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

NEWBORN STUDIES. VI. INFANT SIZE AT BIRTH AND PARITY, LENGTH OF GESTATION, MATERNAL AGE, HEIGHT, AND WEIGHT STATUS

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THE size of an infant at birth is determined by a variety of factors, both genetic and non-genetic. Information on several characteristics of the mother and child which might be listed among these factors was collected at the Nutrition Clinic of the Philadelphia Lying-In Hospital and included parity of the infant, maternal age, length of gestation, mother's pregravid weight status, and mother's height. The analysis to be presented in this report examines the relationship between these variables and the size of the infants at birth as measured by weight, chest circumference, crown-sole length, crown-rump length, rump-sole length, hip breadth, and head circumference.

The analysis is based on the observations on 1,466 singleton infants whose mothers attended the Clinic during the period 1947–1952, and includes 75 babies weighing less than 5.5 lbs. at birth who were therefore classified as premature. The white infants number 1,078 of whom about 75 per cent had one or both parents of Italian ancestry, and the remaining 388 are Negro. Babies of mothers with syphilis or a serious chronic disease have not been included.[4] The condition of the infants

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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 disease classified II-a or higher, chronic nephritis, and chronic pyelitis.

at birth was generally appraised as favorable by the examining pediatricians, only 3 per cent being rated as poor.

During much of the study the measurements were made by one pediatrician (A.R.).[5] Observation of weight was done for all infants, but it was not always possible to make all of the other measurements, especially on prematures, so that there are differences in the numbers on which the analysis of each measurement is based. The procedure for each measurement was 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 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.

If the five factors being considered were independent of each other, the relation of each with the measurements could be studied individually. To see if this independence occurred, the coefficients of correlation between four of the five factors were computed. For the fifth factor, parity of the infant, independ-

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

Variables	Correlation Coefficient	
	White	Negro
Mother's Age and Pregravid Weight Status	.20	.23
Mother's Age and Length of Gestation	−.10	−.02
Mother's Age and Height	−.09	−.01
Mother's Pregravid Weight Status and Length of Gestation	.09	.08
Mother's Pregravid Weight Status and Height	.06	.08
Length of Gestation and Mother's Height	.07	.02
	Chi-Square Probability	
Parity and Mother's Age	<.001	<.001
Parity and Mother's Pregravid Weight Status	<.001	.05–.10
Parity and Length of Gestation	.10–.20	.20–.30
Parity and Mother's Height	.20–.30	.05–.10

Table 1. Correlation among the study variables.

ence of the other variables was examined by means of the Chi-square test, since the distribution of parity seemed to depart too much from "normal" to permit the use of the correlation coefficient. The low correlation coefficients and the non-significant Chi-square test probabilities (Table 1) indicate that length of gestation and mother's height may be considered independently of the other characteristics. Parity and maternal age are, of course, highly associated, and mother's pregravid weight status appears to be significantly correlated with these two variables. Therefore, in the analysis to follow, parity and maternal age will be treated together, while mother's pregravid weight status will be studied separately, and then the association between the measurements and all three factors will be examined.

Mother's Height

The means of the various measurements for the infants classified by mother's height and race and sex are shown in Table 2 and Figure 1. An association between mother's height and the three linear measurements would be expected and was

Mother's Height	Mean				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 (LBS.)											
66 Ins. or More	7.76	7.47	7.62	7.23	.96	.89	1.34	1.19	28	24	31	29
63–65.9 Ins.	7.61	7.25	7.31	6.89	1.03	1.00	1.16	1.19	179	162	70	89
60–62.9 Ins.	7.47	7.17	7.09	6.91	1.09	.99	1.04	1.07	263	221	79	61
59.9 Ins. or Less	7.07	6.90	6.94	5.94	.99	.95	1.01	.99	112	83	16	13
	CHEST CIRCUMFERENCE (CMS.)											
66 Ins. or More	33.29	33.05	32.79	31.54	1.93	1.69	2.05	2.49	28	20	24	25
63–65.9 Ins.	32.70	32.29	31.93	31.62	1.61	1.62	1.92	1.94	162	138	61	72
60–62.9 Ins.	32.47	32.15	31.62	31.67	1.80	1.60	1.86	1.71	232	193	66	54
59.9 Ins. or Less	32.00	31.54	31.25	30.95	1.91	1.53	2.02	1.07	94	72	16	11
	CROWN-SOLE LENGTH (CMS.)											
66 Ins. or More	50.57	50.20	50.88	49.82	2.30	1.55	2.17	2.43	28	20	24	25
63–65.9 Ins.	50.55	49.68	50.20	49.22	2.07	2.01	2.41	1.94	162	137	61	74
60–62.9 Ins.	50.20	49.39	49.46	48.77	2.21	2.10	2.21	1.95	234	193	68	55
59.9 Ins. or Less	49.56	48.98	49.44	47.41	2.04	1.94	2.22	1.83	97	71	16	11
	CROWN-RUMP LENGTH (CMS.)											
66 Ins. or More	34.39	34.50	33.75	33.45	1.65	1.30	1.67	2.27	19	13	20	20
63–65.9 Ins.	34.37	33.72	33.42	33.22	1.46	1.31	1.72	1.42	135	111	53	65
60–62.9 Ins.	33.86	33.57	33.21	32.92	1.50	1.42	1.39	1.61	190	157	59	48
59.9 Ins. or Less	33.26	33.24	32.77	32.37	1.47	1.28	1.53	1.05	76	57	15	8
	RUMP-SOLE LENGTH (CMS.)											
66 Ins. or More	16.57	16.21	16.65	16.78	.92	.87	.75	.54	19	13	20	20
63–65.9 Ins.	16.37	16.14	16.63	16.15	.94	1.00	1.05	1.14	135	111	53	65
60–62.9 Ins.	16.35	15.94	16.50	16.01	1.07	1.09	1.05	.88	190	157	59	48
59.9 Ins. or Less	16.19	15.85	16.25	15.38	.89	.84	.90	.60	76	57	15	8
	HIP BREADTH (CMS.)											
66 Ins. or More	8.38	8.21	8.00	7.73	.49	.46	.51	.62	19	13	20	19
63–65.9 Ins.	8.20	7.93	7.89	7.69	.50	.49	.61	.54	126	109	49	58
60–62.9 Ins.	8.20	7.93	7.78	7.64	.52	.51	.54	.51	176	152	56	46
59.9 Ins. or Less	7.99	7.90	7.61	7.50	.56	.49	.48	.25	73	55	14	8
	HEAD CIRUCMFERENCE (CMS.)											
66 Ins. or More	34.71	34.40	34.67	34.15	1.50	1.34	1.24	1.49	28	20	24	23
63–65.9 Ins.	34.78	33.80	34.43	33.71	1.30	1.37	1.44	1.19	162	138	61	73
60–62.9 Ins.	34.47	33.62	34.29	33.52	1.44	1.33	1.34	1.26	232	193	66	55
59.9 Ins. or Less	34.08	33.50	33.81	32.32	1.29	1.07	1.57	1.95	92	71	16	11

Table 2. Mean of each measurement by mother's height and race and sex.

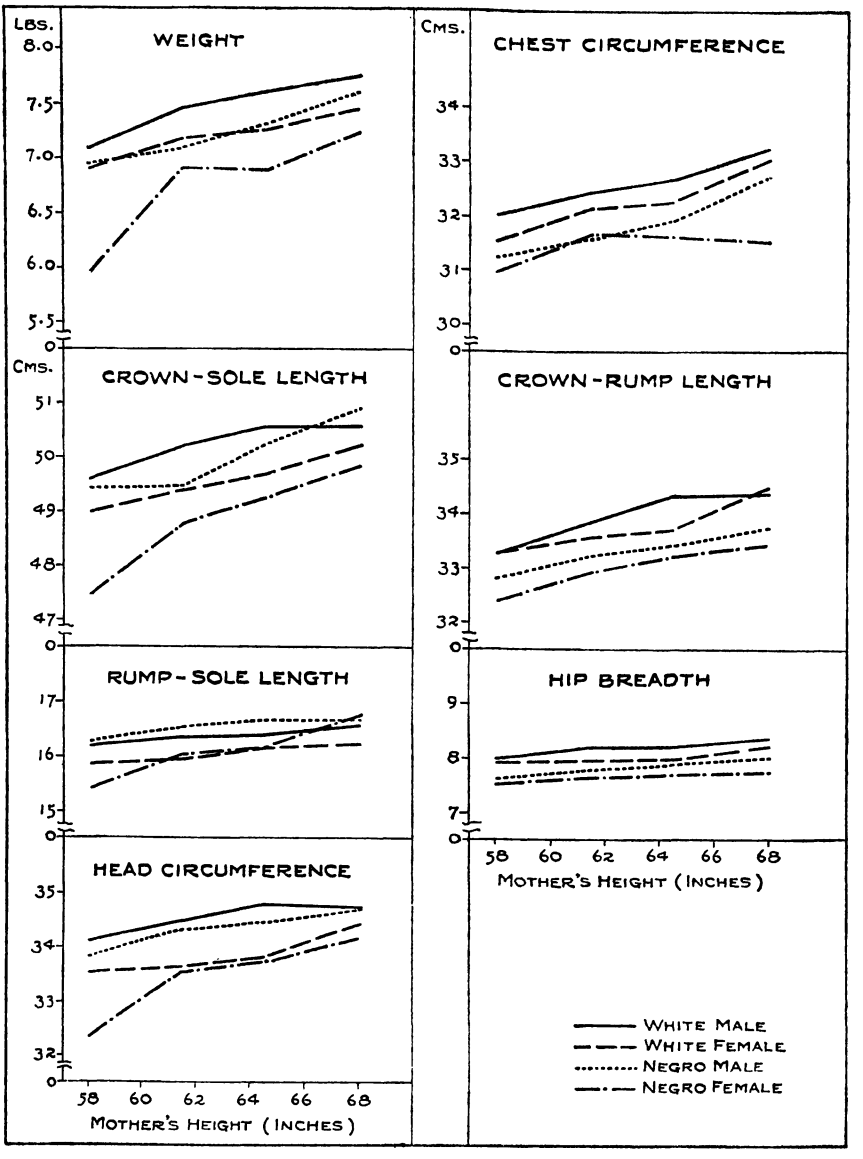

Fig. 1. Means of each measurement by mother's height and race and sex.

observed, but it is of interest that all measurements are to some degree correlated with this variable. Although there are occasional exceptions, in general, there is an increase in the means from a minimum for infants of the shortest mothers to a maximum among infants of the tallest mothers.

Measurement	Correlation Coefficient					Number				
	Total	White Male	White Female	Negro Male	Negro Female	Total	White Male	White Female	Negro Male	Negro Female
Weight	.16	.18	.13	.17	.19	1,460	582	490	196	192
Chest Circumference	.16	.17	.19	.21	*.03*	1,268	516	423	167	162
Crown-Sole Length	.17	.15	.14	.21	.26	1,276	521	421	169	165
Crown-Rump Length	.19	.25	.16	*.16*	*.15*	1,046	420	338	147	141
Rump-Sole Length	.12	*.08*	.11	*.11*	.29	1,046	420	338	147	141
Hip Breadth	.12	.16	*.07*	.19	*.09*	993	394	329	139	131
Head Circumference	.15	.16	.13	*.15*	.17	1,267	514	422	167	164

Note: Coefficients in italics are not significantly different from zero at the 5 per cent level.

Table 3. Coefficients of correlation between each measurement and mother's height, by race and sex.

The correlation between the measurements and mother's height is shown in Table 3. The coefficients are all positive, but not all differ significantly from zero, the range of values being .03 to .29. The weighted combination of the coefficients by race and sex are between .12 for rump-sole length and hip breadth and .19 for crown-rump length. The correlations for the linear measurements are seen to be no higher than those for weight and the other body dimensions.

Although heights of mothers show a significant association with birth measurements of their babies, the correlation is low and there is great variation in the size of babies born to mothers of the same height. The height of the mother obviously is only one factor and a relatively minor factor affecting the length and other measurements of her baby.

Length of Gestation Period

Since length of gestation is a measure of the duration of intrauterine growth, it must affect the size of babies at birth. In general, an increase in mean values is to be expected as the period of gestation lengthens, and the increase from one period to a later period reflects the increment in growth. It is of interest to compare the growth patterns in the ninth month of pregnancy and in the post-maturity weeks for the different body measurements.

The change in the mean values of each measurement with

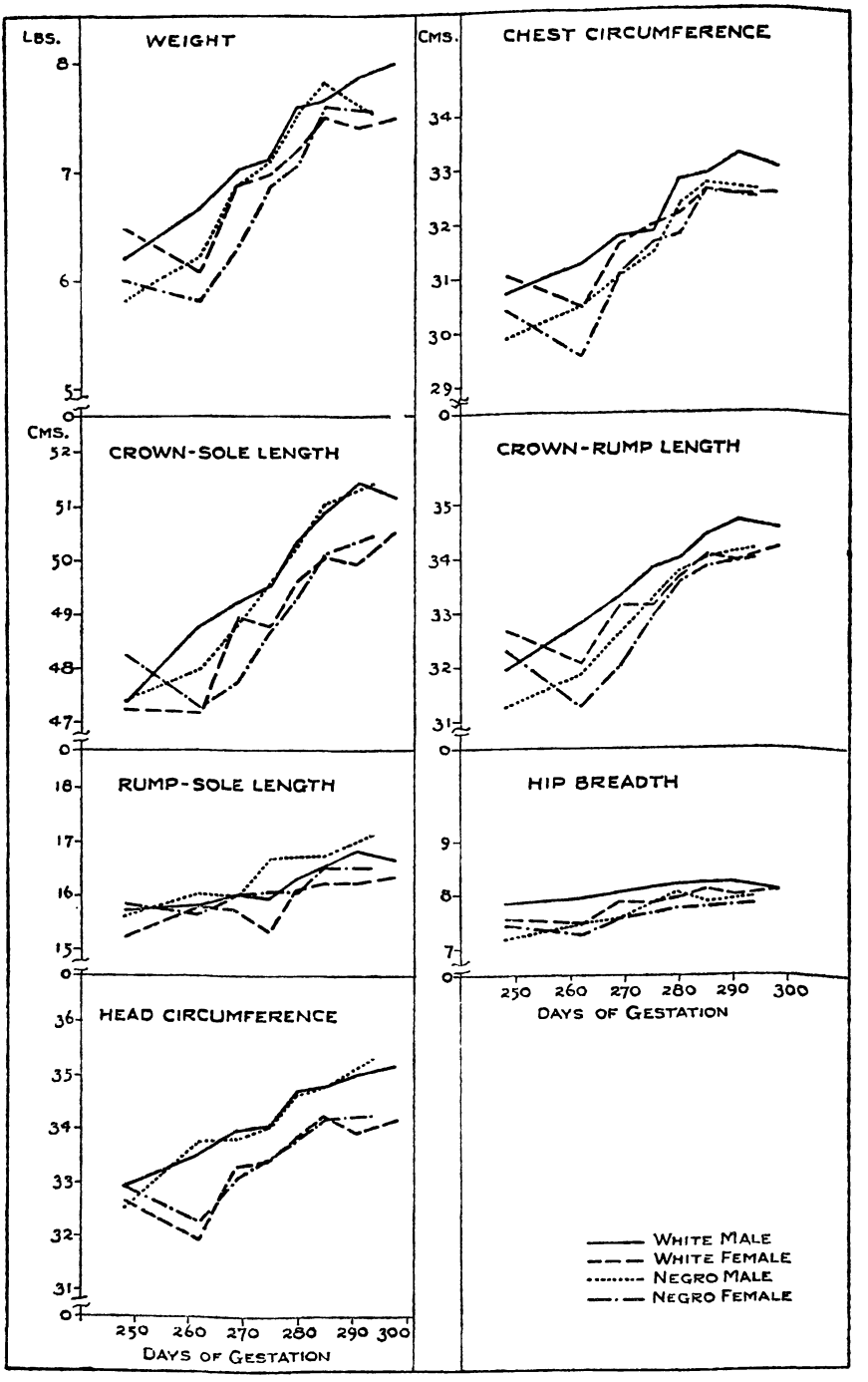

Fig. 2. Means of each measurement by length of gestation, race and sex.

Table 4. Mean of each measurement by length of gestation, race, and sex.

Length of Gestation	Mean				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 (LBS.)											
295 Days or More	8.02	7.51	7.55	7.57	.99	.95	1.03	1.02	50	37	32	36
288–294 Days	7.90	7.43			1.05	.93			75	82		
284–287 Days	7.69	7.52	7.86	7.61	.97	.76	.98	.87	74	63	26	20
277–283 Days	7.62	7.20	7.54	7.07	.88	.93	.90	1.02	180	158	58	50
273–276 Days	7.14	6.99	7.11	6.87	1.03	.89	.95	.97	83	54	26	24
266–272 Days	7.04	6.88	6.90	6.30	.91	1.02	1.00	.78	69	56	31	28
259–265 Days	6.66	6.07	6.23	5.82	.88	.91	.90	.90	32	21	9	14
258 Days or Less	6.20	6.50	5.82	6.01	1.16	1.13	1.55	1.43	25	18	14	20
	CHEST CIRCUMFERENCE (CMS.)											
295 Days or More	33.04	32.56	32.62	32.50	1.82	1.75	1.77	1.61	46	32	25	30
288–294 Days	33.29	32.53			1.59	1.58			66	72		
284–287 Days	32.93	32.63	32.76	32.61	1.38	1.38	1.57	1.37	67	56	23	18
277–283 Days	32.86	32.20	32.28	31.80	1.59	1.52	1.87	1.76	160	135	49	43
273–276 Days	31.82	31.99	31.46	31.65	1.89	1.42	1.46	1.49	74	45	23	20
266–272 Days	31.78	31.62	31.02	31.07	1.59	1.51	1.80	1.79	61	51	29	23
259–265 Days	31.25	30.44	30.50	29.58	1.60	1.74	1.66	1.60	28	18	8	12
258 Days or Less	30.71	31.07	29.90	30.43	2.14	1.99	2.37	2.17	19	14	10	15
	CROWN-SOLE LENGTH (CMS.)											
295 Days or More	51.13	50.56	51.42	50.47	2.07	1.91	1.73	2.21	46	33	26	30
288–294 Days	51.44	49.95			2.03	1.74			67	71		
284–287 Days	50.90	50.10	51.07	50.11	1.80	1.73	2.10	1.11	68	55	23	18
277–283 Days	50.39	49.63	50.30	49.34	1.84	1.83	1.95	2.04	159	135	49	44
273–276 Days	49.53	48.77	49.59	48.69	2.10	1.99	2.17	1.62	76	44	23	21
266–272 Days	49.24	48.97	48.78	47.79	1.97	1.81	2.00	1.62	62	49	29	24
259–265 Days	48.81	47.17	48.00	47.27	1.97	2.29	2.45	2.33	29	18	8	13
258 Days or Less	47.39	47.23	47.41	48.23	1.83	2.32	2.31	1.43	19	15	11	15
	CROWN-RUMP LENGTH (CMS.)											
295 Days or More	34.53	34.19	34.15	34.00	1.66	1.54	1.11	1.67	36	26	20	26
288–294 Days	34.68	33.95			1.25	1.22			55	58		
284–287 Days	34.44	34.08	34.00	33.86	1.41	1.24	1.53	.97	54	45	20	14
277–283 Days	33.99	33.69	33.76	33.58	1.30	1.16	1.33	1.42	124	107	42	38
273–276 Days	33.82	33.13	33.23	32.92	1.45	1.29	1.39	1.27	60	38	22	19
266–272 Days	33.29	33.14	32.61	32.00	1.45	1.42	1.31	1.07	53	39	27	20
259–265 Days	32.82	32.07	31.87	31.25	1.57	1.50	1.79	1.74	25	14	8	12
258 Days or Less	31.96	32.68	31.25	32.33	1.55	1.40	1.39	1.40	13	11	8	12

Table 4. (Continued)

Length of Gestation	Mean				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
	Rump-sole length (cms.)											
295 Days or More	16.70	16.37	17.08	16.54	.84	.80	.93	1.00	36	26	20	26
288–294 Days	16.85	16.25			.97	.95			55	58		
284–287 Days	16.59	16.24	16.73	16.54	.89	.90	.78	.62	54	45	20	14
277–283 Days	16.36	16.12	16.74	16.07	.97	.95	.84	1.06	124	108	42	38
273–276 Days	15.99	15.33	16.71	16.09	.87	1.18	.94	.80	60	38	22	19
266–272 Days	16.04	15.75	15.99	16.00	1.06	1.05	.91	.85	53	39	27	20
259–265 Days	15.81	15.79	16.06	15.63	1.00	.81	1.09	1.03	25	14	8	12
258 Days or Less	15.71	15.25	15.63	15.84	.60	1.23	1.14	1.17	13	11	8	12
	Hip breadth (cms.)											
295 Days or More	8.09	8.06	7.95	7.84	.76	.45	.56	.61	34	24	18	24
288–294 Days	8.25	8.00			.59	.47			53	57		
284–287 Days	8.26	8.11	7.88	7.79	.60	.55	.83	.40	52	45	19	14
277–283 Days	8.22	7.96	8.03	7.78	.53	.43	.50	.47	115	104	41	35
273–276 Days	8.12	7.84	7.85	7.66	.50	.60	.55	.49	60	36	21	17
266–272 Days	8.05	7.86	7.57	7.56	.43	.40	.46	.48	50	39	27	18
259–265 Days	7.93	7.48	7.47	7.25	.41	.54	.37	.43	23	13	7	11
258 Days or Less	7.84	7.53	7.18	7.42	.54	.45	.50	.55	12	11	7	12
	Head circumference (cms.)											
295 Days or More	35.17	34.16	35.30	34.23	1.38	1.47	.89	1.09	45	32	25	30
288–294 Days	35.00	33.92			1.27	1.06			66	71		
284–287 Days	34.80	34.25	34.76	34.17	1.27	1.00	1.33	1.42	67	56	23	18
277–283 Days	34.70	33.83	34.62	33.78	1.20	1.12	1.02	1.50	161	135	49	43
273–276 Days	34.10	33.39	34.02	33.40	1.59	1.07	1.28	1.30	73	46	23	21
266–272 Days	33.95	33.30	33.80	33.08	1.15	1.56	1.46	.85	60	51	29	24
259–265 Days	33.50	31.94	33.75	32.27	1.10	1.25	1.79	1.37	28	18	8	13
258 Days or Less	32.92	32.65	32.50	32.90	1.81	1.79	1.18	1.78	19	13	10	15

increasing length of gestation is indicated in Table 4 and Figure 2 which gives the means for the infants classified by length of gestation period and race and sex. For all measurements there is a definite increase in the means from those for infants with a gestation period of less than 265 days to those for infants born a week or more after the expected period of 280 days. The curves show considerable irregularity in the mean

Measurement	Length						
	258 or Less	259–265	266–272	273–276	284–287	288–294	29 M
	WHITE MALE						
Weight	81.4	87.4	92.4	93.7	100.9	103.7	10
Chest Circumference	93.5	95.1	96.7	96.8	100.2	101.3	10
Crown-Sole Length	94.0	96.9	97.7	98.3	101.0	102.1	10
Crown-Rump Length	94.0	96.6	97.9	99.5	101.3	102.0	10
Rump-Sole Length	96.0	96.6	98.0	97.7	101.4	103.0	10
Hip Breadth	95.4	96.5	98.0	98.8	100.5	100.4	9
Head Circumference	94.9	96.5	97.8	98.3	100.3	100.9	10
	NEGRO MALE						
Weight	77.2	82.6	91.5	94.3	104.2	100.1	
Chest Circumference	92.3	94.2	95.8	97.2	101.2	100.7	
Crown-Sole Length	94.3	95.4	97.0	98.6	101.5	102.2	
Crown-Rump Length	92.6	94.4	96.6	98.4	100.7	101.2	
Rump-Sole Length	93.4	95.9	95.5	99.8	99.9	102.0	
Hip Breadth	89.4	93.0	94.2	97.7	98.1	99.0	
Head Circumference	93.9	97.5	97.6	98.3	100.4	102.0	

Table 5. Mean of each measurement by length of gestation as a per cent of the mean fo infants of 277–283 days gestation, by race and sex.
(100 = Mean for infants of 277–283 days gestation.)

values from week to week, but for most of the measurements the increase in the four weeks preceding term (277–283 days) is rather rapid. For rump-sole length the means for infants with gestation periods up to 276 days are rather constant but are generally lower than the means for babies of longer gestation. The means for female infants of 259 to 269 days gestation are in most cases lower than those for infants of less than 258 days gestation. This inconsistency may result from inaccuracies in estimating the beginning of pregnancy, but it is not apparent why it should occur for female and not for male infants. Some curves tend to flatten or even decline for the points after 288 days gestation. This may be due to a slowing down or cessation of growth in postmature infants or may also be caused by overestimates of the length of the gestation period.

If the means for a given measurement for infants of each

STATION (DAYS)						
258 or Less	259–265	266–272	273–276	284–287	288–294	295 or More
WHITE FEMALE						
90.3	84.3	95.6	97.1	104.4	103.2	104.3
96.5	94.5	98.2	99.3	101.3	101.0	101.1
95.2	95.0	98.7	98.3	100.9	100.6	101.9
97.0	95.2	98.4	98.3	101.2	100.8	101.5
94.6	98.0	97.7	95.1	100.7	100.8	101.6
94.6	93.9	98.7	98.5	101.9	100.5	101.2
96.5	94.4	98.4	98.7	101.2	100.3	101.0
NEGRO FEMALE						
85.0	82.3	89.1	97.2	107.6	107.1	
95.7	93.0	97.7	99.5	102.5	102.2	
97.8	95.8	96.9	98.7	101.6	102.3	
96.3	93.1	95.3	98.0	100.8	101.3	
98.6	97.3	99.6	100.1	102.9	102.9	
95.4	93.2	97.2	98.5	100.1	100.8	
97.4	95.5	97.9	98.9	101.2	101.3	

gestation period are expressed as a per cent of the mean of that measurement of infants of normal gestation (Table 5) some comparison may be made among the measurements with respect to prenatal growth during the final weeks of gestation. The greatest relative change in the means with increasing length of gestation is observed for weight; the mean weights for infants of less than 266 days gestation are between 77 and 90 per cent of the mean weights for infants of normal gestation.[6] The mean weights of infants born 4 to 7 days early were 6 per cent and 3 per cent less for males and females, respectively, than the means at 277–283 days of gestation. The mean weights of postmature infants are, with one exception, between 3 and 8 per cent above the values at term. When the means for the six body dimensions are expressed on this relative basis, it is interesting to note their similarity. The values for babies of the shortest gestation periods are gener-

[6] Since only weight was available for the very small premature babies, the greater change in weight is due in part to exclusion of such babies from other means. However, weight shows the greatest relative change for all weekly periods.

Measurement	Correlation Coefficient					Number				
	Total	White Male	White Female	Negro Male	Negro Female	Total	White Male	White Female	Negro Male	Negro Female
Weight	.31	.36	.23	.32	.35	1,391	569	468	185	169
Chest Circumference	.28	.31	.21	.35	.30	1,223	508	406	161	148
Crown-Sole Length	.36	.38	.31	.44	.36	1,227	513	403	162	149
Crown-Rump Length	.35	.36	.30	.44	.37	1,010	411	327	142	130
Rump-Sole Length	.28	.30	.25	.33	.21	1,010	411	327	142	130
Hip Breadth	.18	.10	.21	.27	.23	968	392	318	136	122
Head Circumference	.31	.31	.26	.43	.28	1,222	506	406	161	149

Table 6. Coefficients of correlation between each measurement and length of gestation, by race and sex.

ally between 93 and 97 per cent of the means for infants of normal gestation while the means of postmature infants are less than 3 per cent above this standard.

The coefficients of correlation between each measurement and length of gestation are given for each race-sex group in Table 6. All are positive and significantly different from zero. The range of values is between .21 and .44 except for hip breadth for white males (.10). The weighted combination of the four coefficients for each race-sex group are .36 and .35 for crown-sole and crown-rump length and .31 for weight and head circumference. The lowest is that between hip breadth and length of gestation (.18). Thus, there is not much difference among these measurements in their correlation with length of gestation.

If the length of gestation could be estimated with a high degree of accuracy, one might expect the correlation with body dimensions to be much greater than that observed. In a few cases, the gestation period may be over- or underestimated by four weeks, and these cases would greatly reduce the coefficients of correlation. However, the standard deviations given in Table 4 indicate a great variation in size of babies having the same length of gestation. For those born at term, the standard deviation for weight was from 14 ounces to one pound; and for length was from 1.83 to 2.04 cms. Thus, some babies at term were smaller than the mean size of babies born three

weeks or more prematurely and most babies in this latter group weighed more than 5.5 lbs. used as the standard weight for determining prematurity. Although the length of gestation represents the degree of maturity attained, it seems apparent that, even after allowing for errors in length of gestation, other factors are affecting size.

Pregravid Weight Status, Parity and Maternal Age

Previous reports (1, 2) have shown that the pregravid weight of mothers in this population was associated with the birth weight and body dimensions of their babies. This relationship is analyzed here for each measurement for infants classified by race and sex. As mentioned earlier, pregravid weight of mothers was correlated positively with age and with parity which also has a direct correlation with age. Because of the correlation among the three factors, weight, age and parity of mothers, these will be studied together for the white population, but the number of Negro infants is too small for this detailed analysis.

Mother's Pregravid Weight Status. On the basis of their height and pregravid weight, the women attending the Nutrition Clinic were classified as being either of normal weight of a specified per cent overweight or underweight.[7] The means of the birth measurements of the babies grouped on the basis of this pregravid weight status of their mothers and by race and sex are shown in Table 7 and Figure 3. The impression gained from the curves in Figure 3 is that for each measurement there is an increase in the means with the shift from underweight to overweight mothers. With only three exceptions, the lowest mean is that for infants of mothers 15 per cent or more underweight. The exceptions are for crown-sole

[7] Patients were carefully questioned in the Clinic as to their immediate pregravid weight and were measured for height without shoes. The standard weight for a specific height and age used is from the Report of the Medico-Actuarial Investigation 1912–1914 up to age 25 years. The average weight at 25 years is extended to older ages and the value used is the mid-point of the weight range for women of medium frame published by the Metropolitan Life Insurance Company. These standards were based upon a population containing few Negro women, and it is not known whether they are fully applicable to the Negro population in this study.

Table 7. Means of each mesaurement by mother's pregravid weight status and race and sex.

Mother's Pregravid Weight Status	Mean				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 (lbs.)											
Overweight 25 Per Cent or More	8.10	7.43	7.85	6.92	.92	.97	.84	1.43	67	53	21	25
Overweight 15–24 Per Cent	7.54	7.34	7.50	7.63	1.16	1.02	1.43	1.04	42	52	21	23
Overweight 5–14 Per Cent	7.57	7.46	7.44	7.12	1.00	.95	1.09	1.01	109	81	45	30
Within 5 Per Cent of Normal	7.47	7.27	6.98	6.97	1.00	.96	1.28	1.04	182	144	49	45
Underweight 5–14 Per Cent	7.32	6.85	7.03	6.56	1.01	.86	.86	1.22	126	105	42	43
Underweight 15 Per Cent or More	6.59	6.83	6.95	6.26	.97	.84	1.09	.87	56	49	18	26
	chest circumference (cms.)											
Overweight 25 Per Cent or More	33.31	32.43	32.78	32.45	1.60	1.45	1.44	1.82	58	43	18	19
Overweight 15–24 Per Cent	32.61	32.22	32.74	32.85	1.71	1.89	2.13	1.65	38	47	17	20
Overweight 5–14 Per Cent	32.69	32.54	32.07	32.00	1.76	1.65	2.01	1.50	98	72	37	24
Within 5 Per Cent of Normal	32.57	32.33	31.50	31.24	1.66	1.55	1.82	1.60	162	126	43	39
Underweight 5–14 Per Cent	32.26	31.74	31.64	31.15	1.81	1.42	1.88	2.10	112	91	35	37
Underweight 15 Per Cent or More	31.37	31.60	31.43	30.59	1.95	1.53	1.69	1.91	48	39	15	23
	crown-sole length (cms.)											
Overweight 25 Per Cent or More	51.04	49.90	51.33	49.78	1.83	2.23	1.87	2.25	57	42	18	18
Overweight 15–24 Per Cent	50.55	49.83	50.56	49.85	2.11	2.30	2.39	1.96	37	46	18	20
Overweight 5–14 Per Cent	50.50	49.82	50.13	49.70	2.00	1.92	2.23	1.65	100	71	38	25
Within 5 Per Cent of Normal	50.28	49.74	49.38	49.37	2.26	1.88	2.29	2.15	165	126	43	39
Underweight 5–14 Per Cent	50.05	48.80	49.61	48.39	2.09	1.87	2.18	2.11	113	91	36	38
Underweight 15 Per Cent or More	48.54	49.04	49.25	47.74	1.84	1.52	2.66	1.70	49	39	16	25

	CROWN-RUMP LENGTH (CMS.)											
Overweight 25 Per Cent or More	34.56	33.81	33.93	33.50	1.35	1.28	1.05	1.46	50	35	14	17
Overweight 15–24 Per Cent	34.15	33.76	34.07	33.91	1.59	1.42	1.84	1.29	34	35	14	17
Overweight 5–14 Per Cent	33.99	34.01	33.44	33.50	1.39	1.43	1.51	1.35	83	57	36	22
Within 5 Per Cent of Normal	33.99	33.69	33.36	33.32	1.69	1.38	1.38	1.60	129	100	37	33
Underweight 5–14 Per Cent	33.72	33.20	32.92	32.50	1.40	1.26	1.52	1.90	91	73	31	31
Underweight 15 Per Cent or More	33.08	33.27	32.43	32.26	1.33	1.17	1.91	1.19	33	35	15	21
	RUMP-SOLE LENGTH (CMS.)											
Overweight 25 Per Cent or More	16.41	16.11	16.97	16.37	1.04	1.16	.62	1.28	50	35	14	17
Overweight 15–24 Per Cent	16.43	16.22	16.68	16.13	1.00	1.12	.89	1.16	34	35	14	17
Overweight 5–14 Per Cent	16.51	16.20	16.54	16.50	1.08	.90	1.04	.77	83	57	36	22
Within 5 Per Cent of Normal	16.38	16.11	16.40	16.37	.94	.97	.91	.84	129	100	37	33
Underweight 5–14 Per Cent	16.25	15.75	16.46	15.87	.95	1.04	1.10	.82	91	73	31	31
Underweight 15 Per Cent or More	15.78	15.71	16.52	15.70	.87	.73	1.21	.98	33	35	15	21
	HIP BREADTH (CMS.)											
Overweight 25 Per Cent or More	8.35	8.06	7.93	7.79	.46	.53	.41	.47	49	36	14	15
Overweight 15–24 Per Cent	8.32	8.12	8.15	8.02	.57	.38	.66	.52	35	33	14	15
Overweight 5–14 Per Cent	8.23	8.05	7.90	7.66	.52	.51	.61	.52	79	54	31	22
Within 5 Per Cent of Normal	8.20	7.91	7.78	7.65	.51	.52	.53	.48	118	99	36	29
Underweight 5–14 Per Cent	8.07	7.84	7.70	7.55	.49	.48	.54	.57	83	71	30	30
Underweight 15 Per Cent or More	7.75	7.78	7.68	7.53	.49	.40	.46	.46	30	34	14	20
	HEAD CIRCUMFERENCE (CMS.)											
Overweight 25 Per Cent or More	35.16	34.03	35.22	34.03	1.31	1.13	1.24	.99	58	43	18	19
Overweight 15–24 Per Cent	34.55	33.79	35.09	34.10	1.43	1.78	1.61	1.28	38	45	17	20
Overweight 5–14 Per Cent	34.73	33.99	34.55	33.92	1.29	1.12	1.36	1.25	97	72	37	24
Within 5 Per Cent of Normal	34.61	33.75	34.03	33.45	1.30	1.34	1.19	1.58	162	126	43	39
Underweight 5–14 Per Cent	34.27	33.45	34.06	33.29	1.39	1.15	1.26	1.52	112	91	36	38
Underweight 15 Per Cent or More	33.46	33.42	33.63	33.15	1.35	1.10	1.41	1.13	47	40	16	23

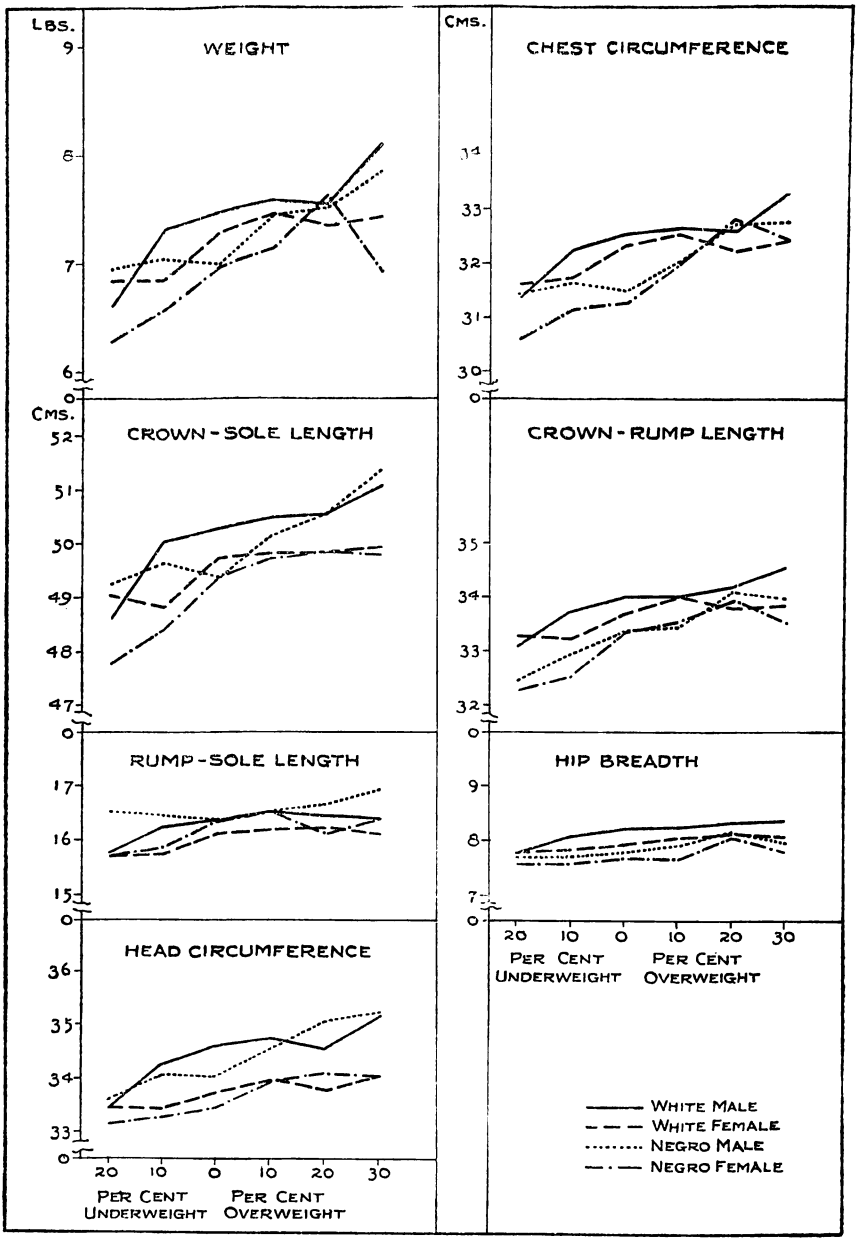

Fig. 3. Means of each measurement by mother's pregravid weight status and race and sex.

and crown-rump length for white females where the minimum value is for babies of mothers 5 to 14 per cent underweight and

rump-sole length for Negro males where the minimum is for babies of mothers of normal weight. The largest means are found for infants of mothers overweight by either 15 to 24 per cent or over 25 per cent, with the exception of five curves for which the maximum is for infants of mothers 5 to 14 per cent overweight. These five are for weight, chest circumference, and crown-rump length for white females, and rump-sole length for white males and Negro females. For most measurements, the means for white males do not differ much over the middle of the range of weight status categories, for females in the overweight categories, or for Negro males in underweight categories. However, despite these variations in trend, it is clear that for all measurements the means for babies of mothers who were underweight before pregnancy are smaller than those for babies of overweight mothers.

A comparison among the measurements of the relative values of the means for each pregravid weight status group may be made by expressing each mean as a per cent of the mean of that measurement for babies of mothers of standard weight (Table 8). The widest variation is observed for weight. For the white groups and Negro females, the mean weight for babies of mothers 15 per cent or more underweight is 88 to 94 per cent of the corresponding mean for babies of mothers of standard weight. For babies of mothers overweight 15 per cent or more, the means, except for white females, are 8 to 13 per cent larger than the means for the standard weight group. For the other measurements, the smallest means are almost never less than 96 per cent of the means for babies of mothers of standard weight while the largest values exceed the "normal" by less than 5 per cent.

Comparison of the relative variation in the different physical measurements that is associated with pregravid weight status of mothers does not show consistent differences for the four race-sex groups and, in general, differences among the measurements are not large. There is a fairly consistent tendency, however, for the relative variation in chest circumference and hip

Measurement	Underweight		Overweight			Underweight		Overweight		
	15 Per Cent or More	5–14 Per Cent	5–14 Per Cent	15–24 Per Cent	25 Per Cent or More	15 Per Cent or More	5–14 Per Cent	5–14 Per Cent	15–24 Per Cent	25 Per Cent or More
	White Male					White Female				
Weight	88.2	98.0	101.3	100.9	108.4	93.9	94.2	102.6	101.0	102.2
Chest Circumference	96.3	99.0	100.4	100.1	102.3	97.7	98.2	100.6	99.7	100.3
Crown-Sole Length	96.5	99.5	100.4	100.5	101.5	98.6	98.1	100.2	100.2	100.3
Crown-Rump Length	97.3	99.2	100.0	100.5	101.7	98.8	98.5	100.9	100.2	100.4
Rump-Sole Length	96.3	99.2	100.8	100.3	100.2	97.5	97.8	100.6	100.7	100.0
Hip Breadth	94.5	98.4	100.4	101.5	101.8	98.4	99.1	101.8	102.7	101.9
Head Circumference	96.7	99.0	100.3	99.8	101.6	99.0	99.1	100.7	100.1	100.8
	Negro Male					Negro Female				
Weight	99.6	100.7	106.6	107.4	112.5	89.8	94.1	102.2	109.5	99.3
Chest Circumference	99.8	100.4	101.8	103.9	104.1	97.9	99.7	102.4	105.2	103.9
Crown-Sole Length	99.7	100.5	101.5	102.4	103.9	96.7	98.0	100.7	101.0	100.8
Crown-Rump Length	97.2	98.7	100.2	102.1	101.7	96.8	97.5	100.5	101.8	100.5
Rump-Sole Length	100.7	100.4	100.9	101.7	103.5	95.9	96.9	100.8	98.5	100.0
Hip Breadth	98.7	99.0	101.5	104.8	101.9	98.4	98.7	100.1	104.8	101.8
Head Circumference	98.8	100.1	101.5	103.1	103.5	99.1	99.5	101.4	101.9	101.7

Table 8. Mean of each measurement by mother's pregravid weight status as a per cent of the mean for infants of mothers within 5 per cent of normal weight by race and sex.
(100 = mean for infants of mothers of normal weight.)

breadth to be somewhat greater than in the linear measures.

If the race-sex groups are compared, white females show the least range of variation for all measurements, and, except for hip breadth, there is very little increase in any means associated with overweight status of mothers. For white males and Negro males and females, the range in relative variation in most of the measures was quite similar; but for Negro males the increase in size associated with overweight status of mothers is relatively large and the decrease associated with underweight status is small.

The coefficients of correlation between each measurement and the pregravid weight status of the mothers are given by race and sex in Table 9. The coefficients are all positive, and

Measurement	Correlation Coefficient					Number				
	Total	White Male	White Female	Negro Male	Negro Female	Total	White Male	White Female	Negro Male	Negro Female
Weight	.26	.30	.22	.24	.25	1,454	582	484	196	192
Chest Circumference	.23	.24	.16	.23	.34	1,261	516	418	165	162
Crown-Sole Length	.23	.24	.18	.25	.32	1,270	521	415	169	165
Crown-Rump Length	.23	.22	.18	.28	.30	1,043	420	335	147	141
Rump-Sole Length	.15	.13	.16	*.13*	.20	1,043	420	335	147	141
Hip Breadth	.23	.26	.21	.19	.22	991	394	327	139	131
Head Circumference	.24	.26	.16	.34	.23	1,261	514	417	167	163

Note: The coefficient in italics is not significantly different from zero at the 5 per cent level.

Table 9. Coefficients of correlation between each measurement and mother's pregravid weight status, by race and sex.

range between .13 and .34. The weighted combinations of the four coefficients for each measurement are between .23 and .26, with the exception of that for rump-sole length which has a value of .15. The coefficients of correlation are significantly different from zero, except for that for rump-sole length among Negro males (.13), confirming the definite association between each measurement and pregravid weight status of the mothers found on examination of the trends in the mean values of each measurement.

It is of interest to note that these coefficients of correlation between pregravid weight and the size of babies are only a little lower than was observed for length of gestation and size. The pregravid weight status of the mothers obviously has a marked effect on the infant's size, although it is clear that other factors also are important.

Parity and Maternal Age. Published reports of the association of these two factors with weight by McKeown and Gibson (3) and length by Meredith (4) have agreed that there is an increase in size with parity when maternal age is held constant and no relationship of size with maternal age when parity is held constant. The information from this study for the analysis of this association is given in Table 10 which shows the means for each measurement for the infants classified by parity and mother's age. Only the data for the white infants are given

Parity	Mean					Standard Deviation					Number				
	Age of mother														
	Under 20	20–24	25–29	30–34	35 or Above	Under 20	20–24	25–29	30–34	35 or Above	Under 20	20–24	25–29	30–34	35 or Above
	Weight (lbs.)														
0	7.36	7.13	7.05	7.38	8.14	.89	1.07	.95	1.21	1.53	89	248	107	27	7
1	*	7.45	7.33	7.21	7.05	*	.99	.95	1.03	.98	*	132	156	64	15
2		7.66	7.47	7.45	7.25		1.02	.95	1.15	.95		25	58	55	18
3 or More		*	7.75	7.66	7.81		*	.91	1.28	.98		*	16	32	21
	Chest circumference (cms.)														
0	32.56	32.15	32.09	32.17	32.50	1.49	1.74	1.55	1.77	2.39	81	211	90	24	7
1	*	32.55	32.28	32.07	31.57	*	1.73	1.78	1.66	1.06	*	118	141	53	15
2		32.89	32.35	32.48	32.38		1.76	1.80	2.07	1.45		23	46	50	16
3 or More		*	32.83	32.74	32.82		*	1.45	1.85	1.83		*	15	29	19
	Crown-sole length (cms.)														
0	49.85	49.50	49.48	50.54	51.07	2.23	2.11	1.99	2.25	2.44	78	211	89	24	7
1	*	50.01	49.99	49.66	49.43	*	1.90	2.19	1.89	1.81	*	121	144	55	15
2		50.28	50.26	50.01	49.69		2.38	2.25	2.14	1.88		23	45	51	16
3 or More		*	50.86	50.30	50.11		*	2.02	2.50	2.36		*	14	30	18
	Crown-rump length (cms.)														
0	33.98	33.62	33.53	34.31	*	1.34	1.49	1.40	1.76	*	61	155	70	21	*
1	*	33.86	33.81	33.72	33.50	*	1.29	1.45	1.42	1.47	*	101	107	49	13
2		33.85	33.99	33.57	33.57		1.80	1.48	1.66	1.28		20	41	43	14
3 or More		*	34.36	34.06	33.70		*	1.12	1.68	1.51		*	14	25	15
	Rump-sole length (cms.)														
0	16.10	16.06	16.11	16.32	*	1.08	1.12	.89	1.03	*	61	155	70	21	*
1	*	16.22	16.23	16.08	16.06	*	.94	.79	.89	.80	*	101	107	49	13
2		16.35	16.13	16.36	16.18		.88	1.05	1.02	1.31		20	41	43	14
3 or More		*	16.65	16.63	15.89		*	1.29	1.47	1.19		*	14	25	15
	Hip breadth (cms.)														
0	8.15	8.02	7.96	8.09	*	.46	.58	.46	.46	*	58	152	64	19	*
1	*	8.03	8.11	8.00	8.15	*	.53	.50	.47	.44	*	94	102	48	10
2		8.08	8.03	8.09	8.10		.60	.47	.62	.46		20	41	41	13
3 or More		*	8.02	8.19	8.22		*	.51	.64	.48		*	13	24	16
	Head circumference (cms.)														
0	34.36	33.84	33.92	34.50	34.93	1.21	1.47	1.39	1.15	1.99	80	211	90	24	7
1	*	34.24	34.25	34.01	33.57	*	1.30	1.42	1.31	1.48	*	119	138	53	15
2		34.11	34.15	34.12	34.63		1.52	1.68	1.34	1.36		23	46	50	16
3 or More		*	34.70	34.60	34.45		*	1.11	1.35	1.93		*	15	29	19

* Means are not shown for cells with five or fewer observations.

Table 10. Means of each measurement by parity and maternal age for white infants.

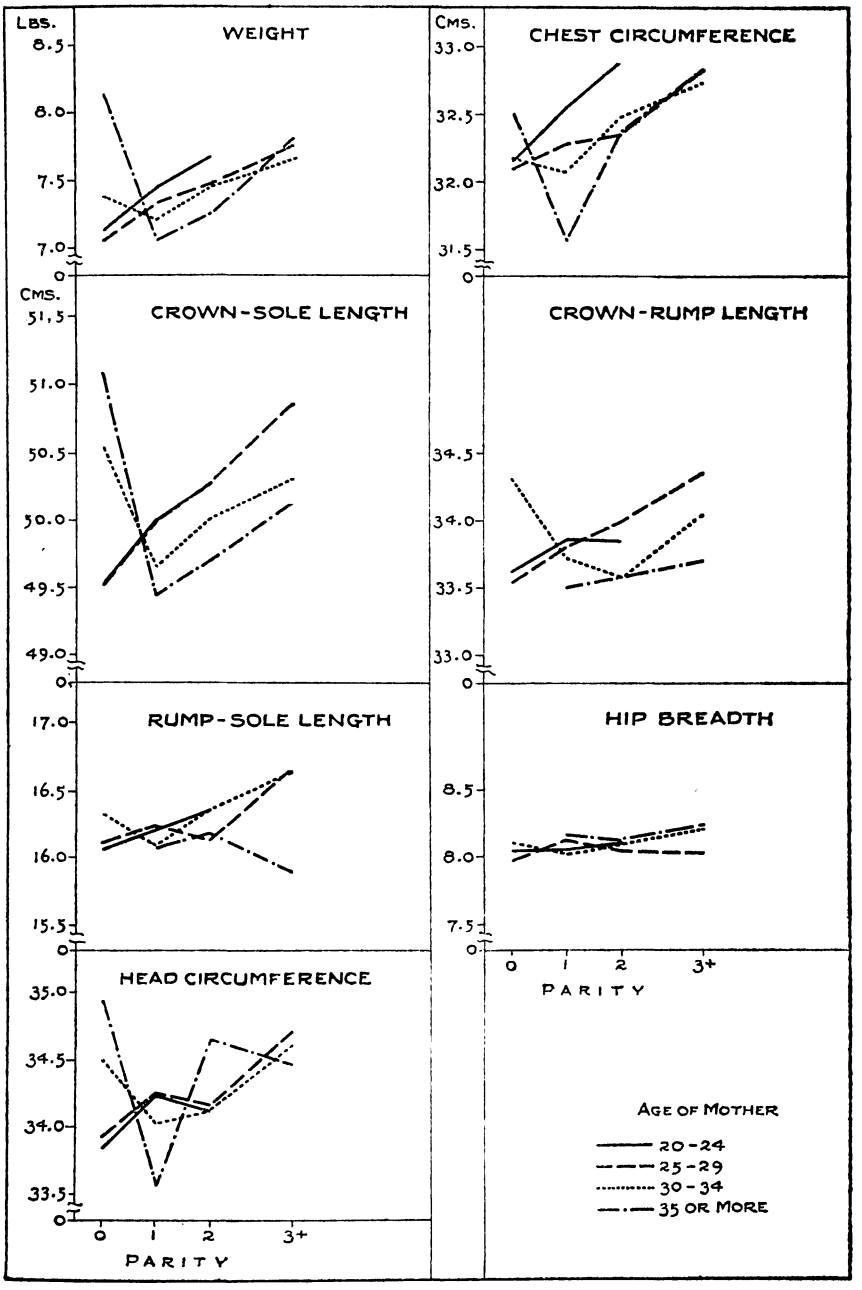

Fig. 4. Means of each measurement by parity and maternal age for white infants.

since the numbers for Negroes after this cross-classification are too small for satisfactory analysis. Even for the white population some cells had only a few cases, and means based upon five observations or less have been omitted from the tables.

The association of parity with infant size at birth is illustrated in Figure 4 which shows the change in the means with parity for each measurement for the babies allocated into four groups by age of mother. Among white infants, those of mothers aged 20 to 24 years exhibit an increase in the means with increasing parity for weight, chest circumference, crown-sole and rump-sole length, and, possibly hip breadth. The means of crown-rump length and head circumference for first-born infants of these mothers are lower than those for parities 1 and 2, but the latter two means do not differ very much. Infants of mothers 25–29 years old show consistently increasing means with increasing parity for weight, chest circumference, crown-sole and crown-rump length, and a less uniform increase for rump-sole length and head circumference. Among babies of mothers in the 30–34 age group, the means for infants of parity 1 are lower than those for first-born infants followed by an increase at the higher parities for weight, chest circumference, rump-sole length, and hip breadth. For the two other linear measurements and head circumference, the curve for this group is U-shaped with the mean for babies of para 0 being larger or almost equal to that for parity 3 or more. The curve for babies of the oldest mothers is at a minimum at parity 1 and increases with rising parity for weight, chest circumference, crown-sole and crown-rump length. The means for first-born infants of these older mothers are large but are based on a very small number of observations. Thus, there seems to be some tendency for the means of all measurements for white infants to increase with rising parity, although this is more pronounced for weight, chest circumference, and crown-sole length than for the other body dimensions.

The change in size of the infants with changing maternal age is shown in Figure 5 which gives for each parity the curve of

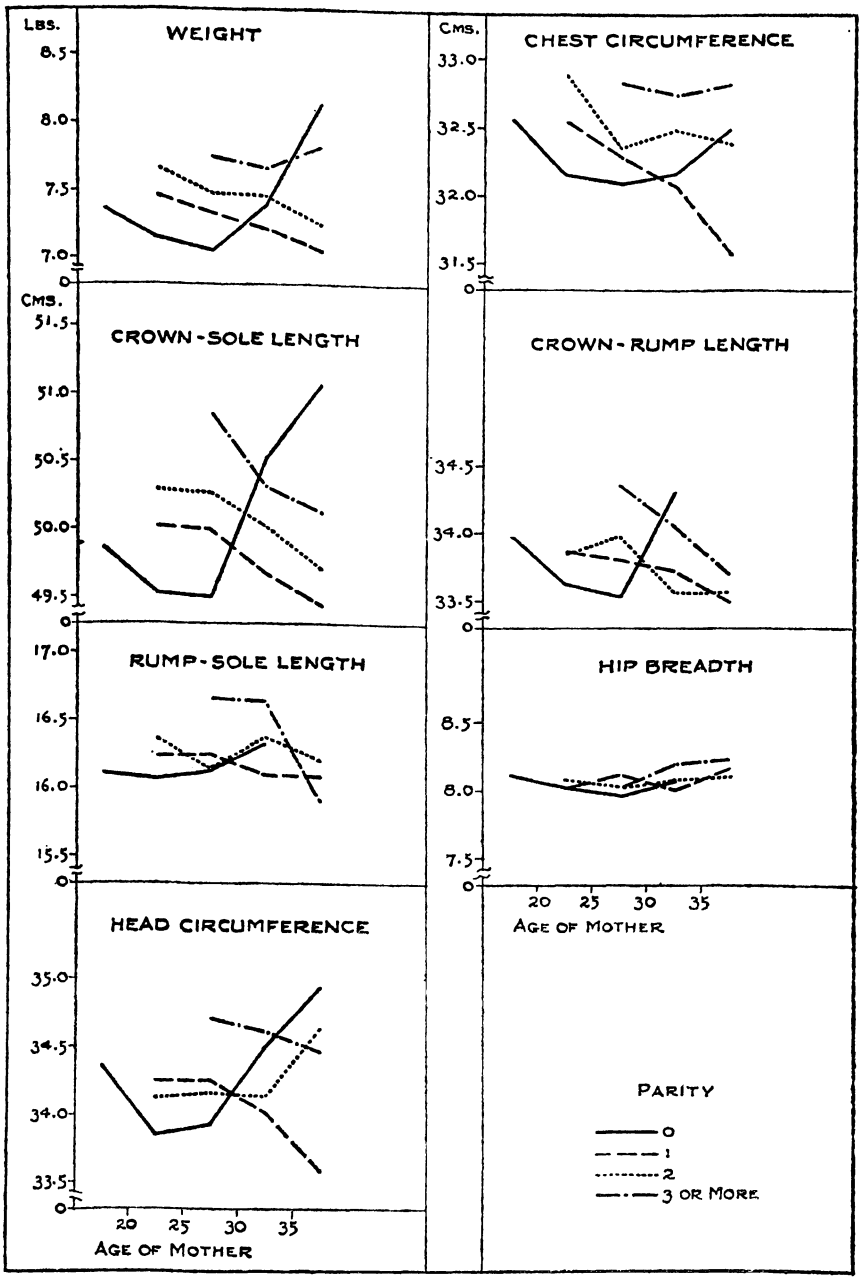

Fig. 5. Means of each measurement by maternal age and parity for white infants.

the means of each measurement by age of mothers. The curves

Table 11. Means of each measurement by parity, maternal age, and pregravid weight status for white infants.

Maternal Age and Pregravid Weight Status	Mean			Standard Deviation			Number		
	Parity								
	0	1	2 or More	0	1	2 or More	0	1	2 or More
	Weight (lbs.)								
30 Years and Above									
Overweight 5 Per Cent or More	8.00	7.27	7.76	.97	.94	1.07	16	38	67
Within 5 Per Cent of Normal	7.05	7.31	7.30	1.31	.99	1.32	11	21	38
Underweight 5 Per Cent or More	7.21	6.92	7.23	1.64	.99	.87	7	18	21
Under 30 Years									
Overweight 5 Per Cent or More	7.40	7.69	7.75	1.03	.96	.99	132	108	43
Within 5 Per Cent of Normal	7.29	7.45	7.52	.96	.92	.87	137	90	33
Underweight 5 Per Cent or More	6.86	7.01	7.34	.97	.92	1.01	172	94	26
	Chest circumference (cms.)								
30 Years and Above									
Overweight 5 Per Cent or More	33.00	31.90	32.81	1.55	1.44	1.88	14	35	62
Within 5 Per Cent of Normal	32.00	32.44	32.44	1.50	1.75	1.91	10	18	33
Underweight 5 Per Cent or More	31.07	31.35	32.13	2.44	1.46	1.90	7	13	19
Under 30 Years									
Overweight 5 Per Cent or More	32.52	32.89	32.84	1.79	1.56	1.69	112	98	35
Within 5 Per Cent of Normal	32.44	32.46	32.53	1.45	1.75	1.58	119	81	30
Underweight 5 Per Cent or More	31.82	31.80	32.32	1.62	1.79	1.97	148	83	22
	Crown-sole length (cms.)								
30 Years and Above									
Overweight 5 Per Cent or More	51.64	49.73	50.53	2.10	1.81	2.18	14	35	61
Within 5 Per Cent of Normal	49.70	50.00	49.56	2.18	1.89	2.53	10	18	35
Underweight 5 Per Cent or More	50.07	48.90	49.45	2.06	1.93	1.43	7	15	19
Under 30 Years									
Overweight 5 Per Cent or More	49.99	50.34	50.80	2.19	1.86	2.07	110	100	33
Within 5 Per Cent of Normal	49.73	50.43	50.37	2.11	2.19	1.99	118	83	30
Underweight 5 Per Cent or More	49.13	49.28	49.68	1.99	1.97	2.66	147	85	22
	Crown-rump length (cms.)								
30 Years and Above									
Overweight 5 Per Cent or More	34.92	33.71	33.93	1.55	1.43	1.57	12	33	54
Within 5 Per Cent of Normal	33.50	33.97	33.31	1.94	1.15	1.87	8	15	27
Underweight 5 Per Cent or More	*	33.29	33.69	*	1.61	1.01	*	14	16
Under 30 Years									
Overweight 5 Per Cent or More	34.15	33.98	34.31	1.39	1.32	1.28	85	79	31
Within 5 Per Cent of Normal	33.61	34.23	34.09	1.46	1.50	1.65	85	67	29
Underweight 5 Per Cent or More	33.37	33.33	33.26	1.38	1.16	1.52	116	65	17
	Rump-sole length (cms.)								
30 Years and Above									
Overweight 5 Per Cent or More	17.00	16.07	16.53	.80	.88	.93	12	33	54
Within 5 Per Cent of Normal	15.63	16.29	16.12	.78	.74	1.28	8	15	27
Underweight 5 Per Cent or More	*	15.86	16.00	*	.91	.90	*	14	16
Under 30 Years									
Overweight 5 Per Cent or More	16.30	16.23	16.41	1.08	.85	1.18	85	79	31
Within 5 Per Cent of Normal	16.18	16.42	16.32	.97	.82	1.02	85	67	29
Underweight 5 Per Cent or More	15.86	16.04	15.99	1.06	.86	.84	116	65	17

Table 11. (*Continued*)

Maternal Age and Pregravid Weight Status	Mean			Standard Deviation			Number		
	Parity								
	0	1	2 or More	0	1	2 or More	0	1	2 or More
	Hip breadth (cms.)								
30 Years and Above									
Overweight 5 Per Cent or More	8.34	8.13	8.35	.45	.38	.48	12	32	54
Within 5 Per Cent of Normal	7.75	8.04	7.96	.38	.53	.58	7	14	24
Underweight 5 Per Cent or More	*	7.75	7.72	*	.52	.60	*	11	16
Under 30 Years									
Overweight 5 Per Cent or More	8.15	8.14	8.25	.57	.45	.54	81	74	31
Within 5 Per Cent of Normal	8.04	8.19	7.93	.58	.50	.49	81	66	28
Underweight 5 Per Cent or More	7.92	7.92	7.87	.48	.52	.37	113	58	17
	Head circumference (cms.)								
30 Years and Above									
Overweight 5 Per Cent or More	34.93	34.01	34.66	1.05	1.13	1.55	14	35	62
Within 5 Per Cent of Normal	34.30	34.17	34.17	1.66	1.53	1.41	10	18	33
Underweight 5 Per Cent or More	34.07	33.42	33.76	1.68	1.27	1.07	7	13	19
Under 30 Years									
Overweight 5 Per Cent or More	34.27	34.52	34.44	1.33	1.31	1.85	111	96	35
Within 5 Per Cent of Normal	34.11	34.34	34.27	1.36	1.41	1.40	120	80	30
Underweight 5 Per Cent or More	33.66	33.87	33.82	1.41	1.29	1.18	147	84	22

* Means are not shown for cells with five or fewer observations.

for first-born infants tend to be U-shaped for all measurements, suggesting that primipara under 20 and over 30 years of age have larger infants than do those in their twenties. Among infants of para 1 the means for all measurements except hip breadth, generally decrease with increasing age of mother, while this is true for infants of para 2 only for weight, crown-sole length and, to some extent, crown-rump length. For infants of parity 3 and above, increasing maternal age is associated with decreasing means for the linear measurements and head circumference. From this, it would seem that for these white babies of parities 1 and above there is some evidence of decreasing size with increasing maternal age but it is not present for all measurements over all parities.

Parity, Maternal Age, and Pregravid Weight Status. The lack of independence among these three variables creates some difficulty in the analysis, since the population is not large enough to permit a classification sufficiently fine for the rela-

tionship between the measurements and one of these factors to be studied, while the other two are held constant. However, a crude sub-classification has been done for the white infants dividing them into three maternal weight status groups (underweight, normal, and overweight), three groups by parity (0, 1, and 2 or more), and two groups by age of mother (under 30, and 30 and above). The means for each measurement in these groupings are given in Table 11 and Figure 6.

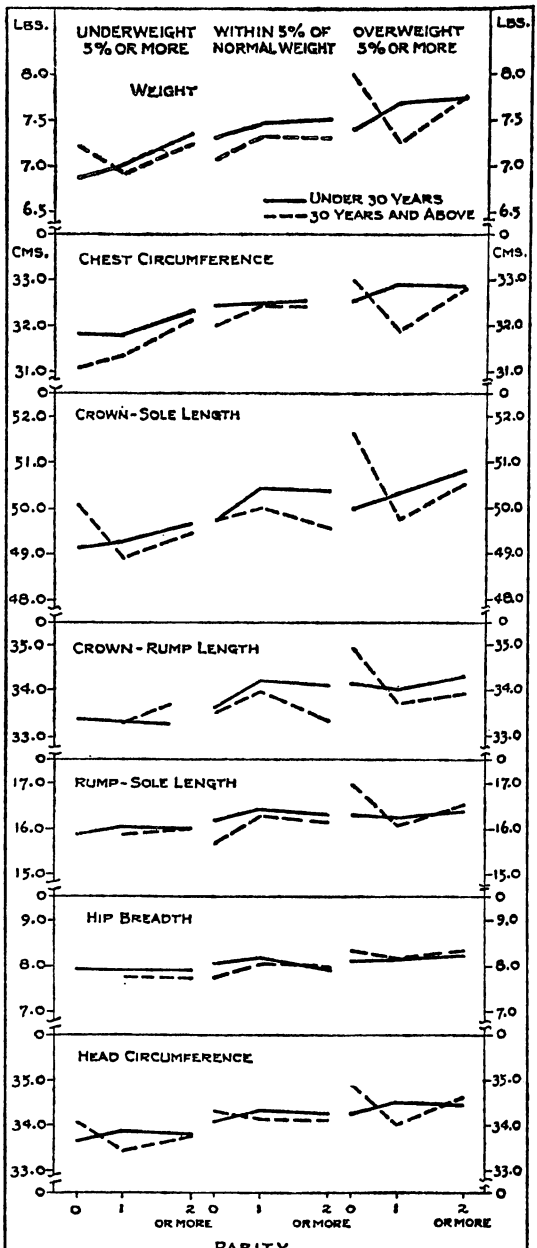

Fig. 6. Means of each measurement by parity, maternal age, and pregravid weight for white infants.

The relationship of pregravid weight status and infant size previously noted is substantiated when maternal age and parity are controlled. In about two-thirds of the age-parity groups, mean values increase progressively with weight status, that is the lowest means are those for infants of underweight mothers,

the largest those for infants of overweight mothers, with the means for infants of mothers of normal weight falling between. In all age and parity groups for each measurement, means were larger for babies of overweight mothers than for those of underweight mothers.

With respect to parity, it was noted that among white infants, higher parity was associated with larger means, most markedly for weight, chest circumference, and crown-sole length. This seems to hold true for infants of mothers under 30 in all three weight status groups for weight, and, less consistently, for chest circumference and crown-sole length. The curves for infants of mothers over 30 for these three measurements tend to be V-shaped for overweight and underweight mothers, with the lowest means found for infants of parity 1. The means for first-born infants of older mothers of normal weight are smaller than those for higher parities for weight and chest circumference.

In the analysis of the measurements by maternal age, some tendency toward decreasing size with increasing age of mother was found for white infants of parities 1 and above. This association persists among infants of underweight mothers for weight, chest circumference, crown-sole length, and hip breadth. Among babies of mothers of standard pregravid weight this association is found to some extent over all parities for weight, chest circumference, and the three linear measurements. Among infants of overweight mothers smaller means for the infants of older mothers are found with any consistency only for parity 1. For first-born infants in this group, the means are consistently larger for the babies of mothers over 30, although based on small numbers, while the means for infants of parity 2 or above are about the same in the two age groups except for two of the linear measurements.

Thus, this analysis of the measurements with the three variables, pregravid weight status, parity, and maternal age, in combination, suggests that the most consistent relationship is that between size and mother's pregravid weight status. There

is evidence of a positive association of size and parity and an inverse association of size and maternal age, but both of these relationships seem to be influenced by the factor of weight status.

Summary

Data on the association between the measurements at birth of weight, chest circumference, crown-sole length, crown-rump length, rump-sole length, hip breadth, and head circumference, and parity, maternal age, pregravid weight status, and height, and length of gestation are presented for 1,466 white and Negro infants.

Mother's height is associated positively with all seven measurements.

The average of each measurement generally increases with increasing length of gestation.

The babies of mothers underweight before pregnancy tend to be smaller than those of overweight mothers for all measurements.

Increasing parity in white infants is associated with increasing size, most markedly for weight, chest circumference, and crown-sole length. For white babies of parity 1 and above there is evidence that rising maternal age is associated with decreasing infant size. These relationships between size and parity and maternal age appear to be affected by the pregravid weight status of the mothers.

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