Original article

Sonographic assessment of gestational age in Nepalese population

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Abstract

Introduction: Knowledge of gestational age is important for the management of pregnancy. Ultrasonography is a safe and reliable method for accessing gestational age. However, since built and stature are differ amongst various ethnic groups, nomograms based on western population may not be relevant to our community. This study is carried out to determine gestational age of Nepalese women, to compare with previously published charts and to standardize the gestational age charts for Nepalese population.

Methods: Nepalese women with a history of amenorrhea coming for ultrasound scan in the Department of Radiology and Imaging, TUTH were included in this prospective study. About 630 patients fulfilling the criteria were screened for BPD, HC, AC and FL during one year from 15th August 2004 to 14th June 2005. A gestational chart was made from the data and it was compared with the previously published charts.

Results: All fetal biometric parameters showed an increase with gestation. When compared with that of Hadlock's nomogram, our values were similar at 20-21 weeks. After 21 weeks, our estimated values decreased gradually with a difference of 3-5mm in BPD, 3-24mm in HC, 1-21mm in AC and 1-4 mm in FL.

Conclusions: There was earlier flattening of growth starting from 22 weeks. The nomogram of Hadlock significantly overestimated gestational age in the later part of third trimester from 34 weeks onwards. This supported the argument that there is a need to have our own nomogram.

Key words: Gestational age, BPD, HC, AC, FL, nomogram

Introduction

An accurate knowledge of gestational age is perhaps the most important piece of information in pregnancy management. It is indispensable when considering management during pregnancy and interpreting other diagnostic tests. Reliance on the last menstrual period as the sole determinant of age is liable to potential error from faulty memory, an irregular cycle and recent usage of oral contraceptives.

In Nepal, there has been a strong move toward scanning all obstetric patients; in part to verify gestational age. The gestational age (GA) is calculated by correlating with charts determined in the Western population. However, since built and stature are differ amongst various ethnic groups, nomograms based on western population may not be relevant to our community. Hence, this study is planned to determine the GA in Nepalese women and to compare with previously published charts.

Methods

Nepalese women with a history of amenorrhoea coming for ultrasound scan in Dept. of Radiology, TUTH were included in this prospective study. The patients who fulfilled the inclusion criteria were scanned for BPD (biparietal diameter), AC (abdominal circumference), HC (head circumference) and

FL (femoral length) and the data is recorded. About 630 patients were screened within the period from 15th August 2004 to 14th June 2005. The measurements were obtained with commercially available, curvilinear array real time, B-mode ultrasound, equipped with a 3.5 MHz transducer [Sonace 8800 Medison and Aloka 1000 machines]. The participants were explained about the procedure and it was performed in the supine position with hips and knees in extension. The probe was held with right hand and the same observer performed all the measurements in mm. Specific methods regarding imaging criteria, caliper placement, and averaging of at least two measurements for each were followed. A gestational chart was produced from the data and it was compared with the previously published charts.

Criteria for BPD – (13-41 weeks) (Fig 5)

1. The transducer must be positioned at the correct cephalo-caudal position so that the plane of section intersects the third ventricle and thalamus.
2. The transducer must be perpendicular to the parietal bones so that the margin of the calvaria is symmetrical.
3. Outer to the inner distance is measured.

Criteria for HC – (13-41 weeks) (Fig 6)

1. The correct plane of section is through the third ventricle and thalamus in the central position of the brain. Cavum septi pellucidi must be visible in the anterior portion of the brain. This gives rise to 'arrow' appearance.[1]
2. Calvaria must be smooth and symmetrical bilaterally.
3. The curses should be positioned at the outer edge.

Criteria for AC- (13-41 weeks) (Fig 7)

1. The correct cephalo-caudal plane is position where the right and left portal veins are continuous with one another. The shortest length of the umbilical segment of the left portal vein is depicted. This gives rise to 'hockey stick' appearance.
2. The appearance of the lower ribs is symmetrical.
3. The ellipse is fit to the skin edge.

Criteria for FL – (13-41 weeks) (Fig 8)

1. Only the ossified portion of the diaphysis and metaphysis is measured. The transducer must be aligned to the long axis of the diaphysis. Femoral head or greater trochanter and femoral condyle are simultaneously in the plane of section.
2. The cursors are positioned at the junctions of the bone with cartilage.

Inclusion criteria:

1. History of amenorrhoea
2. Certain date of the first day of the last normal menstrual period
3. Regular menstrual cycles (26 – 30 days) prior to pregnancy
4. Diagnosis of pregnancy by pelvic examination and urine pregnancy test

Exclusion criteria:

1. Multiple gestation
2. Uncertain first day of last normal menstrual period
3. Irregular menstrual cycle
4. IUGR
5. Menstrual cycles less than 26 or greater than 30 days
6. Major fetal abnormalities
7. Maternal complications – Hypertension, pre-eclampsia, abnormal glucose tolerance test, diabetes mellitus, abruptio placentae, isoimmunisation.

This is a cross-sectional study since single observations from a large number of patients over a specified interval of the independent variable are taken. The statistical method is of regression analysis which is the best statistical method of relating two continuous variables. It is particularly useful in generating growth and dating curves for various fetal parameters.

Correlation and regression analysis was done to derive the formula (Fig. 1-4) (Tables 1 -2). The estimated values were compared with that of Hadlock and Jamil 'Z' test, chi-square test, and Karl Pearson correlation coefficient test were performed for statistical analysis.

Results

This was a prospective study in which obstetric ultrasound was performed on 630 women and various fetal biometric parameters namely – BPD, HC, AC, and FL were recorded. The subjects ranged from 16 to 38 years with a mean of 26 years. The mean parity was 3 ranging from 0 to 6. The gravidity of the subjects ranged from 1 to 7 with a mean of 4. The most common conception period was from 13th February to 13th March. The least common conception period was from 15th August to 14th September. Correlation and regression analysis was done to derive the formula (Fig. 1-4) (Tables 1 -2). The estimated values were compared with that of Hadlock and Jamil 'Z' test, chi-square test, and Karl Pearson correlation coefficient test were performed for statistical analysis.

The difference in mm of our measurements for each gestational age was compared with data from that of Hadlock. When compared with mean BPD values of Hadlock, our values were similar at 20 –21 weeks. Between 13-15 weeks, there was [+] 6-8 mm difference. Between 16-19 weeks, there was [+] 1-4 mm difference in comparison to that of Hadlock. There was [–] 1-5 mm difference between 27-30 weeks. Between 31- 41 weeks there was [–] 3-5 mm difference. There was statistically significant [p<0.05] reduction in estimated values after 34 weeks (Table 3).

estimated values of HC were similar at 20 weeks with that of Hadlock. During the period 13-15 weeks and 16-19 weeks, estimated values were more by 24-30mm and 3-19mm respectively. During 21-30 weeks and 31-40 weeks, the estimated values decreased by 3-23 and 7-24 mm respectively. The p value was <0.05 after 30 weeks (Table 4). Estimated values of AC were more than that of Hadlock by 2-18 until 20 weeks. There was decreasing trend from 21 weeks by 1-21. The p value was <0.05 after 28 weeks (Table 5). Estimated values of FL are more than that of Hadlock by 1-7 until 19-20 weeks. There was deceasing trend from 21 weeks by 1-3. There is statistically significant reduction in estimated values after 26 weeks (Table 6). Based on these findings, we can have an estimated fetal biometry values for Nepalese population (Table 7).

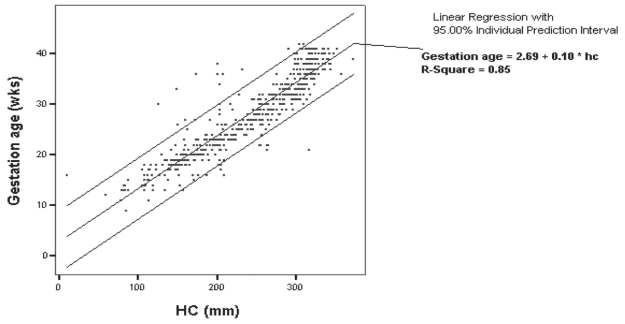

Fig. 1: Correlation between BPD & GA

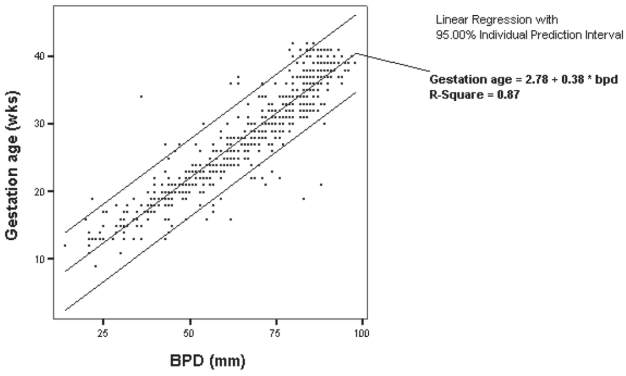

Fig. 2: Correlation between HC & GA

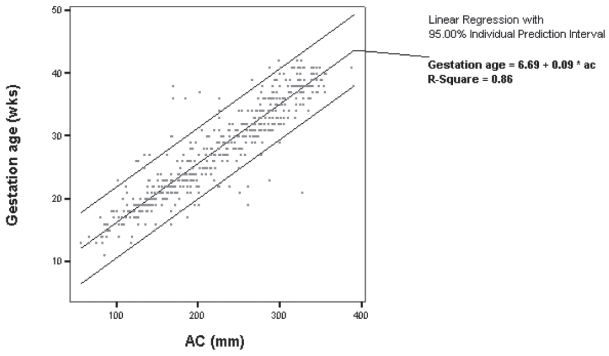

Fig. 3: Correlation between AC & GA

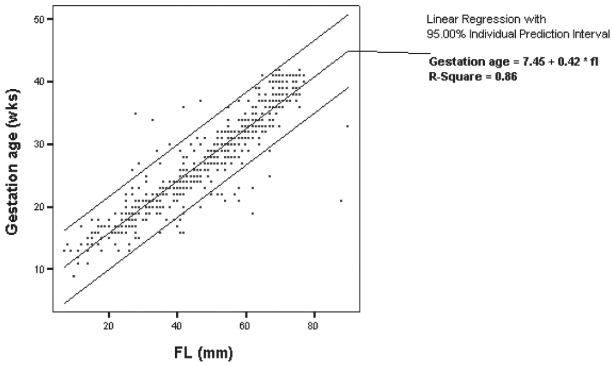

Fig. 4: Correlation between FL & GA

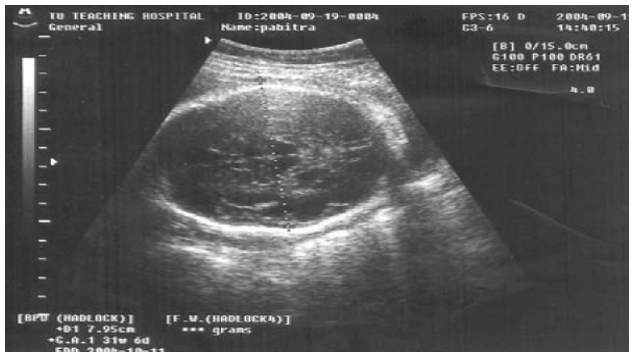

Fig. 5: Display of the fetal BPD Measurement

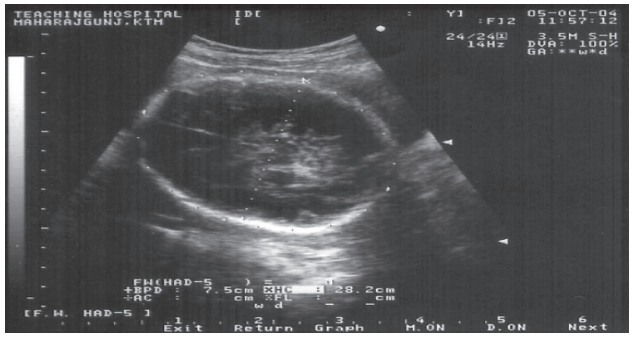

Fig. 6: Display of the fetal HC Measurement

Fig. 7: Display of the fetal AC Measurement

Fig. 8: Display of the fetal FL Measurement

Table 1: Regression equations derived from study for predicting fetal parameter from GA

Parameter	Regression Equation	R^2[%]
BPD	BPD=2.15+2.26GA	87
HC	HC=13.43+8.12GA	85
AC	AC=-30.21+9.14GA	86
FL	FL=-8.80+2.07GA	86
BPD	$BPD=-27.95+4.63GA-0.04GA^2$	88
HC	$HC=-107.27+17.53GA-0.17GA^2$	87
AC	$AC=-74.89+12.55GA-0.06GA^2$	87
FL	$FL=-29.27+3.67GA-0.03GA^2$	87
BPD	$BPD=4.22+0.74GA+0.11GA^2-0.002GA^3$	88
HC	$HC=5.54+2.93GA+0.35GA^2-0.006GA^3$	87
AC	$AC=30.33+0.10GA+0.41GA^2-0.006GA^3$	86
FL	$FL=-24.14+3.05GA-0.005GA^2-0.0003GA^3$	86

Table 2: Regression equations derived from study for predicting GA from fetal measurements

Parameter	Regression Equation	R2[%]
BPD	GA=2.78+0.38BPD	87
HC	GA=2.69+0.18HC	85
AC	GA=6.69+0.09AC	86
FL	GA=7.45+0.42FL	86
BPD	GA=10.20+0.1138BPD+0.0072BPD2	
HC	GA=11.47+0.0188HC+0.0002HC2	
AC	GA=8.52+0.076AC+0.0004A2	
FL	GA=10.31+0.2716FL+0.0016FL2	
BPD	GA=11.19+0.0543BPD+0.0033BPD2-0.000006BPD3	
HC	GA=11.095+0.0252HC+0.0002HC2+0.00000005HC3	
AC	GA=12.08+0.019AC+0.0003AC2-0.0000004AC3	
FL	GA=15.027-0.1312FL+0.0114FL2-0.00007FL3	

Table 3: BPD data characteristics and comparison with established nomogram

GA (wks)	N	This study mean	SD	SÉ	Had[6]	BPD Centile			Estd	P	MD	95% CI of mean difference	
						5	50	95				Lower limit	Upper Limit
13	12	28.25	6.6	1.9	23	21	26	43	31.5	.019	5.25	1.03	9.47
14	7	30.14	7.2	2.7	27	21	31	44	33.8	.296	3.14	-3.58	9.86
15	9	32	6.2	2	30	25	31	45	36.1	.360	2	-2.75	6.75
16	14	38.71	11	2.9	34	20	35	62	38.3	.132	4.71	-1.63	11.06
17	18	36.56	7.3	1.7	37	25	38	57	40.6	.800	-0.44	-4.10	3.21
18	27	40.15	6.1	1.2	40	30	41	55	43	.900	0.15	-2.25	2.55
19	39	43.13	8.3	1.3	44	34	42	59	45.1	.518	-0.87	-3.57	1.83
20	31	46.32	3.7	.7	47	39	47	53	47.3	.323	-0.68	-2.05	0.70
21	26	51.92	9.7	1.9	50	41	50	82	49.6	.320	1.92	-1.98	5.83
22	26	55.31	8.7	1.7	53	41	54	74	51.9	.189	2.31	-1.21	5.83
23	31	54.84	5.4	.96	56	47	54	66	54.1	.238	-1.16	-3.13	0.81
24	22	58.82	4.8	1.0	55	51	59	70	56.4	.860	-0.18	-2.30	1.93
25	21	60.19	6.2	1.3	61	44	61	67	58.6	.558	-0.81	-3.64	2.02
26	18	62	6.7	1.6	64	46	62	74	60.9	.220	-2.00	-5.32	1.32
27	20	64.65	8.8	1.9	67	43	68	77	63.2	.247	-2.35	-6.46	1.76
28	21	68.43	4.8	1.1	69	59	69	76	65.4	.592	-0.57	-2.76	1.62
29	19	70.79	5.3	1.2	72	59	71	77	67.7	.336	-1.21	-3.78	1.36
30	22	72.27	6.9	1.5	75	55	73	88	69.9	.077	-2.73	-5.77	0.32
31	25	75.96	4.9	1	77	65	76	84	72.2	.305	-1.04	-3.09	1.01
32	28	78.39	4.8	1	79	71	78	86	74.5	.511	-0.61	-2.48	1.26
33	17	80.59	5.7	1.4	82	67	82	89	76.7	.325	-1.41	-4.36	1.54
34	31	78.16	8.8	1.6	84	56	79	86	79	.001	-5.84	-9.06	-2.61
35	14	83.64	3.1	.81	86	80	83	90	81.2	.012	-2.36	-4.11	-0.61
36	23	82.78	7.9	1.7	88	62	86	93	83.5	.005	-5.22	-8.66	-1.77
37	26	85.85	8.7	1.1	90	70	86	94	85.6	.001	-4.15	-6.48	-1.83
38	23	88	4.0	.83	92	80	88	96	88.0	.001	-4.0	-5.73	-2.27
39	17	90.41	4.6	1.1	95	81	91	98	90.3	.001	-4.59	-6.94	-2.29
40	15	88.33	4.7	1.2	97	80	88	97	92.5	.001	-8.67	-11.3	-6.05
41	28	87.89	3.3	.63	98	80	88	93	94.8	.001	-10.11	-11.41	-8.80

Table 4: HC data characteristics and comparison with established nomogram

GA wks	N	This study mean	SD	SE	Had[7]	HC Centile			Estd	P	MD	95% CI of mean difference	
						5	50	95				L. limit	U. limit
13	10	107	25	7.9	89	80	108	157	119	.047	18.2	0.27	36
14	7	109	24	8.9	98	83	109	153	127	.258	11.1	-10.7	32.9
15	7	121	27	10	111	88	113	171	135	.378	9.6	-15	34.2
16	13	137	99	136	124	10	135	210	143	.366	12.7	-16.9	42.4
17	13	139	24	6.8	137	106	139	206	151	.833	1.46	-13.4	16.3
18	25	148.9	22	4.4	150	111	148	204	159	.808	-1.08	-10.1	7.97
19	36	159.3	17	2.7	163	136	154	205	168	.185	-3.72	-9.3	1.87
20	27	169.4	13.	2.6	175	138	168	195	176	.042	-5.56	-10.9	-0.21
21	26	192.6	33	6.5	187	149	183	298	184	.394	5.65	-7.8	19.1
22	26	22.3	30	5.8	199	152	197	265	192	.830	1.27	-10.8	13.3
23	31	202.4	15	2.7	210	168	203	223	200	.001	-7.61	-13.2	-2.06
24	20	216.7	18	3.9	221	186	220	257	208	.293	-4.30	-12.6	4.02
25	19	226	25	5.8	232	163	231	263	216	.312	-6.00	-18.1	6.13
26	16	228.1	28	7	242	151	234	267	225	.065	-13.9	-28.9	1.00
27	20	240.1	31	7	252	162	247	277	233	.105	-11.9	-26.6	2.73
28	19	256.9	16	3.8	262	204	259	280	241	.197	-5.05	-13	2.87
29	18	262.2	23	5.4	271	204	266	297	249	.123	-8.78	-20	2.62
30	21	260.9	39	8.4	280	134	266	308	257	.035	-19.1	-36.8	-1.47
31	25	280	20	4	289	246	285	312	265	.036	-8.96	-17.3	-.63
32	28	286.5	19	3.7	297	240	289	315	273	.008	-10.4	-17.9	-2.9
33	16	289.2	39	9.7	304	149	301	317	281	.149	-14.7	-35.4	5.9
34	30	293.5	21	3.8	312	242	293	319	289	.001	-18.5	-26.4	-10.6
35	12	311.7	10	3	318	290	312	324	296	.058	-6.33	-12.8	0.19
36	23	298.7	41	9.2	325	179	314	353	306	.009	-26.3	-45.4	-7.1
37	24	315.5	21	4.2	330	249	318	343	314	.002	-14.5	-23.2	-5.8
38	24	315.3	27	5.5	336	225	318	344	322	.001	-20.7	-32.1	-9.4
39	18	325.4	18	4.4	341	300	323	374	330	.002	-15.6	-24.8	-6.3
40	15	324.4	15	3.9	345	398	325	349	338	.001	-20.6	-28.9	-10.3
41	28	323.3	13	4.2	352	298	324	348	346	.003	-17.8	-27.3	-6.3

Table 5: AC data characteristics and comparison with established nomogram

GA	N	This study mean	SD	SÉ	Had[8]	AC Centile			Estd	P	MD	95% CI of mean difference	
						5	50	95				L. limit	U. Limit
13	6	87	26.3	10.8	69	57	80	119	88.6	.155	18	-9.68	45.7
14	6	91	18.2	7.43	81	68	86	120	97.7	.223	10.3	-8.76	29.4
15	4	104	28.5	14.3	93	88	91	147	107	.488	11.2	-34.2	50.7
16	10	116	27.4	8.7	105	86	108	167	116	.218	11.5	-8.1	31.1
17	13	124	30.9	8.6	117	81	118	188	125	.456	6.62	-12.1	25.3
18	24	125	20.1	4.1	129	95	123	176	134	.333	-4.0	-12.5	4.41
19	35	141	27.9	4.7	141	121	132	213	143	.923	0.46	-9.1	10.0
20	28	146	13.5	2.5	152	114	145	171	153	.015	-6.64	-11.9	-1.40
21	26	172	40.6	7.9	164	123	162	301	162	.338	7.77	-8.6	24.1
22	26	180	34.5	6.8	175	122	171	253	171	.501	4.62	-9.3	18.5
23	30	176	33.3	6.1	186	103	179	250	180	.119	-9.8	-22.2	2.66
24	20	186	17.4	3.9	197	151	188	217	189	.014	-10.5	-18.7	-2.41
25	19	202	27.6	6.3	208	135	208	250	198	.372	-5.8	-19.1	7.5
26	16	200	35.8	8.9	219	125	203	248	207	.048	-19.3	-38.4	-.23
27	20	215	36.3	8.1	229	135	220	277	217	.096	-14.3	-31.3	2.76
28	18	227	19.7	4.6	240	192	225	254	225	.010	-13.4	-23.2	-3.57
29	18	241	26.5	6.2	250	192	237	300	235	.181	-8.7	-21.9	4.47
30	21	240	29.8	6.5	260	168	245	274	244	.005	-20.4	-33.9	-6.8
31	25	260	22.7	4.5	270	209	267	290	253	.044	-19.0	-19	-.28
32	28	273	16.8	3.2	280	241	269	303	262	.033	-13.7	-13.7	-.62
33	16	286	21.6	5.4	290	226	288	319	271	.470	-15.5	-15.5	7.49
34	30	279	21.6	3.9	300	239	278	328	280	.001	-28.7	-28.7	-12.6
35	14	301	16.4	4.4	309	276	299	329	290	.085	-17.6	-17.6	1.3
36	23	288	41.8	8,7	318	173	297	338	299	.003	-47.7	-47.7	-11.6
37	23	314	32.4	6.7	327	218	322	356	308	.066	-27.1	-27.1	0.92
38	23	320	39.4	8.2	336	192	325	384	317	.062	-33.0	33.2	0.86
39	18	324	23.4	5.5	345	267	335	352	326	.005	-29.6	-29.6	-6.38
40	15	333	19.5	5.0	354	300	339	357	335	.001	-31.6	-31.6	-9.98
41	28	332	18.2	3.4	365	294	330	377	344	.003	-40.3	-40.3	-26.1

Table 6: FL data characteristics and comparison with established nomogram

GA wks	N	This study (mean)	SD	SÉ	Had [9]	FL Centile			Estd	P	MD	95% CI of mean difference	
						5	50	95				L. limit	U. Limit
13	9	14.8	6.4	2.1	11	7	14	26	18	.114	3.8	-1.14	8.7
14	7	16.3	6.1	2.3	15	8	15	26	20	.596	1.3	-4.33	6.9
15	9	18.4	6.1	2	18	14	15	29	22	.832	.44	-4.23	5.1
16	14	24.9	8.8	2.4	21	15	23	42	24	.126	3.9	-1.24	8.9
17	17	22.6	6.5	1.6	24	12	23	40	26.4	.405	-1.3	-4.70	2
18	26	26.3	6.1	1.2	27	15	26	40	28.5	.593	-.65	-3.14	1.8
19	37	29.1	6.6	1.1	30	24	28	44	30.5	.431	-.86	-3.07	1.3
20	31	32.4	4.5	.8	33	26	32	44	32.6	.483	-.58	-2.25	1.1
21	26	37.9	12	2.4	36	26	34	77	34.7	.440	1.92	-3.12	6.9
22	26	39.4	7.8	1.5	39	26	39	56	36.7	.784	.42	-2.72	3.6
23	31	40.3	6.7	1.2	42	28	40	60	38.8	.161	-1.7	-4.2	.73
24	22	41.7	4.0	.86	44	32	42	50	40.9	.021	-2.1	-3.92	-.36
25	21	45.1	6.9	1.5	47	31	46	65	42.9	.212	-1.9	-5.11	1.2
26	18	45.1	6.1	1.4	49	27	46	54	45.0	.014	-3.9	-6.98	-.91
27	20	47.2	8	1.7	52	29	49	59	47.1	.015	-4.8	-8.54	-1.0
28	20	51.2	4.4	.97	54	42	51	58	49.2	.012	-2.7	-9.81	-.69
29	19	52.4	7.3	1.7	56	34	53	67	51.2	.046	-3.6	-7.09	-.07
30	22	53.3	5.7	1.2	58	39	54	63	53.3	.001	-4.7	-7.23	-2.1
31	25	57	4.2	.85	61	47	58	64	55.4	.001	-4.0	-5.75	-2.2
32	28	59	3.6	.67	63	52	60	66	57.4	.001	-3.6	-5.03	-2.3
33	17	65	7.4	1.8	65	55	64	90	59.5	.949	.12	-3.72	3.9
34	31	61	6.1	1.1	66	46	61	68	61.6	.001	-5	-7.25	-2.7
35	13	63	11	2.9	68	28	65	69	63.6	.107	-5.2	-11.7	1.3
36	23	66	6.7	1.4	70	45	67	75	65.7	.009	-4	-6.91	-1.1
37	26	68	5.6	1.1	72	51	69	74	67.8	.001	-4.3	-6.54	-2
38	24	71	2.8	.57	73	64	70	76	69.9	.003	-2.4	-3.60	-1.2
39	18	71	3.4	.79	75	63	71	76	71.9	.001	-4	-5.74	-2.4
40	15	71	2.8	.72	76	67	71	77	74	.001	-4.5	-6.08	-2.9
41	28	72	3.1	.58	79	65	73	76	76.1	.001	-6.9	-8.05	-5.7

Table 7: Estimated fetal biometry values for Nepalese population

GA	BPD	HC	AC	FL
13	25	92	78	13
14	29	105	89	16
15	32	117	100	19
16	36	130	110	22
17	39	142	121	24
18	42	153	131	27
19	46	164	142	30
20	49	175	152	32
21	52	186	162	34
22	54	196	172	37
23	57	206	182	39
24	60	215	192	42
25	63	225	201	44
26	65	234	211	46
27	68	242	220	48
28	70	250	229	50
29	73	258	239	52
30	75	266	248	54
31	77	273	256	56
32	79	280	265	57
33	81	286	274	59
34	83	292	282	61
35	85	298	291	62
36	87	304	299	64
37	89	309	307	65
38	90	314	315	67
39	92	318	323	68
40	93	322	331	70
41	95	326	338	71
42	96	329	346	72

Discussion

Ultrasound is probably the most important innovation in obstetric care in the past 50 years. The benefits of sonography include accurate determination of fetal age, detection of fetal anomalies, estimation of amniotic volume, and assessment of fetal growth. Accurate assessment of gestational age (synonymously used with menstrual age) by sonography can be of great importance in management decisions during pregnancy. In the first trimester, CRL is a reliable predictor of gestational age. In the second and third trimesters, methods of gestational age estimation that take head shape into account are more accurate than methods using BPD alone Uncertain gestational age is associated with higher perinatal mortality rates and in increased incidence of low birth and spontaneous preterm delivery.[1]

The importance of an accurate assessment of gestational age in all pregnancies is therefore obvious to all obstetric practitioners. Precise knowledge of menstrual age should also help the obstetrician avoid a pregnancy of post-dates and its attendant risks to the fetus. Finally, knowledge of menstrual age helps the sonologist to recognize the growth-retarded or macrosomic fetus, since the normal range of values for fetal growth parameters varies with advancing menstrual age. [2]

Traditionally, gestational age is estimated in all women from the first day of the last menstrual period by Nagele calculation and from estimation of the size of the uterus, either bimanually during the first trimester or from an estimation of the fundal height during the second trimester. Both of these methods are fallible, however, more and more practitioners are employing a policy of routine dating by ultrasound examination during the first or more commonly the second trimester of pregnancy. [3]

Even using a reliable last menstrual date about 7 to 10 percent of women appear to have pregnancies lasting longer than 42 weeks, compared to the figure of 2 to 4 percent (the expected figure in a normal distribution) when ultrasound measurements are used to assign gestational age in the whole populations. This skewness must be based on the variability of ovulation in relation to the LMP (follicular phase length) and to a lesser degree on variable time of fertilization after ovulation. [4]

In this study regarding HC growth charts, figures of Jamil were almost identical to those of Hadlock. There was an earlier flattening of later growth starting from around 30 weeks. However, 50th centile figures of Jamil were well within normal of their graphs. 5th centile figures were about 6-10mm off from 30week onwards which was about 2.5 % lower. This earlier flattening of growth may be characteristic of the Malyasian population. Our 5th centile values were 1-21mm off that of Jamil from 30 weeks onwards which was about 6 % lower. There was an earlier flattening of later growth starting from around 22 weeks. Hence, there was much earlier flattening of growth than that of Malayasian population.[5]

Our AC values were similar at 18 weeks with that of Jamil but varying 1.6 % with that of Hadlock. At 37 weeks, our value was less by 2.5 % with that of Jamil and 5 % with that of Hadlock. Compared to the rest, our study had a definite

earlier tapering of growth at 22 weeks, which earlier than that of Malayasian population. The cause of this trend may be due to different biologic growth pattern and population differences. This supported the argument that there was a need to have our nomogram for BPD, HC, AC and FL.[6]

Conclusions

There is high degree of positive correlations between BPD & GA, HC & GA, AC & GA and FL and GA. Earlier flattening of later growth starting from 22 weeks was present which may be a characteristic of the Nepalese population. There is a need to have a separate nomogram for Nepalese population which should be developed with larger sample size based on CRL in the first trimester.

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