

Comparison of Sudanese standard parameters for intrauterine growth with other population.

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Summary:

A normal Sudanese intrauterine growth parameters was obtained by studying six hundred and fifty single newborns of 28 to 44 weeks gestational age. The newborns were born to healthy mothers from different social classes in hospitals. The mothers of different ages were very sure of their date of the last menstrual period for calculation of gestational age. The means of birth weight were obtained for each gestational age and were compared to analogous age of American, English, Nigerian, Chinese, Hong-Kong series. The crown-heel length and head circumference means were compared to Nigerian series.

There are is no significant differences between the means of birth weight when compared to Chinese and Hong-Kong series, but the American, English and Nigerian newborns were significantly heavier at later weeks of pregnancy. Also Nigerian newborns were significantly longer and have larger head circumference towards end of pregnancy when compared to our newborns.

This retardation of growth noted in our newborns at later weeks of pregnancy is possibly due to environmental causes, but this has to be confirmed by further study.

Introduction:

In recent perinatology people are interested in constructing

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intrauterine growth charts to show the pattern of growth during foetal life.^(1,2,3,4,5,6,7,8,9,10,11,12,13,14,16) As genetic and environmental factors have influence affecting growth it becomes a necessity for each population to construct its own intrauterine growth curves. A recent report by WHO division of Family Health (1980) emphasizes that data on birth weight are lacking, particularly from the developing countries. Information of other intrauterine growth variables are even more scarce⁽⁹⁾. Intrauterine growth is affected by many determinants that should be considered in obtaining curves and in comparison with other population curves.

These determinants are sex of the baby, race, parity, maternal height and weight, marital status, socioeconomic level, smoking of the mother, maternal age, altitude and medical diseases associated with pregnancy.⁽¹⁰⁾

Comparison between population foetal growth charts will show the influence of genetic and/or environmental factors among that population. During the past half century curves of intrauterine growth were constructed for American,^(12, 16) Swedish,⁽²⁾ Nigerian,⁽¹³⁾ Chinese,⁽¹⁴⁾ Hong Kong⁽¹⁴⁾ population.

Similarly intrauterine growth studies were carried out for Sudanese infant.^(11,18,19,20,21,22) We hereby report a comparison of Sudanese intrauterine growth parameters⁽¹¹⁾ with Asian,⁽¹⁴⁾ European,⁽¹⁴⁾ Nigerian (African standard)⁽¹³⁾ to determine any kind of difference and its possible causes.

Patients and Methods:

All Sudanese single live born babies delivered between the first of March and thirty first of December 1982 in Khartoum Teaching and Soba University Hospitals were studied.

Khartoum being the capital, centrally located and density

populated with a mixture population coming from different parts of the country. The city itself is of low altitude.

The two hospitals are chosen because they are the biggest and normal and complicated birth took place in them and also because of their good facilities. Normal deliveries at hospitals are becoming increasing trend with the rise of health education. Mothers belong to different social strata upon reviewing the records of the previous year.

The inclusion criteria were as follows:

- 1-Both parents are Sudanese.
- 2-The mothers were very sure of their date of the last menstrual period (L.M.P) the mothers have regular cycles of 21 – 35 days duration and must have experienced at least two normal periods before the pregnancy.

The exclusion criteria were as follows:

- 1- If the mothers have any serious medical complications during pregnancy that is known to cause intrauterine growth retardation such as pregnancy induced hypertension, essential hypertension, diabetes, chronic nephritis, severe anaemia, malnutrition and other debilitating diseases.
- 2- If the mother was smoker.
- 3- Congenital malformation in the newborns.
- 4- Multiple pregnancies.

Gestational age was calculated in completed weeks according to the recommendation of WHO expert on health statistics, American Academy of Paediatrics Measurements.⁽¹⁵⁾

For each baby admitted to the study a birth history form was filled. The measurements were taken within the first twenty four hours of birth and babies were completely naked.

The birth weight was determined using the nursery baby scale,

the Cherub (manufactured by Herbert and Sons Ltd. Angle RD Edmenton, London W. 18), that have an accuracy of up to 10 gm and was checked before hand and adjusted to zero point each day. The crown-heel length was measured with the infant lying supine and the legs were fully extended by pressing down on the knees, using the neonatometer, the Holtain neonatometer (manufactured by Holtain Limited Crypmych, Pemp, U.K) that can read to the nearest millimeter.

The head circumference was measured using a non stretchable tape that can read to the nearest millimeter. Head was measured around the longest occipito-frontal diameter.

The means of birth weight of Sudanese newborns at different gestational were obtained (Table I) and were compared to their analogues ages of Asian (Table II), American, English and Nigerian newborns (Table III).

The means of crown-heel length and head circumference were obtained and compared to Nigerian series which is regarded as African standard.⁽¹³⁾

Statistical test:

The means of birth weight, crown-heel length and head circumference were compared and analyzed statistically. The test of significance used is $d = *$

$$\frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

Where d is standard normal variable deviation, X' is the mean, n is the sample number. When d value is equal or greater to 2.576, the difference is considered significant to p value of less or equal to 0.01.

When comparing the means of two samples each less than 30, the student t test was used to test significance. The P . value of less or equal to 0.01 was considered significant.

The value of d or t was underlined in tables II, III and IV when there is significant difference.

RESULTS:

The mean birth weight, crown-heel length and head circumference plus one standard deviation were obtained for each gestational age as shown in (table I).

These figures represent the normal intrauterine growth parameters for Sudanese newborns.⁽¹¹⁾ Comparison of the means of birth weight of Sudanese newborns at different gestational ages to Asian (Chinese and Hong Kong) did not show any significant difference except in only one isolated week (table II).

Comparison of the means of birth weight of Sudanese newborns at different gestational ages to American, English and Nigerian newborns showed significant difference towards later weeks 39 to 42 (table III).

This shows a retardation of growth towards later weeks of pregnancy noted in our newborns.

Comparison of the means of crown-heel length with Nigerian newborns at different ages show isolated significant differences at weeks 28, 30 and 35 and also a continuous pattern of significant differences at weeks 40, 41 and 42 (table IV).

Comparison of the means of head circumference with Nigerian newborn at different gestational ages show isolated significant difference at weeks 30, 35 but also a continuous pattern of significant differences at week 40 and 42 (table IV).

Discussion:

The study aimed to obtain normal intrauterine growth standard in Sudanese newborns and to compare them to different population. Population of Khartoum is coming from different parts of the country. The mothers were from different social classes as apparent from their husbands jobs, were healthy, non smokers, receiving reasonable care and the city at low altitude, so it is reasonable to assume that this sample comprises a group of babies whose parameters represent normal intrauterine growth in Khartoum, most of studies carried out to determine intrauterine growth parameters of different ages depend solely in assessing gestational age by calculating length of gestation from last menstrual period to birth,^(1,2,3,4,6,7,8,12,13,14,16) some studies add clinical gestational assessment⁽²³⁾ but recently this should be assessed by ultrasound.

The mean birth weight at 40 weeks is 3087 ± 439 gm, while that reported by Mudawi. O⁽¹⁸⁾ is 3009 gm in 1963, also Ahmed, N. and Abdalla, L.⁽¹⁹⁾ reported a mean birth weight of 3093 ± 360 gm in 1967 from a hospital sample of 525 single newborns. Omer, M.⁽²⁰⁾ found the mean birth weight of 2740 ± 785 gm. Recently Ibrahim, S.⁽²²⁾ found the mean birth weight in rural community to be 3124 ± 484 gm from a total sample of 13060 newborns.

In all these studies there was no consideration of gestational age when obtaining the mean birth weight, therefore statistical comparison is not feasible.

When comparing the means of Sudanese newborn of birth weight

at different gestational ages to Asian,⁽¹⁴⁾ It was found that; the mean of birth weight of Sudanese newborns⁽¹¹⁾ are compared well with Asian newborns⁽¹⁴⁾ at different gestational ages, except for only two isolated weeks which are not considered because they are only isolated weeks and do not reflect a general pattern (table II). Also they are compared well with American, English, and Nigerian newborns except towards term where our newborns are significantly lighter (table III).

It is interesting to know that Nigerian newborns were from a highly selected mothers, who were well looked after and were receiving antimalarial prophylaxis during pregnancy. Hence Nigerian newborns (African Standard) are compared well to European standard.⁽¹³⁾ Also Taha S.A, et al concluded from their study of live born Saudi infants that there was no significant difference between birth weight of upper class Saudi and European.⁽²³⁾ These excludes a genetic or racial causes between African, Arab and European population. The explanation of high incidence of low birth weight reported from various centres of Africa, Arab countries should be sought in factors other than genetic and race.⁽¹³⁾

It is possible that the retardation of growth noted at later weeks of pregnancy in our newborns is due to environmental factors, these needs to be confirmed by study controlling for such factors and noting the change of the pattern of the growth.

Comparing our figures of crown-heel length with Nigerian series (table IV) show a significant difference at weeks 28, 30 and 35, but this does not reflect a continuous pattern, however, Nigerian series are longer towards end of pregnancy. Also this is a reflection of the retardation of growth in our series towards end of pregnancy.

Comparing our figures of means of head circumference with

Nigerian series show a significant difference at weeks 30, 35, but these are only isolated weeks and do not reflect a continuous pattern, but again a significant difference is noted towards end of pregnancy (weeks 40 and 42), indicating again the retardation of growth towards end of pregnancy in our series. The retardation of growth is mostly apparent in birth weight followed by crown-heel length and leastly in the head circumference (tables II, III and IV). This agrees to statement of lubchenco that the birth weight is the first to be affected by intrauterine malnutrition followed by length and lastly the head circumference.⁽¹⁶⁾

Therefore, it is reasonable to conclude that our newborns were comparable to Asian newborns, but there is retardation of growth towards later pregnancy when compared to American, English and Nigerian newborns. It possible that environmental factors may be blamed for that, but a study is needed to provide evidence for this possibility.

Canadian authors recently established Canadian reference for birth weight for gestational age.⁽²⁴⁾ Similarly, I recommend that since more than two decades had passed since collection of data⁽¹¹⁾ a recent population based, country-wide, sex-specific, large scale study to be carried out to show any secular trends and to be used as reference of Sudanese newborns.

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Table 1 Mean and standard deviation of birth weight, crown-heel length and head circumference by gestational age of Sudanese newborns.

N	Weeks of gestation	Birth weight (gm)		Crown-heel length (cm)		Head circumference	
		Mean	SD	Mean	SD	Mean	SD
5	28	1100	187	34.2	1.1	24.3	1.3
6	29	1066	79	36	107	25.2	2.3
5	30	1142	64	34.9	0.3	23.3	0.8
7	31	1454	298	40.6	3.2	29.7	3.5
5	32	1914	349	45.1	1.9	32.5	2.1
5	33	2144	692	44.2	3.8	30.2	3
7	34	2228	484	45.4	3.6	30.7	2.4
7	35	2586	135	49.1	0.8	34.3	0.4
9	36	2793	538	47.9	3.9	33.4	2.2
30	37	2778	561	48.1	2.9	33.7	2.2
45	38	3018	466	49.7	2.5	34.2	1.8
103	39	3081	501	49.3	2.3	34.2	1.3
162	40	3087	439	49.3	2.4	34.5	1.1
139	41	3224	431	50.2	2.0	34.9	1.3
71	42	3165	505	50.1	1.9	35.0	1.3
28	43	3223	554	50.5	2.6	34.8	1.7
15	44	3197	321	49.9	2.0	34.5	1.0

N: number, **SD:** standard deviation.

Table II birth weight in this study compared with Asian population by gestational age.

Gestational week	N	X	SD	N	X	D OR T		N	X	SD	d or t								
28	5	1100	187	26	1173	375	0.421 DF 51					13	1681	640	3.13 DF 27	14	1357	317	3.639 DF16
29	6	1066	79	49	1513	544	1.994 DF52					25	1530	563	1.989 DF46	20	1855	636	2.466 DF20
30	5	1142	64	55	1534	497	1.798					43	1938	708	2.469	23	2272	784	2.675
31	7	1454	298	77	1800	561	1.605					41	2170	747	2.484	42	2300	570	1.473
32	5	1914	349	109	1881	535	0.029					75	2285	624	1.311	44	2457	587	1.112
33	5	2144	692	1.27	2209	643	0.224					100	2406	596	972	81	2627	450	2.378
34	8	2228	484	194	2486	549	1.230	57	2210	440	0.107	168	2570	510	1.76	168	2779	548	0.928
35	7	2986	135	340	2596	528	0.05	73	2460	423	0.785	290	2714	534	0.633	307	2857	492	0.984
36	9	2793	538	483	2828	501	0.207 DF-10	109	2790	514	0.017	530	2825	490	0.194	495	2915	423	1.315
37	30	2778	561	1005	2922	426	1.393	238	3030	445	2368	914	2889	417	1.074	1108	2969	383	0.696
38	45	3018	466	2570	3045	396	0.386	632	3030	414	0.168	2114	2954	398	0.914	2021	3068	366	0.26
39	103	3081	501	4911	3149	373	0.644	1115	3120	382	0.769	3658	3048	376	0.663	2372	3147	380	1.696
40	162	3087	434	5419	3238	388	4.328	1244	3180	408	2.556	3969	3130	385	1.228	1530	3175	392	1.293
41	139	3224	431	3263	3287	405	1.691	710	3240	408	0.404	2572	3169	393	1.472	791	3210	397	0.731
42	71	3165	505	1440	3282	424	1.919	328	3290	427	1.991	1229	3197	405	0.525	174	3200	348	0.386
43	28	3223	554													48	3200	337	0.131
44	15	3187	321																

Table VI Comparison of crown heel length and head circumference with that of standard African population.

Gestation week	Present study crown heel length (cm)		Nigerian Series crown heel length (cm)			Present series head circumference (cm)		Nigerian series head circumference		
	Mean	SD	Mean	SD	t or d	Mean	SD	Mean	SD	t or d
28	34.2	1.1	36.8	1.4	3.610	24.3	1.3	25	1.2	1.088
29	36	1.7	36.6	1.8	0.594	25.0	2.3	25.7	0.8	0.503
30	34.9	0.3	41.8	1.3	11.177	23.3	0.8	28.4	0.5	15.308
31	40.6	3.2	41.5	2.9	0.551	29.7	3.5	28.9	1.8	0.538
32	45.1	1.9	42.2	2.0	2.59	32.5	2.1	28.9	1.9	2.309
33	44.2	3.8	43.9	0.8	0.221	30.2	3	31.5	0.9	1.172
34	45.4	3.6	44.9	1.3	0.408	30.7	2.4	32.2	1	2.001
35	49.1	0.8	46.9	1.6	3.387	34.2	0.4	32.4	1.1	4.37
40	47.9	3.9	47.6	2.9	0.226	33.4	2.2	33.6	0.9	0.338
41	49.3	2.5	48.1	1.2	0	33.7	2.2	33.4	0.9	0.684
37	50.2	2.3	49.7	1.6	1.901	34.2	1.8	34.2	1.4	0
38	50.1	2.4	48.9	1.7	1.390	34.2	1.3	34.6	1.2	2.234
39	50.5	2.0	50.4	1.6	4.475	34.5	1.1	34.9	1.2	2.731
41	49.9	1.9	51.3	1.9	2.886	34.9	1.3	35.3	1.3	1.549
42	48.1	2.6	51.5	1.4	3.025	33.0	1.3	35.9	0.7	3.45
43	49.7	2.6				34.8	1.7			
44	49.3	2.9				34.5	1.0			