth to 12 Months	10.98	10.58	11.72	11.73	1.34	1.24	1.49	1.33	105	84	65	6
	HIP BREADTH (cms.)											
Birth to 3 Months	2.61	2.38	2.49	2.24	1.07	1.03	1.01	1.08	190	167	106	9
3 Months to 6 Months	1.18	1.15	1.12	1.04	.41	.41	.46	.46	180	157	110	9
6 Months to 12 Months	1.18	1.23	1.05	1.25	.43	.48	.44	.44	113	97	70	6
Birth to 6 Months	3.71	3.49	3.55	3.25	.63	.66	.66	.73	172	136	98	8
Birth to 12 Months	4.94	4.73	4.49	4.26	.70	.78	.63	.74	98	80	61	5
	HEAD CIRCUMFERENCE (cms.)											
Birth to 3 Months	6.20	5.83	6.48	6.28	.97	.95	1.04	1.06	240	208	131	11
3 Months to 6 Months	3.13	2.92	3.25	3.09	.63	.62	.64	.69	209	203	132	11
6 Months to 12 Months	3.23	3.14	3.07	3.29	.79	.74	.72	1.00	127	122	88	8
Birth to 6 Months	9.30	8.59	9.81	9.40	1.08	1.12	1.17	1.23	215	174	123	10
Birth to 12 Months	12.54	11.74	12.85	12.47	1.30	1.19	1.27	1.60	122	103	81	7
	CALF CIRCUMFERENCE (cms.)											
Birth to 3 Months	5.08	4.08	5.00	4.45	1.08	1.14	1.26	1.34	51	41	52	4
3 Months to 6 Months	2.37	2.59	2.37	2.18	1.01	.85	1.04	.84	58	48	55	4
6 Months to 12 Months	1.75	2.11	1.86	2.04	.88	1.24	.80	.99	42	30	30	3
Birth to 6 Months	7.35	6.49	7.37	6.65	1.53	1.29	1.42	1.82	59	39	51	4
Birth to 12 Months	8.90	8.56	9.17	8.19	1.36	1.92	1.37	1.46	25	17	24	2

Table 13. Mean gain in each measurement between examinations, by race and sex.

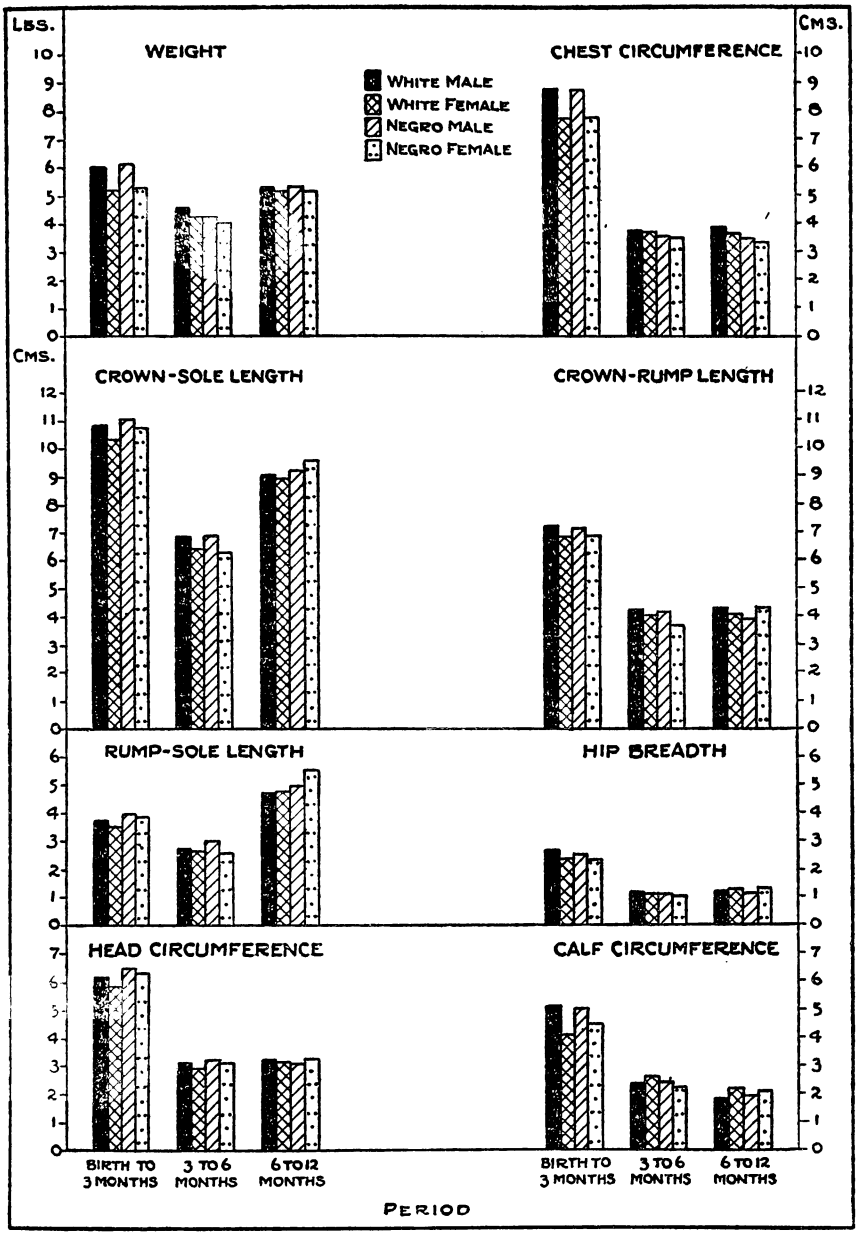

Fig. 9. Mean gain in each measurement between examinations, by race and sex.

white babies than for Negro infants. In the final six month period the means were 5.3 lbs. for males and 5.1 lbs for females.

Table 14. Quartile values of gain in each measurement between examinations, by race and sex.

Period	White Male			White Female			Negro Male			Negro Female		
	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile	1st Quartile	Median	3rd Quartile
	WEIGHT (lbs.)											
Birth to 3 Months	5.20	5.95	6.81	4.45	5.17	5.90	5.26	6.15	6.91	4.12	5.19	6.22
3 Months to 6 Months	3.78	4.55	5.41	3.41	4.14	4.92	3.35	4.15	4.88	3.24	3.89	4.73
6 Months to 12 Months	4.29	5.28	6.17	4.23	4.87	5.89	4.35	5.26	6.30	4.16	5.00	5.91
Birth to 6 Months	9.23	10.43	11.72	8.18	9.23	10.32	9.06	10.40	11.53	7.67	9.14	10.67
Birth to 12 Months	14.09	16.08	17.58	12.67	13.92	16.26	13.60	15.18	16.69	12.00	13.88	16.23
	CHEST CIRCUMFERENCE (cms.)											
Birth to 3 Months	7.44	8.69	9.93	6.48	7.73	8.95	7.37	8.67	10.07	6.41	7.63	8.99
3 Months to 6 Months	2.78	3.70	4.65	2.82	3.68	4.54	2.55	3.43	4.49	2.55	3.44	4.34
6 Months to 12 Months	2.58	3.73	4.98	2.51	3.62	4.62	2.43	3.41	4.38	2.33	3.24	4.21
Birth to 6 Months	11.08	12.45	13.66	10.06	11.50	12.66	10.78	11.93	13.85	9.65	11.19	12.75
Birth to 12 Months	15.09	16.53	17.91	13.50	15.10	16.50	13.73	15.62	17.00	13.00	14.50	15.91
	CROWN-SOLE LENGTH (cms.)											
Birth to 3 Months	9.95	10.81	11.73	9.35	10.28	11.15	10.21	11.12	11.78	9.79	10.69	11.73
3 Months to 6 Months	5.86	6.91	7.75	5.49	6.35	7.25	5.93	6.79	7.81	5.41	6.36	7.08
6 Months to 12 Months	8.03	9.10	10.01	7.79	8.89	9.83	7.98	9.07	10.16	8.73	9.66	10.56
Birth to 6 Months	16.44	17.54	18.68	15.45	16.57	17.82	16.35	17.76	19.24	15.54	16.95	17.88
Birth to 12 Months	25.16	26.60	27.84	23.75	25.18	26.89	24.98	26.50	28.11	24.45	26.26	27.61
	CROWN-RUMP LENGTH (cms.)											
Birth to 3 Months	6.41	7.22	7.92	6.09	6.77	7.60	6.49	7.24	7.77	6.02	6.82	7.69
3 Months to 6 Months	3.49	4.19	4.82	3.26	3.98	4.68	3.33	3.96	4.79	2.99	3.60	4.34
6 Months to 12 Months	3.51	4.27	4.93	3.33	4.24	4.89	3.04	3.83	4.70	3.36	4.08	5.29
Birth to 6 Months	10.30	11.10	12.13	9.83	10.66	11.66	10.26	11.13	12.28	9.43	10.43	11.31
Birth to 12 Months	14.55	15.56	16.55	13.46	14.82	16.07	13.80	14.96	16.08	13.43	14.59	15.67

	RUMP-SOLE LENGTH (cms.)											
Birth to 3 Months	3.03	3.65	4.41	2.80	3.49	4.19	3.28	3.90	4.65	3.19	3.74	4.47
3 Months to 6 Months	2.07	2.68	3.46	1.83	2.56	3.36	2.10	2.82	3.72	1.75	2.62	3.47
6 Months to 12 Months	3.91	4.71	5.60	3.75	4.76	5.68	4.11	5.04	5.79	4.61	5.35	6.22
Birth to 6 Months	5.57	6.35	7.16	5.23	6.08	6.78	6.00	6.79	7.76	5.51	6.42	7.24
Birth to 12 Months	10.05	11.05	11.87	9.69	10.67	11.50	10.92	11.78	12.69	10.79	11.74	12.72
	HIP BREADTH (cms.)											
Birth to 3 Months	2.23	2.60	2.93	2.05	2.37	2.74	2.12	2.47	2.84	1.83	2.27	2.68
3 Months to 6 Months	.86	1.18	1.45	.84	1.16	1.42	.76	1.10	1.44	.70	.97	1.31
6 Months to 12 Months	.87	1.18	1.44	.89	1.23	1.56	.71	.97	1.32	.90	1.21	1.49
Birth to 6 Months	3.28	3.72	4.12	3.04	3.40	3.92	3.09	3.48	3.94	2.81	3.26	3.71
Birth to 12 Months	4.44	4.89	5.51	4.21	4.67	5.15	4.05	4.40	4.99	3.71	4.28	4.84
	HEAD CIRCUMFERENCE (cms.)											
Birth to 3 Months	5.50	6.19	6.78	5.18	5.75	6.47	5.78	6.46	7.08	5.52	6.19	6.82
3 Months to 6 Months	2.58	3.16	3.64	2.40	2.89	3.46	2.77	3.31	3.73	2.55	3.16	3.62
6 Months to 12 Months	2.61	3.24	3.77	2.56	3.16	3.64	2.53	3.15	3.63	2.66	3.29	3.81
Birth to 6 Months	8.50	9.31	9.99	7.90	8.55	9.30	8.99	9.78	10.62	8.48	9.32	10.18
Birth to 12 Months	11.58	12.47	13.44	10.99	11.67	12.55	11.80	12.92	13.75	11.40	12.43	13.38
	CALF CIRCUMFERENCE (cms).											
Birth to 3 Months	4.34	5.04	5.78	3.51	3.90	4.90	4.25	4.86	5.86	3.51	4.31	5.40
3 Months to 6 Months	1.61	2.41	3.08	2.00	2.68	3.17	1.68	2.20	3.02	1.45	2.23	2.75
6 Months to 12 Months	1.14	1.72	2.34	1.42	1.85	2.81	1.29	1.81	2.38	1.20	1.85	2.91
Birth to 6 Months	6.29	7.38	8.35	5.65	6.55	7.53	6.29	7.47	8.52	5.13	6.58	8.13
Birth to 12 Months	8.04	8.93	9.96	7.25	8.13	9.75	8.00	9.20	10.33	7.17	7.89	9.17

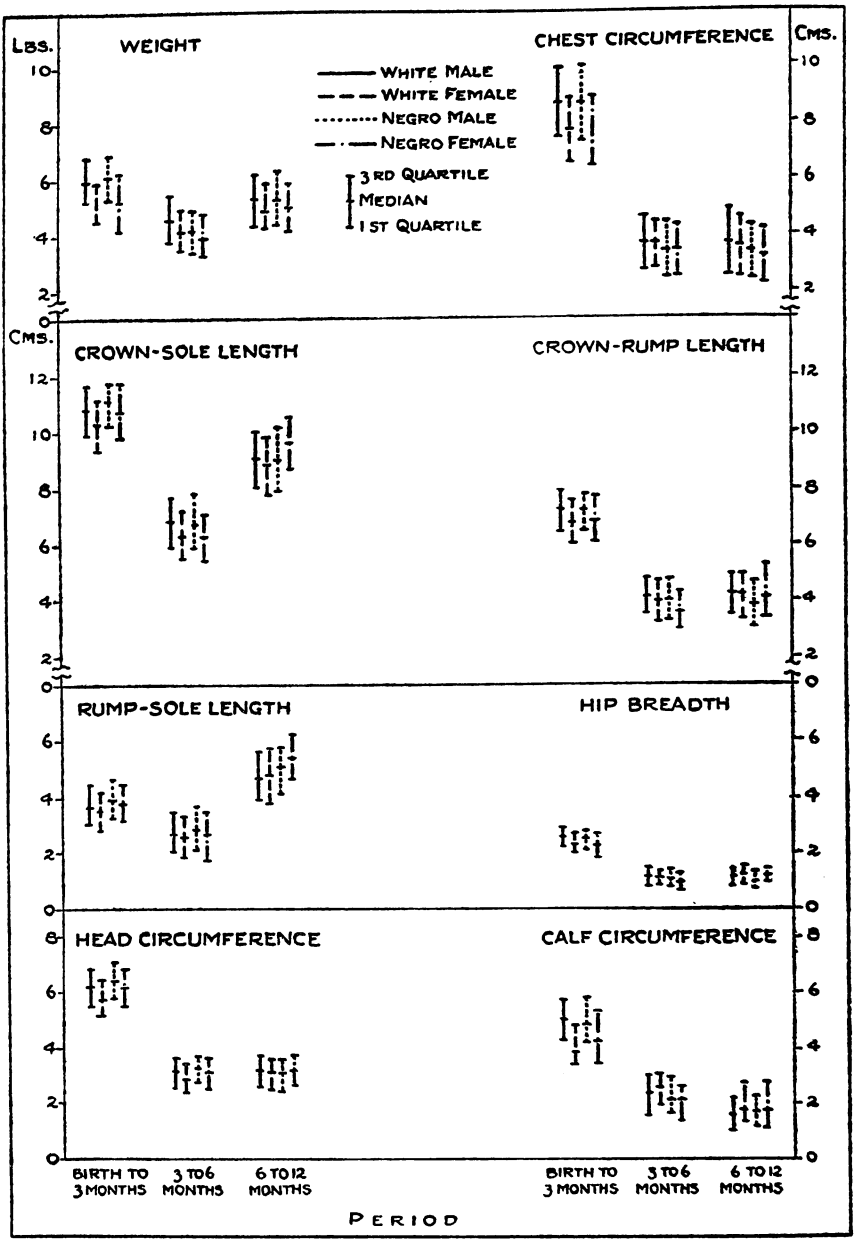

Fig. 10. Quartile values of gain in each measurement between examinations, by race and sex.

Chest Circumference. The average growth in chest circumference from birth to three months of age was greater for males

than for females. The means for both groups of male infants were about 8.7 cms. and those for the female babies about 1 cm. less. The difference by sex in the quartile values was such that the third quartiles for females barely exceeded the median values for males. In the next two intervals differences in the means by race and sex were small, but the mean values for males were slightly greater than those for females and those for white infants greater than those for Negroes. Between three and six months the mean increase varied between 3.49 cms. and 3.76 cms. and during the final six month period between 3.30 cms. and 3.83 cms.

Crown-Sole Length. The largest average gain in crown-sole length between birth and three months of age was found for Negro males (11.08 cms.) with that for the white male babies being slightly smaller (10.80 cms.). Among females the mean for Negroes (10.73 cms.) also exceeded that for white babies (10.30 cms.) during this period. Between three and six months of age the mean increase in crown-sole length was 6.9 cms. for both male groups and 0.5 to 0.6 cms. smaller for the two female groups. This difference by sex was also reflected in the quartile values. During the final period the mean for Negro females was 9.59 cms. while the values for the other three groups fell between 8.89 cms. and 9.12 cms.

Crown-Rump Length. The mean increase in this measurement between the birth and three months examinations was near 7.2 cms. for males and 6.85 cms. for females. During the next interval the means for the male groups were between 4.21 cms. and 4.09 cms. while the mean was 3.95 cms. for white females and 3.63 cms. for Negro females. From six to twelve months the largest average growth in crown-rump length was found for white males (4.26 cms.) and Negro females (4.28 cms.) and the smallest for Negro males (3.89 cms.).

Rump-Sole Length. In the initial period the mean increase in rump-sole length was greater among both groups of Negro infants than among the white population. The mean for Negro males was 3.96 cms. and for Negro females 3.82 cms. while

the corresponding values for white infants were 3.69 cms. and 3.52 cms. During the following period the largest average gain was among Negro males (2.95 cms.) and the smallest among Negro females (2.59 cms.). Between six and twelve months of age the largest mean increase was that for Negro female (5.49 cms.) with the means for the other race-sex groups ranging between 4.71 cms. for white males to 4.97 cms. for Negro males.

Hip Breadth. Although the differences among the means for growth in this dimension during the initial three month period were small there was a discernible pattern of larger increases among males and among white infants. This may also be seen in the quartile values. The mean for white males was 2.61 cms. and for Negro males 2.49 cms. and for females the corresponding values were 2.38 cms. and 2.24 cms. In the next interval there was almost no difference among the four values, all falling between 1.04 cms. and 1.18 cms. In the last interval the range of the means was from 1.05 cms. to 1.23 cms., but with some suggestion in the means and quartile values of slightly greater growth in this measurement among females than among males during this time.

Head Circumference. The average increase in this measurement during the first period was larger for Negroes and for males. The values for Negro males and females respectively, were 6.48 cms. and 6.28 cms., while for white babies the corresponding means were 6.20 cms. and 5.83 cms. In the next interval the same pattern may be observed, but the differences were smaller. The means ranged from 2.92 cms. for white females to 3.25 cms. for Negro males. In the last period all four means were between 3.07 cms. and 3.29 cms.

Calf Circumference. From birth to three months of age the mean gain in calf circumference was about 5.00 cms. for both groups of male infants while the mean for white females was about 1.0 cms. smaller and that for Negro females about 0.6 cms. less. During the three to six month interval the largest mean was observed for white females (2.59 cms.) and the

smallest for Negro females (2.18 cms.). From six to twelve months of age the mean gains were larger for females (2.11 cms. and 2.04 cms.) than for males (1.75 cms. and 1.89 cms.).

During the first three months after birth the male infants tended to have a greater absolute growth in all measurement than did females of the same race, but this difference was most marked for weight, chest circumference, and calf circumference. Racial differences in growth may be noted in crown-sole length, rump-sole length, and head circumference, for which the gain in Negro babies tended to be greater than that for white infants of the same sex, and in hip breadth for which the gain for white infants seemed to be larger.

In the next two periods the differences by race and sex were less consistent. Within each racial group in the interval from three to six months the average growth among males appears to be greater than that among females for weight, crown-sole and crown-rump length, and possibly head circumference. The differences by race during this period were small and generally irregular, although the average weight gain in white infants was larger than that for Negroes of the same sex.

In the six to twelve month interval the mean increase in weight and chest circumference was slightly larger in male than in female infants of the same race, while the mean gain in calf circumference was larger among females. During this time white infants had a greater average growth in chest circumference than did Negro babies and a smaller mean growth in rump-sole length.

Growth in these measurements during the intervals birth to six months and birth to twelve months was in much the same pattern with respect to age and sex differences as was growth during the birth to three month period. The average increase in each measurement for both groups of male infants during these two periods was almost always greater than the mean for either of the female groups. Exceptions to this were rump-sole length for the twelve month period for which the mean for Negro females exceeded that for white males and

Period	Mean Per Cent Gain				Standard Deviation				Number			
	White Male	White Female	Negro Male	Negro Female	White Male	White Female	Negro Male	Negro Female	White Male	White Female	Negro Male	Negro Female
	WEIGHT											
Birth to 3 Months	80.4	72.0	83.7	74.4	19.9	18.9	22.4	22.3	265	247	151	130
3 Months to 6 Months	33.6	33.8	31.3	32.4	8.3	8.5	8.9	8.8	212	204	134	116
6 Months to 12 Months	29.5	30.1	30.4	31.1	8.9	8.3	8.4	7.2	133	120	91	84
	CHEST CIRCUMFERENCE											
Birth to 3 Months	27.3	24.1	27.4	24.5	6.2	6.0	7.2	6.8	241	207	131	113
3 Months to 6 Months	9.1	9.1	8.6	8.8	3.4	3.1	3.4	3.1	207	202	131	111
6 Months to 12 Months	8.6	8.3	7.5	7.8	3.6	3.5	3.0	3.2	126	119	87	81
	CROWN-SOLE LENGTH											
Birth to 3 Months	21.6	20.7	22.2	21.7	3.0	3.2	3.9	3.6	244	206	132	114
3 Months to 6 Months	11.2	10.7	11.3	10.3	2.3	2.3	2.2	2.4	209	203	132	114
6 Months to 12 Months	13.3	13.3	13.3	14.5	2.2	2.4	2.5	2.2	127	122	87	81
	HIP BREADTH											
Birth to 3 Months	32.1	30.0	31.5	28.7	8.1	7.8	8.0	7.6	191	167	106	94
3 Months to 6 Months	10.6	10.7	10.4	10.0	3.9	3.9	4.2	4.4	180	157	110	95
6 Months to 12 Months	9.7	10.6	9.3	11.0	3.5	3.9	4.1	4.3	113	97	70	67
	CALF CIRCUMFERENCE											
Birth to 3 Months	45.0	35.9	45.3	39.9	10.8	11.2	13.0	13.9	51	41	52	49
3 Months to 6 Months	14.5	16.3	14.7	13.7	6.6	5.6	7.0	5.5	58	48	55	48
6 Months to 12 Months	9.6	11.9	10.2	11.5	5.5	7.2	4.7	5.9	42	30	30	31

Table 15. Mean per cent gain between examinations for selected measurements, by race and sex.

equaled that for Negro males and hip breadth during the same interval for which the mean for white females equaled that for Negro males. During these two periods the average gain was greater for white than for Negro babies of the same sex for chest circumference and hip breadth, and, over the twelve month interval, for crown-rump length. The means for Negro infants were the larger for rump-sole length and head circumference.

The mean percentage increase for five of the measurements during the intervals birth to three, three to six, and six to

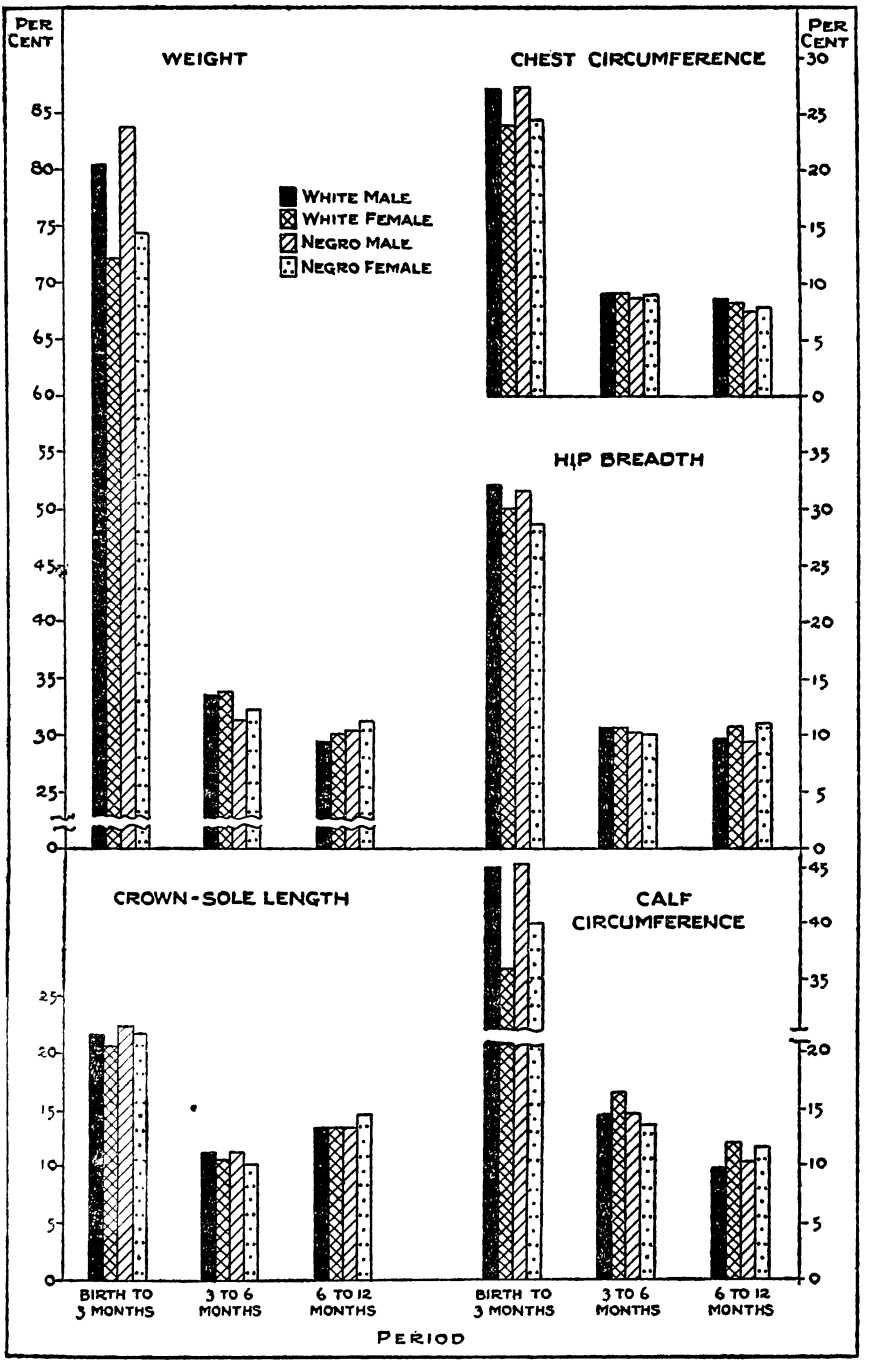

Fig. 11. Mean per cent gain between examinations for selected measurements, by race and sex.

twelve months is given in Table 15 and Figure 11. (The means for the birth to three month period are also in Table 9.) In the period from birth to three months of age, the mean per cent increase in weight was over 80 per cent for male babies and almost 75 per cent for females. The mean was slightly larger for Negroes than for white infants of the same sex. In the following period the average gains were much smaller falling between 31 and 34 per cent, with the values for both groups of white infants being a little larger than those for Negroes. The means were somewhat lower during the final six month interval, ranging from 29.5 per cent for white males to 31.1 per cent for Negro females.

The mean per cent gain in chest circumference between birth and three months was 27 per cent for males and 24 per cent for females. During the next interval, the average increase was near 9 per cent for all groups, and in the final period the means were slightly above 8 per cent for white babies and just below this figure for Negroes.

The means for crown-sole length in the first period range from 20.7 per cent for white females to 22.2 per cent for Negro males. From three to six months the mean per cent gain is just above 11 per cent for males and slightly below this level for females. The mean values in the last period for Negro females is 14.5 per cent, and 13.3 per cent for the other three groups.

The average increase in hip breadth between the birth and three month examinations was 32.1 and 31.5 per cent for white and Negro males, respectively, and the corresponding values for females were 30.0 and 28.7 per cent. All four means for the three to six month interval fell between 10.0 and 10.7 per cent. Between the last two examinations, the average per cent gain was greater for females, 10.6 and 11.0 per cent for white and Negro infants, than for males (9.7 and 9.3 per cent).

During the first interval the mean gain in calf circumference was 45 per cent for males and 36 per cent for white females and 40 per cent for Negro females. In the three to six month

period, the largest mean increase was observed for white females (16.3 per cent) and the smallest for Negro females (13.7 per cent), while the values for the two male groups were around 14.6 per cent. From six to twelve months, the means for females (11.9 and 11.5 per cent) exceeded those for males (9.6 and 10.2 per cent).

Greater relative growth was observed for males in all five measurements during the first interval and in weight and crown-sole length during the second. During the six to twelve month period, the mean per cent gains were greater for females in weight, hip breadth, and calf circumference. Higher means were observed for Negroes in weight and crown-sole length between birth and three months of age and in weight during the six to twelve month period. White infants had the larger relative growth in hip breadth during the first two intervals and in weight during the second three month period.

The coefficients of correlation between the increments of the different measurements during each time period are given in Table 16. As before, each coefficient is the weighted average of the coefficients for the four race-sex groups. Sixteen of the 130 sets of correlations were found to be non-homogeneous, and their coefficients are shown in italics in Table 16 with the correlations for each race-sex group given in Table 17.

During the interval from birth to three months, the highest correlations between increments in the measurements were observed for weight and calf circumference (.72) and weight and chest circumference (*.60*). The lowest coefficients were between gain in rump-sole length and gain in each of the other measurements, for which the range of value was between .04 and – *.14*. Most of the other correlations were between .30 and .50.

In the following period, from the three month to the six month examination, the highest correlation between the increments was again between those for weight and calf circumference (.71), while none of the other coefficients exceeded .47. The correlations involving the growth of rump-sole length

Table 16. Coefficients of correlation between increments of the measurements during each period.

Measurement	Birth to Three Mos.	Three to Six Mos.	Six to Twelve Mos.	Birth to Six Mos.	Birth to Twelve Mos.	Birth to Three Mos.	Three to Six Mos.	Six to Twelve Mos.	Birth to Six Mos.	Birth to Twelve Mos.	Birth to Three Mos.	Three to Six Mos.	Six to Twelve Mos.	Birth to Six Mos.	Birth to Twelve Mos.	Birth to Three Mos.	Three to Six Mos.	Six to Twelve Mos.	Birth to Six Mos.	Birth to Twelve Mos.
	WEIGHT					CHEST CIRCUMFERENCE					CROWN-SOLE LENGTH					CROWN-RUMP LENGTH				
Weight	—	—	—	—	—	*.60*	.43	.46	.63	.64	.45	.37	.37	.53	.54	.50	.43	.35	.57	.62
Chest Circumference	*.60*	.43	.46	.63	.64	—	—	—	—	—	.38	.16	.10	.41	.39	*.48*	.30	.10	.48	.56
Crown-Sole Length	.45	.37	.37	.53	.54	.38	.16	.10	.41	.39	—	—	—	—	—	—	—	—	—	—
Crown-Rump Length	.50	.43	.35	.57	.62	*.48*	.30	.10	.48	.56	—	—	—	—	—	—	—	—	—	—
Rump-Sole Length	.04	.07	.04	.10	.18	−.01	−.05	−.04	.04	.11	—	—	—	—	—	*−.14*	*−.07*	−.26	−.07	.00
Hip Breadth	*.45*	.47	.41	.57	.61	*.46*	.31	.27	.50	.58	.25	.26	.22	.40	.45	.33	.26	.19	*.43*	*.51*
Head Circumference	.35	.31	.28	.37	.42	.33	.23	.21	.40	.38	*.24*	.23	.13	.32	.35	.32	.27	.27	.40	.44
Calf Circumference	.72	.71	.55	*.75*	*.83*	*.48*	*.32*	*.19*	.54	.66	.34	.20	.20	.46	.39	.36	.27	.35	.46	.56
	RUMP-SOLE LENGTH					HIP BREADTH					HEAD CIRCUMFERENCE					CALF CIRCUMFERENCE				
:	.04	.07	.04	.10	.18	*.45*	.47	.41	.57	.61	.35	.31	.28	.37	.42	.72	.71	.55	*.75*	*.83*
Circumference	−.01	−.05	−.04	.04	.11	*.46*	.31	.27	.50	.58	.33	.23	.21	.40	.38	*.48*	*.32*	*.19*	.54	.66
-Sole Length	—	—	—	—	—	.25	.26	.22	.40	.45	*.24*	.23	.13	.32	.35	.34	.20	.20	.46	.39
-Rump Length	*−.14*	*−.07*	−.26	−.07	.00	.33	.26	.19	*.43*	*.51*	.32	.27	.27	.40	.44	.36	.27	.35	.46	.56
Sole Length	—	—	—	—	—	−.03	.07	.06	.11	.16	−.03	*.07*	−.08	.05	.01	.01	.01	−.08	.08	.00
eadth	−.03	.07	.06	.11	.16	—	—	—	—	—	.28	.17	.14	.30	.31	*.53*	.28	.27	.64	.64
Circumference	−.03	*.07*	−.08	.05	.01	.28	.17	.14	.30	.31	—	—	—	—	—	.36	.28	.29	.36	.45
rcumference	.01	.01	−.08	.08	.00	*.53*	.28	.27	.64	.64	.36	.28	.29	.36	.45	—	—	—	—	—

	NUMBER																			
Measurements	Birth to Three Mos.	Three to Six Mos.	Six to Twelve Mos.	Birth to Six Mos.	Birth to Twelve Mos.	Measurements	Birth to Three Mos.	Three to Six Mos.	Six to Twelve Mos.	Birth to Six Mos.	Birth to Twelve Mos.	Measurements	Birth to Three Mos.	Three to Six Mos.	Six to Twelve Mos.	Birth to Six Mos.	Birth to Twelve Mos.
Ch.	686	646	406	610	367	Ch. × R-S	586	554	351	527	310	C-R × Head	586	559	356	530	314
C-S	689	653	410	616	375	Ch. × Hip	557	538	342	491	293	C-R × Calf	191	207	133	193	9
C-R	580	554	349	528	309	Ch. × Head	692	651	413	613	373	R-S × Hip	549	536	343	488	29
R-S	580	554	349	528	309	Ch. × Calf	193	204	132	193	90	R-S × Head	586	559	356	530	31
Hip	550	537	341	490	291	C-S × Hip	556	542	347	492	297	R-S × Calf	191	207	133	193	9
Head	685	653	411	613	372	C-S × Head	690	658	417	614	378	Hip × Head	557	542	347	493	29
Calf	190	207	132	194	92	C-S × Calf	193	209	133	195	92	Hip × Calf	182	205	129	181	9
Ch. × C-S	691	651	412	611	373	C-R × R-S	587	559	356	531	315	Head × Calf	193	209	133	196	9
Ch. × C-R	586	554	351	527	310	C-R × Hip	549	536	343	488	293						

Note: Coefficients in italics are based on coefficients by race and sex which are not homogeneous.

were all between .07 and $-.07$. The other coefficients were mostly between .20 and .40. In general, the correlation coefficients between the increments of growth during this period were either equal to or less than the corresponding values for the preceding three month period.

The association between gain in the measurements during the six to twelve month interval was, in most instances, lower than that during the previous three months. The highest correlations were found between increase in weight and calf circumference (.55), weight and chest circumference (.46) and weight and hip breadth (.41). The lowest correlations were,

Table 17. Non-homogeneous correlations by race and sex between increments during each period.

Measurements	Period	Correlation Coefficient				Number			
		White Male	White Female	Negro Male	Negro Female	White Male	White Female	Negro Male	Negro Female
Weight and Chest Circumference	Birth–3 Months	.52	.64	.58	.71	239	205	130	112
Weight and Hip Breadth	Birth–3 Months	.36	.42	.39	.68	188	164	105	93
Chest Circumference and Crown-Rump Length	Birth–3 Months	.45	.36	.57	.61	204	172	111	99
Chest Circumference and Hip Breadth	Birth–3 Months	.39	.40	.46	.65	190	167	106	94
Chest Circumference and Calf Circumference	Birth–3 Months	.28	.58	.31	.70	51	41	52	49
Crown-Sole Length and Head Circumference	Birth–3 Months	.23	.37	.06	.20	239	207	131	113
Crown-Rump Length and Rump-Sole Length	Birth–3 Months	−.30	.03	−.21	.00	205	172	111	99
Calf Circumference and Hip Breadth	Birth–3 Months	.27	.67	.44	.69	46	40	50	46
Chest Circumference and Calf Circumference	3–6 Months	.16	.32	.60	.14	56	47	54	47
Rump-Sole Length and Crown-Rump Length	3–6 Months	−.01	−.14	−.27	.18	188	164	112	95
Rump-Sole Length and Head Circumference	3–6 Months	.23	−.05	.02	−.01	188	164	112	95
Chest Circumference and Calf Circumference	6–12 Months	.13	.58	.19	−.14	42	29	30	31
Weight and Calf Circumference	Birth–6 Months	.62	.83	.70	.84	57	39	51	47
Crown-Rump Length and Hip Breadth	Birth–6 Months	.31	.40	.57	.52	171	134	97	86
Weight and Calf Circumference	Birth–12 Months	.66	.94	.78	.87	25	17	24	26
Crown-Rump Length and Hip Breadth	Birth–12 Months	.31	.57	.55	.67	96	78	61	58

again, those between the gain in each measurement and gain in rump-sole length, all of which, with one exception were near zero. The exception was the correlation between growth in rump-sole and crown-rump length for which the coefficient was −.26. Almost all the other coefficients were between .10 and .30.

The correlations for the period, birth to six months, tended to be slightly higher than those for the birth to three month interval. The largest values were those for gain in weight and calf circumference (*.75*) weight and chest circumference (.63) and hip breadth and calf circumference (.64). The correlations with gain in rump-sole length were low (.11 to −.07). All the other coefficients were above .40 with the exception of those involving head circumference which were between .30 and .40.

The coefficients of correlation between growth in each measurement over the entire first year of life were slightly larger than the corresponding values during the other two periods starting at birth. Six coefficients were over .60, those of the increments in weight and calf circumference, chest circumference, crown-rump length, and hip breadth, and the increments in calf circumference and both chest circumference and hip breadth. Except for the correlations involving rump-sole length, the other coefficients were above .30.

The correlations between the increments which were not homogeneous by race and sex are shown in Table 17. Half of these sets of coefficients are for the interval birth to three months. In six of these sets the correlations for females were higher than those for males and, hence, the combined coefficient was an underestimate for the former group and an overestimate for the latter. These sets are: in the birth to three month period, weight and chest circumference, chest and calf circumference, crown-sole length and head circumference, and calf circumference and hip breadth; and in the birth to six and twelve month intervals, weight and calf circumference. The correlations for males were greater than those for females for

crown-rump and rump-sole length during the initial period, and those for Negroes exceeded those for the white groups for chest circumference and crown-rump length in the first interval and crown-rump length and hip breadth in the birth to six month period. The other sets of correlations were in no consistent pattern with respect to differences by race and sex.

Although the coefficients of correlation between the increments in each period were generally significantly different from zero, it seems evident that the association between the growth of most of these body dimensions is not strong. As might be expected, the measurement whose increase was most closely correlated with increase in the other measurements was weight. When the highest correlation of the increments of a measurement was not with weight gain, it was usually with the gain in calf circumference, which, in turn, was more highly correlated with weight gain than were increases in any other dimension.

The low or non-existent association between increase in rump-sole length and increases in the other measurements is puzzling. If it is a correct expression of the relationships it implies that the growth in length of the legs during infancy is almost completely independent of the growth in any of the other body measurements considered here. On the other hand, the fact that rump-sole length is the only measurement not observed directly but is obtained by subtraction of crown-rump length from crown-sole length suggests the possibility that errors of some magnitude may have been introduced by this procedure.

The coefficients of correlation between the increments in each measurement in one period with the increments of the same measurement in the following period are given in Table 18. The four sets of correlations by race and sex which were found to be non-homogeneous are shown in Table 19. All coefficients were negative except those for weight and one coefficient for head circumference. While none were higher than $-.39$, all were significantly different from zero, with the excep-

tion of the four which were less than ±.10. The negative values, while low, are suggestive of a tendency for large or small increases in a body measurement during one period to be followed by relatively small or large increases, respectively, in the next period. The higher correlations for rump-sole gain indicate that this tendency is most marked for this measurement. On the other hand, large or small weight gains in one period are associated, to some degree, with similar increases in the other periods.

The correlations for each race-sex group in Table 19 for the non-homogenous sets of correlations show that for white babies the correlation of increments between the first two three-month periods were definitely negative for chest circumference, rump-sole length, and calf circumference, and posi-

Table 18. Coefficients of correlation between increments of each measurement.

Measurement	Birth to Three Months and Three to Six Months	Three to Six Months and Six to Twelve Months	Birth to Six Months and Six to Twelve Months
	CORRELATION COEFFICIENT		
Weight	.23	.24	.20
Chest Circumference	*−.16*	−.14	−.18
Crown-Sole Length	−.13	−.23	−.13
Crown-Rump Length	−.10	−.23	−.20
Rump-Sole Length	*−.22*	−.38	−.39
Hip Breadth	−.03	−.15	−.19
Head Circumference	*.06*	−.11	−.11
Calf Circumference	*−.06*	−.01	−.53
	NUMBER		
Weight	666	420	427
Chest Circumference	572	408	364
Crown-Sole Length	579	412	372
Crown-Rump Length	490	336	306
Rump-Sole Length	490	336	306
Hip Breadth	455	321	284
Head Circumference	575	413	369
Calf Circumference	163	109	88

Note: Coefficients in italics are based on coefficients by race and sex which are not homogeneous.

Measurement	Correlation Coefficient				Number			
	White Male	White Female	Negro Male	Negro Female	White Male	White Female	Negro Male	Negro Female
Chest Circumference	−.32	−.17	−.01	.02	190	167	116	99
Rump-Sole Length	−.33	−.31	−.02	−.07	167	138	97	88
Head Circumference	.11	.21	−.06	−.17	190	167	117	101
Calf Circumference	−.10	−.25	−.27	.32	40	32	47	44

Table 19. Non-homogeneous correlations by race and sex between increments in the birth to three months and three to six month periods.

tive for head circumference. Among Negro infants, these coefficients were either near zero or, in the case of calf circumference, differed between the two sex groups.

Summary

Data on the measurements of weight, chest circumference, crown-sole length, crown-rump length, rump-sole length, hip breadth, head circumference, and calf circumference at birth and three, six, and twelve months of age are presented for 1,391 white and Negro infants.

The mean values of these measurements are almost always larger for males than for females at each age. The means for the white babies are usually larger than those for Negroes of the same sex for weight, chest circumference, crown-rump length, hip breadth, and calf circumference, and are smaller for rump-sole length and head circumference.

The mean per cent increase from birth to each subsequent age is given for five of the measurements. The largest relative increases were found for weight, followed by calf circumference, hip breadth, crown-sole length, and chest circumference.

Correlation coefficients between the measurements at each age indicate that the size of each body dimension is more highly correlated with weight than with any of the other dimensions. The lowest correlations were those between rump-sole length and the other measurements.

The correlations between the same measurement at the different ages are shown. The highest correlations are those be-

tween the observations at three and six months and six and twelve months. The largest correlations between the birth observations and subsequent measurements are found for length and head circumference.

The mean and quartile value of the increments in each measurement between each examination are given. From birth to the later ages, the average increments were usually greater for males than for females. The difference by race and sex during the other intervals were less consistent.

Comparison of mean per cent gain in each interval for five of the measurements indicated greater growth for males during the first three months of life. From six to twelve months, the mean per cent increase in weight, hip breadth, and calf circumference was larger for females than for males.

The correlation coefficients between the increments in each interval are presented. Weight gain is most highly correlated with the increments of the other measurements while the association of growth in rump-sole length with the other increments is usually near zero.

Correlations of the increments of a measurement in one period with those of the same measurement in another period are, with the exception of those for weight gain, usually negative.

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