PRACTICE GUIDELINE

Evaluation of Applicability of Standard Growth Curves to Indian Women by Fetal Biometry

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Abstract

Objective: To verify the applicability of standard fetal growth curves proposed for western populations to an Indian population.

Method: Thirty patients were included and ultrasound scans were performed on Indian pregnant women to measure fetal growth parameters of biparietal diameter, head circumference, abdominal circumference and femur length for every weekly interval from 14 to 40 weeks. Twenty-five hundred women had ultrasonic measurements of fetal BPD,HC, AC and FL between 12 to 42 weeks of pregnancy were also included in study for confirming the growth parameters and plotting of Growth curves. The data were compared with the commonly recommended standards of Hadlock, Campbell, Jeanty and Chitty.

Results: First and second trimester biometry findings are comparable to western charts but none of the standard charts agreed with the data in the present study particularly in third trimester.

Conclusion: Since most parameters of the standard growth curves developed in the west are not applicable for assessing the intra-uterine growth of Indian babies we have developed growth curves for the Indian population to prevent over-diagnosis of intrauterine growth retardation and correct prediction of fetal age in Indian population.

Keywords: Ultrasonography, biparietal diameter, head circumference, abdominal circumference, femur length, fetal growth.

Proper assessment of fetal well-being requires an accurate knowledge of the gestational age of the fetus. From among the abundant charts and growth curves in the literature relating various ultrasonic fetal parameters to gestational age, only a few have been recommended as standard. Queries have been raised regarding the applicability of these standard curves to a racially mixed population due to ethnic variations. There might be a risk of over-diagnosing intrauterine growth retardation in the Indian population. This study evaluates the validity of the standard growth curves proposed for western populations to an Indian population.

METHOD

This prospective longitudinal cohort study was performed at Paras maternity and nursing home and Reshambai hospital Ahmedabad from 01.01.2005 till 31.03.2006.

Only those women who fulfilled the following criteria were included in the study.

1. Known last menstrual period with a cycle length of 26-30 days.
2. No fetal abnormalities and no pregnancy complications.
3. Live birth at term.
4. Birth weight above the 3rd and below the 97th centile for gestation (Yudkin et al, Early Hum Dev 1987;15:45-52).

Out of a total of 35 healthy pregnant Indian (western region) women originally included in the study, 5 were excluded due to maternal or fetal complications thirty patients were included and ultrasound scans were performed on Indian pregnant women to measure fetal growth parameters of biparietal diameter, head circumference, abdominal circumference and femur length for every weekly interval from 14 to 40 weeks. Twenty-five hundred women had ultrasonic measurements of fetal BPD, HC, AC and FL between 12 to 42 weeks of pregnancy were also included in study for confirming the growth parameters and plotting of growth curves. The data were compared with the commonly recommended standards of Hadlock, Campbell, Jeanty and Chitty.

The ultrasound machines used for the study were Medison make 9900 and Pico with a 3.75 MHz linear array transducer. To avoid inter-operator error, all the ultrasound examinations in this study were performed by the author only. The parameters measured on each examination were the biparietal diameter (BPD), head circumference (HC), femur length (FL) and abdominal circumference (AC). Uterine artery Doppler at 22-24 weeks, umbilical artery Doppler and middle cerebral artery Doppler every 2 weeks interval after 30 weeks. Measurements

were repeated until three successive readings and the average was taken.

Biparietal diameter (BPD): This was measured from the leading edge of the echo from the proximal skull surface to the leading edge of the echo from the distal skull surface — 'outer to inner' diameter.

Abdominal circumference (AC): Measured on a transverse image of the fetus at the level of the umbilical vein. The circumference was measured by (APTD + TTD) × 1.62.

Femur length (FL): Measured using a straight-line measurement between the two ends of the femoral diaphysis.

The gestational age in this study has been expressed as completed weeks of gestation and all measurements are in centimeters.

STATISTICS

For each fetal parameter measured, the mean was calculated for each of the studied weeks of gestation. These means were compared with the means of the published Standards for each parameter. Based on the data obtained from published standards, graphs were generated to show the relationship between gestational age and the means of the measured Parameters. The data obtained in this study were superimposed for comparison.

RESULTS AND DISCUSSION

Biparietal Diameter (BPD)

Graph 1 shows the BPD measurements in cms for the Indian women studied. For each specified week of gestation, the number of women and the minimum and maximum measurements obtained are shown along with the mean ± 2SD.

Graph 2 compares the BPD means obtained in the present study against the published standards of those presented by Campbell, Jeanty, Chitty and Hadlock.

All the data sets are comparable till the end of 34 weeks. The table shows that all the means in the present study are lower than after 34 weeks till 40 weeks.

HEAD CIRCUMFERENCE (HC)

Measured on the same section of the fetal head used for BPD. The occipitofrontal diameter was measured at this plane and the HC calculated using the formula: HC = (BPD + OFD) × 1.62.

The minimum and maximum measurements along with the mean ± 2SD for the HC at each specified week of gestation are shown in Graph 3.

Graph 4 compares the mean against the standards of Hadlock, Campbell, Chitty and Philip Jeanty.

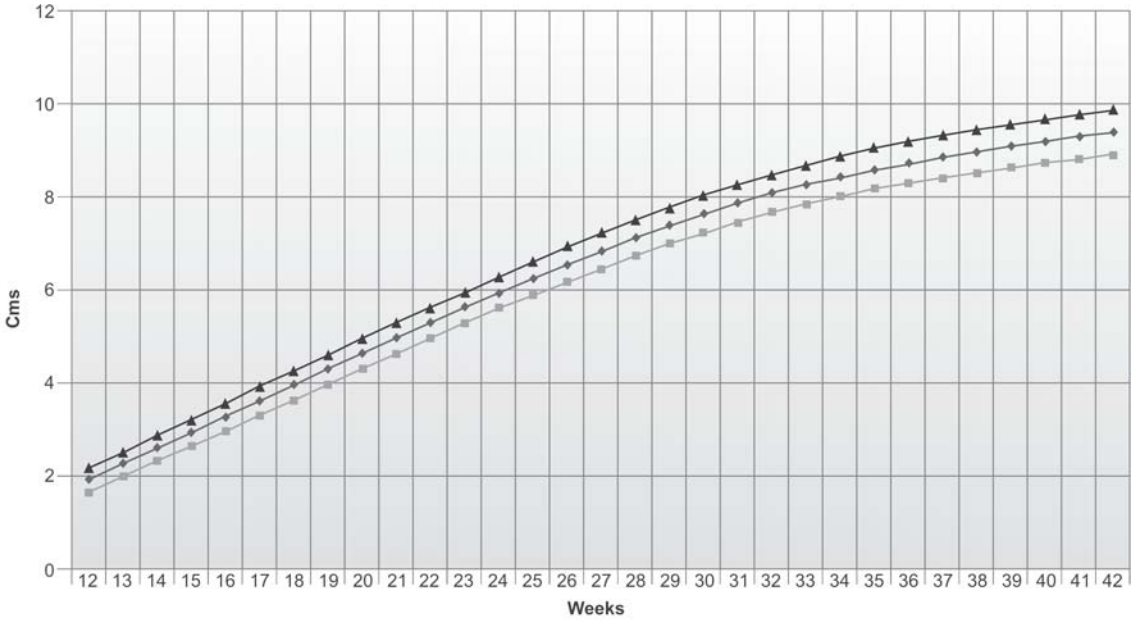
Measurement is quit comparable till 35 weeks but starts differing from 35 weeks onwards.

ABDOMINAL CIRCUMFERENCE

Graph 5 shows the minimum, maximum and mean ± 2SD for the abdominal circumference in the Indian population. A comparison of the obtained of mean with mean against the standards of Hadlock, Campbell, Chitty and Philip Jeanty in Graph 6.

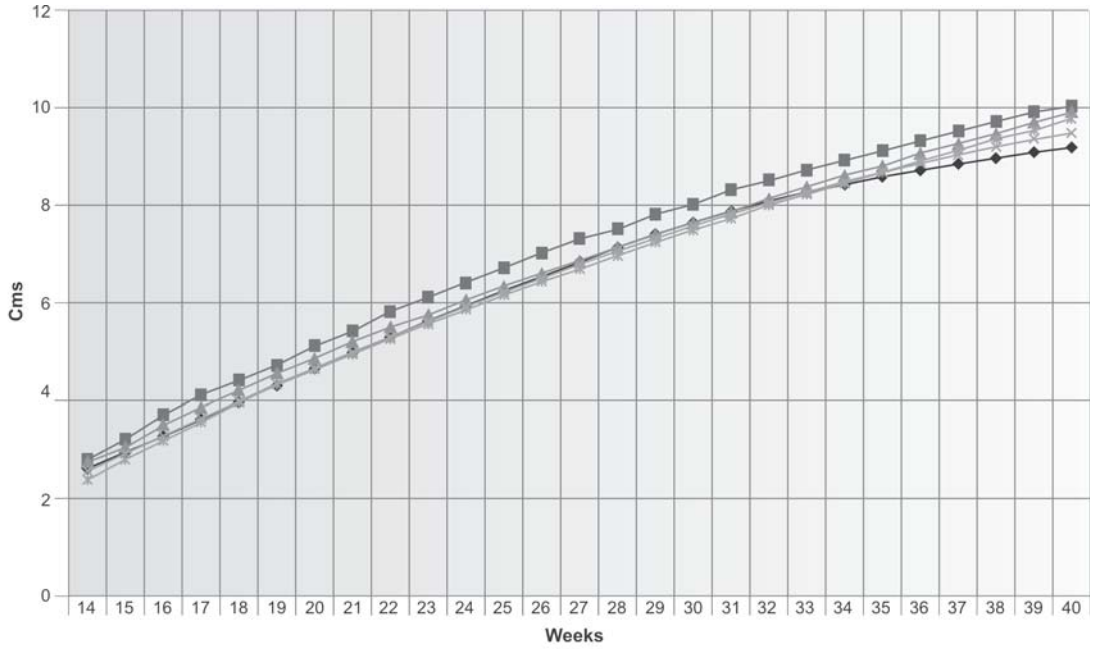
The reported means of all the four authors are higher significantly after 30th weeks than those obtained for the Indian women.

AC is the parameter which is affected at the earliest.



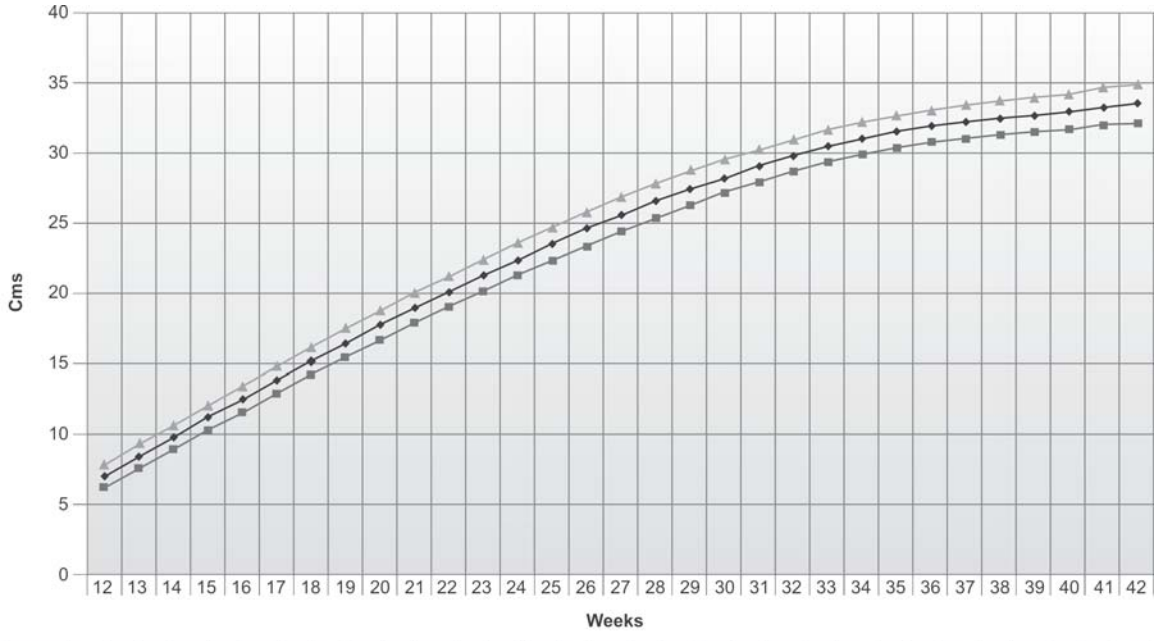
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Mean	1.93	2.28	2.61	2.94	3.28	3.63	3.97	4.31	4.64	4.98	5.3	5.63	5.93	6.25	6.54	6.84	7.13	7.4	7.65	7.88	8.09	8.27	8.43	8.58	8.72	8.85	8.97	9.08	9.19	9.3	9.39
5th Centile	1.66	2	2.34	2.66	2.99	3.31	3.64	3.98	4.31	4.64	4.97	5.3	5.62	5.9	6.18	6.46	6.74	7	7.23	7.46	7.68	7.86	8.03	8.18	8.31	8.42	8.52	8.64	8.74	8.82	8.91
95th Centile	2.19	2.52	2.86	3.21	3.56	3.92	4.26	4.61	4.96	5.29	5.62	5.94	6.28	6.61	6.93	7.23	7.5	7.77	8.04	8.26	8.46	8.68	8.88	9.05	9.19	9.32	9.44	9.55	9.66	9.77	9.86

Graph 1: BPD Indian parameters–Prashant Acharya



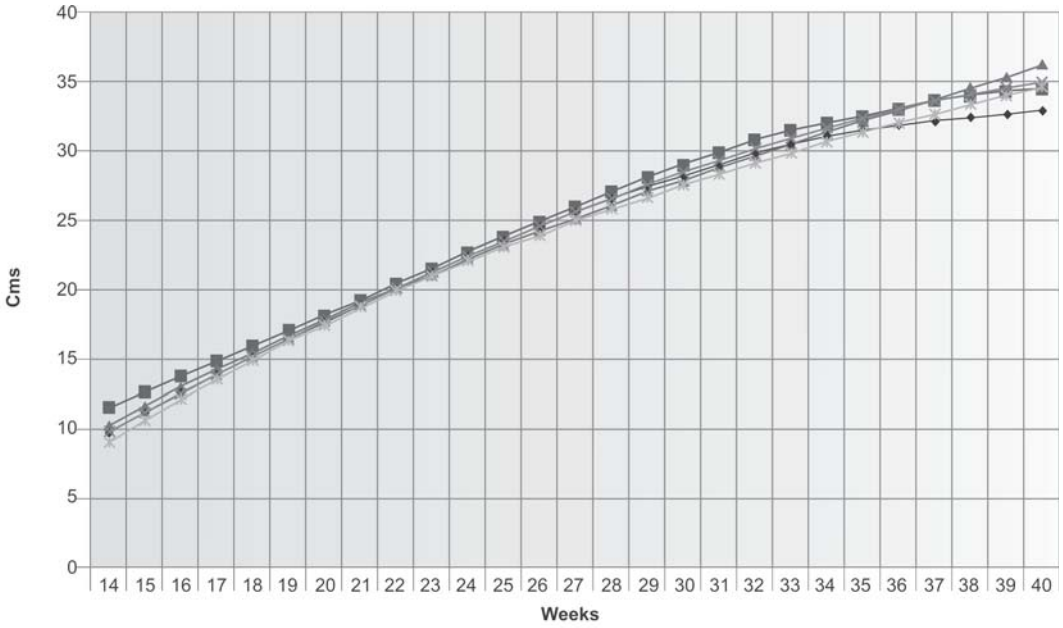
	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Prashant-India	2.61	2.94	3.28	3.63	3.97	4.31	4.64	4.98	5.3	5.63	5.93	6.25	6.54	6.84	7.13	7.4	7.65	7.88	8.09	8.27	8.43	8.58	8.72	8.85	8.97	9.8	9.19
Campbell-UK	2.8	3.2	3.7	4.1	4.4	4.7	5.1	5.4	5.8	6.1	6.4	6.7	7	7.3	7.5	7.8	8	8.3	8.5	8.7	8.9	9.1	9.3	9.5	9.7	9.9	10
Jeanty-USA	2.75	3.05	3.5	3.85	4.2	4.55	4.85	5.2	5.5	5.75	6.05	6.33	6.6	6.85	7.13	7.4	7.63	7.85	8.13	8.37	8.6	8.8	9.06	9.25	9.45	9.7	9.9
Chitty-UK	2.57	2.93	3.28	3.64	3.98	4.32	4.65	4.98	5.3	5.61	5.92	6.22	6.5	6.78	7.05	7.32	7.57	7.81	8.04	8.26	8.47	8.67	8.86	9.03	9.2	9.35	9.48
Hadlock-USA	2.38	2.8	3.18	3.56	3.96	4.32	4.63	4.94	5.25	5.56	5.86	6.16	6.43	6.69	6.96	7.24	7.49	7.72	8	8.22	8.44	8.68	8.9	9.13	9.35	9.54	97.7

Graph 2: BPD comparison chart



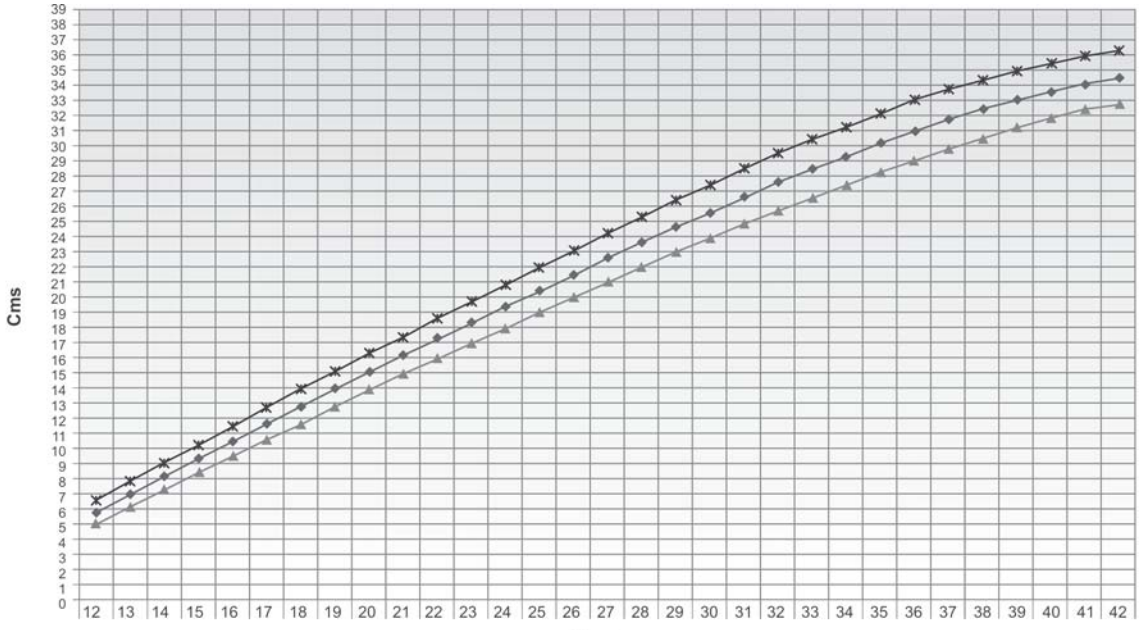
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Mean	6.9	8.33	9.72	11.1	12.5	13.8	15.1	16.4	17.7	18.9	20.1	21.2	22.3	23.5	24.6	25.5	26.5	27.4	28.2	29	29.8	30.4	31	31.5	31.9	32.2	32.4	32.6	32.9	33.2	33.5
5th Centile	6.18	7.52	8.9	10.3	11.6	12.9	14.1	15.4	16.6	17.8	19	20.1	21.2	22.3	23.3	24.4	25.3	26.2	27.1	27.9	28.6	29.3	29.9	30.3	30.7	31	31.2	31.5	31.7	31.9	32
95th Centile	7.73	9.15	10.6	12	13.3	14.7	16	17.4	18.7	19.9	21.1	22.3	23.5	24.6	25.7	26.7	27.7	28.6	29.4	30.2	30.8	31.6	32.1	32.6	33	33.4	33.6	33.9	34.1	34.6	34.8

Graph 3: HC Indian parameters–Prashant Acharya



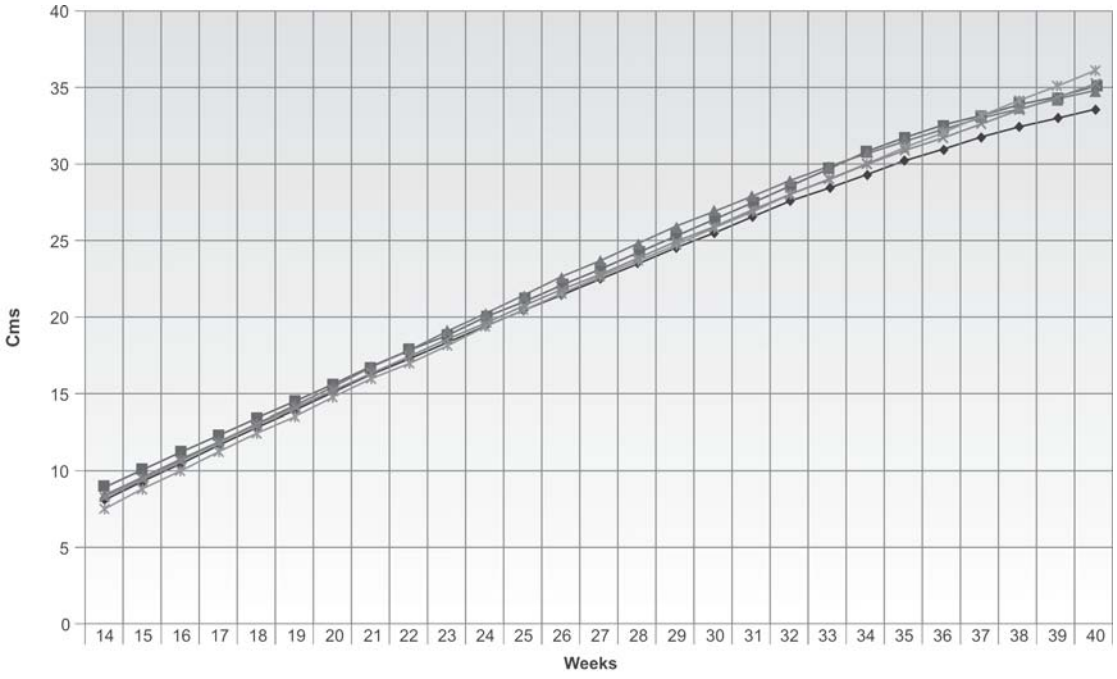
	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Prashant-India	9.72	11.1	12.5	13.8	15.1	16.4	17.7	18.9	20.1	21.2	22.3	23.5	24.6	25.5	26.5	27.4	28.2	29	29.8	30.4	31	31.5	31.9	32.2	32.4	32.6	32.9
Campbell-UK	11.5	12.6	13.7	14.8	15.9	17	18.1	19.2	20.4	21.5	22.7	23.8	24.9	26	27.1	28.1	29	29.9	30.8	31.5	32	3.25	33	33.6	34	34.3	34.5
Jeanty-USA	10.2	11.6	13	14.2	15.4	16.6	17.8	18.9	20	20.9	22.2	23.2	24.2	25.1	26	27.1	27.8	28.8	29.6	30.5	31.3	32.1	3.29	33.7	34.5	35.3	36.2
Chitty-UK	9.76	11.1	12.5	13.8	15.2	16.4	17.7	18.9	20.1	21.3	22.4	23.5	24.6	25.6	26.6	27.6	28.5	29.3	30.2	30.9	31.7	32.3	33	33.5	34.1	34.5	35
Hadlock-USA	8.93	10.5	12.1	13.6	14.9	16.3	17.4	18.7	19.8	20.9	22	23	23.9	24.9	25.8	26.6	27.5	28.2	29.1	29.8	30.6	31.3	32	33.6	33.3	34	34.6

Graph 4: HC comparison chart



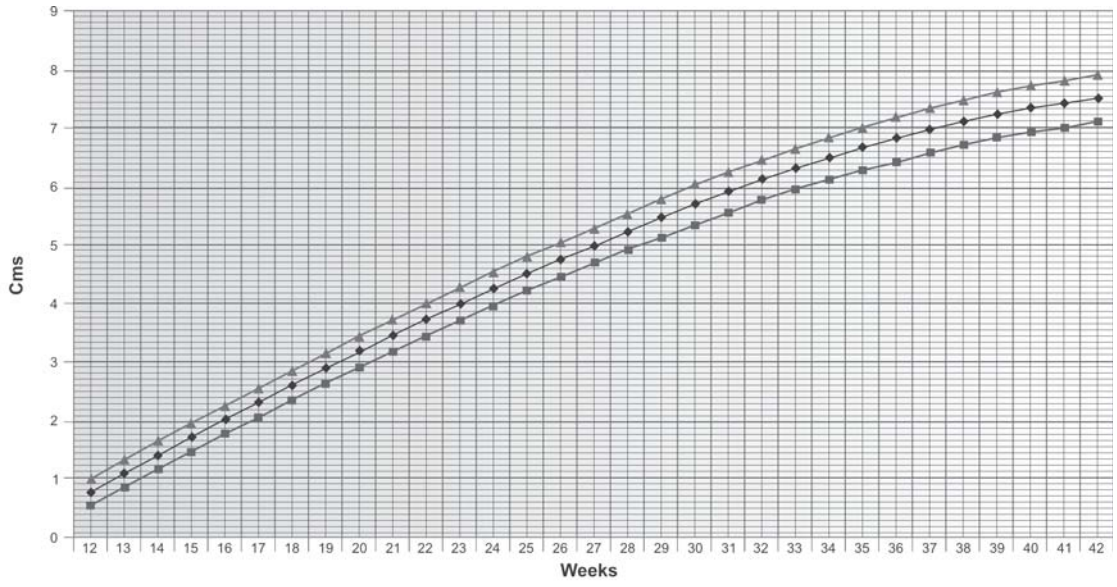
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Mean	5.81	7.02	8.2	9.35	10.5	11.67	12.81	13.69	15.08	16.2	17.25	18.33	19.38	20.41	21.48	22.62	23.62	24.62	25.56	26.6	27.6	28.44	29.3	30.2	30.97	31.75	32.4	33	33.55	34.09	34.5
5th Centile	5.11	6.2	7.31	8.48	9.52	10.6	11.7	12.81	13.9	14.98	15.98	17	17.98	19.01	20.02	21.03	22.03	23	23.93	24.86	25.73	26.57	27.38	28.29	29.02	29.79	30.51	31.23	31.83	32.4	32.77
95th Centile	6.61	7.9	9.08	10.24	11.49	12.72	13.97	15.13	16.29	17.41	18.6	19.71	20.81	21.96	23.09	24.24	25.32	26.43	27.42	28.52	29.55	30.43	31.23	32.12	33.02	33.76	34.37	34.94	35.47	35.93	36.29

Graph 5: AC-Indian parameters-Prashant Acharya



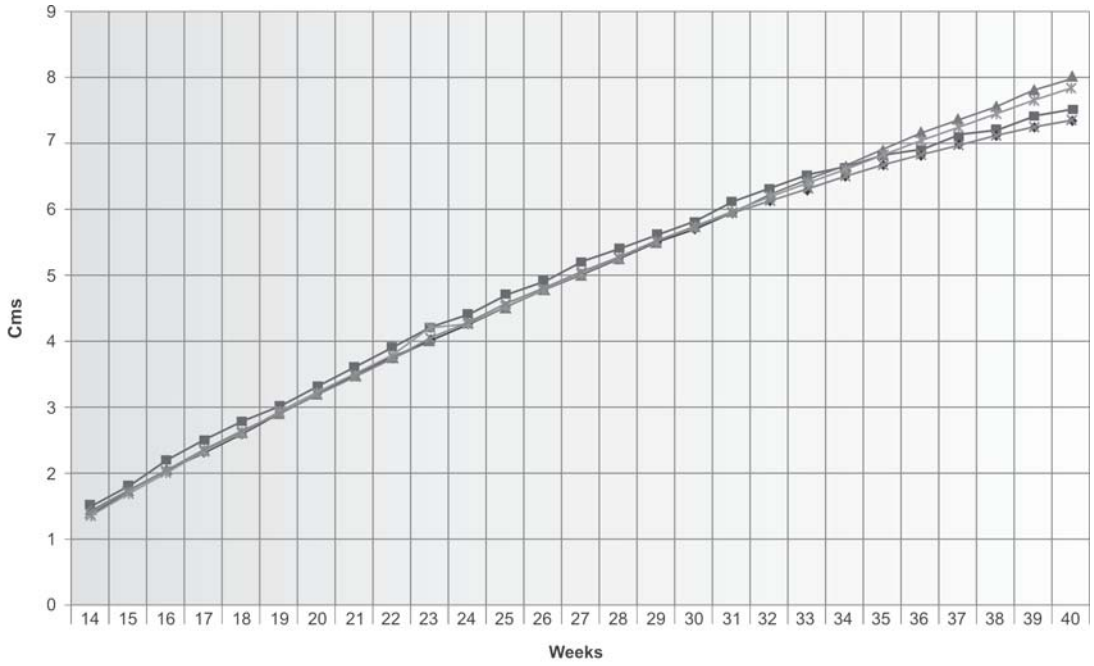
Prashant-India	8.2	9.35	10.5	11.67	12.81	13.96	15.06	16.2	17.25	18.33	19.38	20.41	21.48	22.82	23.62	24.62	25.56	26.6	27.6	28.44	29.3	30.2	30.97	31.75	32.4	33	33.55
Campbell-UK	9	10.1	11.2	12.3	13.4	14.5	15.6	16.7	17.8	18.8	19.9	21	22.1	23.1	24.2	25.3	26.4	27.5	28.6	29.7	30.8	31.7	32.5	33.2	33.8	34.4	35
Jeanty-USA	8.5	9.6	10.8	11.9	13.1	14.3	15.5	16.7	17.9	19.1	20.2	21.4	22.6	23.7	24.8	25.9	26.9	27.9	28.9	29.8	30.7	31.5	32.3	33	33.6	34.2	34.8
Chitty-UK	8.27	9.44	10.61	11.77	12.93	14.07	15.21	16.33	17.45	18.55	19.65	20.73	21.8	22.86	23.9	24.93	25.95	26.95	27.94	28.91	29.87	30.81	31.73	32.63	33.52	34.39	35.24
Hadlock-USA	7.49	8.79	10	11.23	12.41	13.52	14.73	15.94	17.01	18.17	19.38	20.47	21.58	22.64	23.68	24.73	25.77	26.87	28.02	29.01	30	31.07	32.08	33.14	34.13	35.11	36.1

Graph 6: AC comparison chart



Mean	0.78	1.1	1.4	1.72	2.02	2.31	2.6	2.9	3.18	3.45	3.73	3.99	4.25	4.51	4.75	4.99	5.23	4.47	5.7	5.92	6.12	6.3	6.49	6.66	6.82	6.97	7.1	7.23	7.34	7.42	7.5
5th Centile	0.55	0.86	1.17	1.47	1.78	2.06	2.34	2.63	2.63	2.91	3.18	3.45	3.71	3.96	4.22	4.46	4.7	4.92	5.12	5.35	5.55	5.77	5.95	6.12	6.27	6.42	6.58	6.71	6.83	6.92	7 7.1
95th Centile	1	1.34	1.66	1.96	2.25	2.54	2.84	3.14	3.43	3.71	3.99	4.28	4.54	4.8	5.04	5.28	5.54	5.78	6.03	6.24	6.45	6.63	6.83	7	7.18	7.33	7.47	7.6	7.71	7.8	7.9

Graph 7: FL Indian parameters-Prashant Acharya



Prashant-India	1.4	1.72	2.021	2.31	2.6	29	3.18	3.45	3.73	3.99	4.25	4.51	4.75	4.99	5.23	5.47	5.7	5.92	6.12	6.3	6.49	6.66	6.82	6.97	7.1	7.226	7.339
Campbell-UK	1.5	1.8	2.2	2.5	2.8	3	3.3	3.6	3.9	4.2	4.4	4.7	4.9	5.2	5.4	5.6	5.8	6.1	6.3	6.5	6.6	6.8	6.9	7.1	7.2	7.4	7.5
Jeanty-USA	1.45	1.75	2.05	2.35	2.63	2.9	3.2	3.45	3.75	4	4.25	4.5	4.75	5	5.25	5.5	5.73	5.95	6.23	6.46	6.65	6.9	7.16	7.36	7.58	7.8	8
Chitty-UK	1.41	1.72	2.03	2.33	2.63	2.92	3.21	3.49	3.76	4.03	4.29	4.55	4.8	5.04	5.27	5.49	5.71	5.92	6.12	6.31	6.49	6.66	6.82	6.97	7.11	7.24	7.35
Hadlock-USA	1.37	1.7	2.01	2.34	2.61	2.92	3.2	3.47	3.77	4.2	4.25	4.52	4.77	5.02	5.25	5.51	5.73	5.94	6.18	6.4	6.59	6.82	7.03	7.23	7.43	4.64	7.83

Graph 8: Femur length comparison chart

FEMUR LENGTH

The minimum and maximum measurements along with the mean ± 2SD are shown in Graph 7. A comparison of the mean ±2SD in the present study against the standards of Headlock, Campbell, Chitty and Philip Jeanty Graph 8. This parameter only differs then BPD, HC and AC in comparison as it differ very late after 37-38 weeks, that too not significantly.

The idea to study the applicability of standard fetal biometric growth curves to an ethnic Indian population Stemmed from the fact that there exist population differences with regard to height, weight, body mass index. Population differences apply to birth weight as Well.

For Indian babies, the mean birth weight is 2892 grams.

Applying the standard western curves would lead to an over diagnosis of intrauterine growth retardation in this population. Though there are several studies on fetal biometry for different.

Ethnic groups living in the same country, there is none yet on the Indian population in particular Gujarati population as Patel's and Shahs are distributed not only in India but through out the world especially in USA and. This study is a pioneering one.

CONCLUSION

Indian population is distributed throughout the world.

If western parameters of fetal biometry are applied to all patients , IUGR/ FGR will be over diagnosed , Fetal macrosomia will be missed and dating of the gestation using the fetal biometric parameters will be wrong for Indian population especially in 3rd trimester.

Till the end of 34 weeks growth parameters are quit same for the BPD, HC and FL but then these parameters starts legging behind till 40th weeks.

Till the end of 30th week AC remains comparable to western chart but then AC starts legging behind till 40th weeks significantly.

The diagnosis of IUGR/FGR is based on the measurement of AC (<10th centile) and EFW (<10th centile). In both these factors value of AC is very high so diagnosis is highly dependent on correct value and interpretation of AC.

Lot more is to done for the fetal biometry parameters, probably developing the regional biometry (North, East, South and West part of India) will be ideal.

Although fetal Doppler and amniotic fluid index are comparable to all studies as fetal physiology remains similar but fetal anatomy is different in this population. Fetal biological clock may be different throughout the different population.

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