International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2019): 7.583

Establishing Fetal Weight Standards in North Indian Population

Dr. Mukesh Mittal[1], Dr. Agrima Bansal[2], Dr. Pragati Gakher[3]

[1]Associate Professor, Department of Radio-Diagnosis and Modern Imaging, Zenana Hospital, SMS Medical College and Hospital, Jaipur777-Barkat Nagar, TonkPhatak, Jaipur- 302015, Rajasthan, India

[2]Post Graduate Student, Department of Radiodiagnosis and Modern Imaging, SMS Medical College, Jaipur
Room no 526, PG Girls Hostel, SMS Jaipur- 302004, Rajasthan, India (Corresponding Author)

[3]Post Graduate Student, Department of Radiodiagnosis and Modern Imaging, SMS Medical College, Jaipur
Room no 510, PG Girls Hostel, SMS Jaipur- 302004, Rajasthan, India

Abstract: ***Objective*: To create a reference chart for estimated fetal weight (EFW) in normal pregnancy for use in North Indian population and compare it with reference chart with western population. Single reference standard charts that were developed for the western population are being followed worldwide despite many differences between the populations in terms of genetics, nutrition, cultural practices, socio-economic status, and environmental factors. These factors can affect the fetal weight and using same reference can lead to a risk of over diagnosis of growth restriction in some populations. Fetal weight is an important clue when it comes to the assessment to growth of the fetus. This study is an attempt to provide reference values for the targeted north Indian population. We included 2433 normal singleton pregnancies coming for routine antenatal ultrasonography examination at our institute.Ultra-sonographic measurements included fetal biparietal diameter (cm), head circumference (cm), abdominal circumference (cm) and femur length (cm). Estimated fetal weight (gm) was calculated by using Hadlock algorithm. These values thus obtained were recorded, tabulated and centiles (10th, 50th, 90th, 95th and 97th) were derived from this data. It was then compared with western population reference.Estimated fetal weight was found to be at lower range in Indian population compared to western population.***

Keywords: Fetal weight, North Indian population, IUGR, Ultrasound

1. Introduction

Ultrasound to date remains the most important investigation when it comes to in-utero evaluation of the fetus. Biometric parameters like biparietal diameter, femur length, abdominal circumference and head circumference allow for estimation of fetal weight, liquor evaluation and color doppler allow satisfactory evaluation of the fetus. In order to monitor the growth of a fetus the traditional method is to compare it with the established standards.

However, current single reference standards being applied to all the populations worldwide come largely from high income nations with considerable amount of differences with respect to race, genetics, environmental factors, nutrition, socio-economic status which vary from region to region. These factors can affect the estimated fetal weight and therefore can lead to lead to considerable differences in fetal weights amongst various populations. [1, 2, 3, 4, 5] Hence the applicability of these standards to all populations is questionable.

Available literature from different populations points to the need of a targeted population based biometric parameters for the most reliable estimation of fetal wellbeing.

WHO has also therefore requested new fetal growth charts based on multiple populations to be made available for general use [6]. Recently published multinational study by the Intergrowth-21st Project presented biometric growth but not EFW data [7].

India, being a developing country, if the western standards are applied to Indian fetuses may be falsely diagnosed as growth restriction. Existing ultrasound-based fetal weight estimation models have been shown to have high errors when used in the Indian population. [8]

Use of existing standards in Indian population has proved to have a high rate of error leading to an erroneously high estimation of fetal intrauterine growth restriction [9]. Many studies have highlighted differences in fetal growth patterns between Indian and other populations and have observed that Indian fetuses have lower birth weight and are smaller in all body measurements [10, 11]. Thus, if practitioners incorporate existing standards in formulating fetal growth charts, overestimation of incidence of IUGR and microcephaly is likely.

Here in this study we have tried to find reference charts in the north Indian population by studying the fetal weight at various gestation ages. These values obtained were then compared with the existing western standard values.

2. Methods

This prospective study was conducted to formulate targeted population based fetal biometric parameters and corresponding reference fetal growth charts.

BPD, HC, FL and AC in all normal pregnancies from 20 weeks to term gestation were recorded after taking written and informed consent.

Patients with Maternal illness like diabetes mellitus, hypertension, severe anemia, maternal cardiac illness,

maternal infections, Pregnancy complications like PIH, oligohydramnios, polyhydramnios, IUGR, Multifetal gestation, Pregnancy with anomalous fetus, LMP not confirmed were not included in the formulation of charts.

Data collection was done after approval from the ethical committee of the institute.

Routine ultrasound scan was done for all patients fulfilling the inclusion criteria after taking written and informed consent.

BPD, HC, FC, AC was calculated using established guideline for proper measurement:

BPD: Maximum distance between the two parietal bones taken from the leading edge of the skull to the leading edge i.e. outer to inner at the level of the cavum septum pellucidum.

HC: Same level at which the BPD, taken by using the ellipsoid mode of the machine and adjusting the elliptical calipers to the outer margin of the skull table.

AC: At the level where the umbilical vein enters the left branch of portal vein; alternatively, a scan at a slightly lower level showing a short segment of the umbilical vein may be taken.

The outline of the abdomen should be as circular as possible. FL: Diaphysis from the greater trochanter above to the lateral condyle below.

EFW as per the Hadlock formula was obtained for each fetus [12]

LMP was recorded for each patient. Data thus collected was compared to established Western standards for each gestational week.

Thereafter,3rd, 5th, 50th, 95th, 97th centiles were formulated for the targeted population.

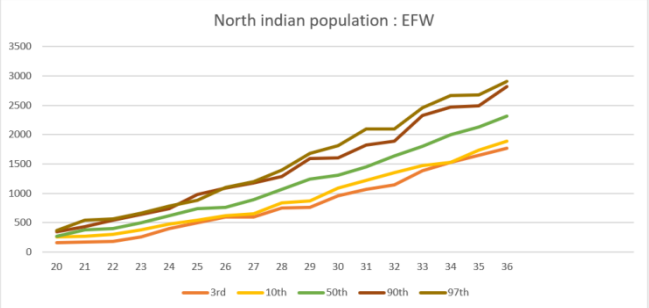
The centiles thus obtained were compared with corresponding centile values of already established standard for French population.

3. Results

A total of 2433 pregnant females with singleton pregnancy meeting all the inclusion criteria were studied. The fetal weight with gestation age was recorded. This data was tabulated and centile values were obtained. (Table 1)

Table1: Table showing centile weight (in gm) values obtained from the study for respective gestation ages

GESTATION WEEKS	3rd	10th	50th	90th	97th
20	162.48	255.22	271.91	345.68	366.2
21	168.38	271.21	373.24	426.38	543.36
22	183.34	295.79	393.56	542	567
23	259.31	379.16	495.45	635.59	660.44
24	394.2	476.09	621.97	734.44	778.77
25	497.25	535.49	734.64	977.44	884.52
26	598	615.35	761.29	1089.49	1094.03
27	600.26	646.54	886.33	1180.62	1195.88
28	746.24	833.71	1064.41	1284.61	1399.02
29	756.71	864.86	1237	1592.84	1681.67
30	960.23	1089.6	1308.81	1602.46	1808.88
31	1071.237	1220.74	1447.846	1823.885	2097.182
32	1141.36	1351.81	1633.35	1887.87	2100.27
33	1379.81	1469.67	1798.49	2320.71	2455.35
34	1524	1524.18	1993	2472.38	2660.08
35	1644.28	1733.42	2131.7	2493.14	2676.87
36	1767.54	1889.74	2316.17	2820.75	2905.46



Graph 1: graph showing centile weight (in gm) values obtained from the study for respective gestation ages

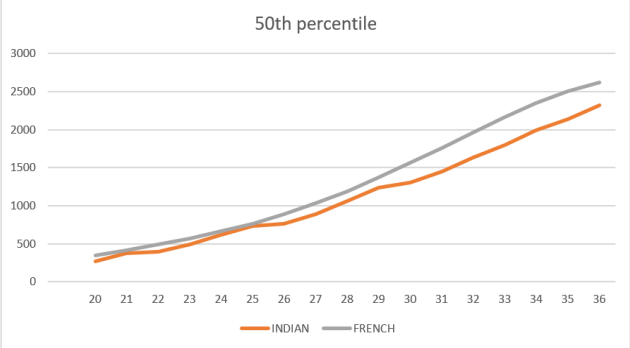
These centiles thus obtained for target north Indian population were then compared with existing standards for French population [13]. (Table 2)

Table 2: Table showing centile weight (in gm) for respective gestation ages in French population

GESTATION WEEKS	3rd	10th	50th	90th	97th
20	274	296	343	389	411
21	335	362	419	476	503
22	392	424	493	562	595
23	451	489	572	655	694
24	518	564	662	760	806
25	597	651	767	882	937
26	692	755	890	1024	1087
27	803	876	1031	1187	1259
28	931	1014	1192	1369	1453
29	1073	1168	1369	1571	1666
30	1227	1333	1561	1788	1895
31	1386	1506	1761	2016	2136
32	1546	1680	1964	2248	2382
33	1699	1847	2162	2477	2625
34	1834	1997	2345	2693	2856
35	1942	2121	2503	2886	3065
36	2009	2205	2624	3042	3238

Table 3: Table showing 50th percentile values for EFW in Indian and French at each respective gestation age

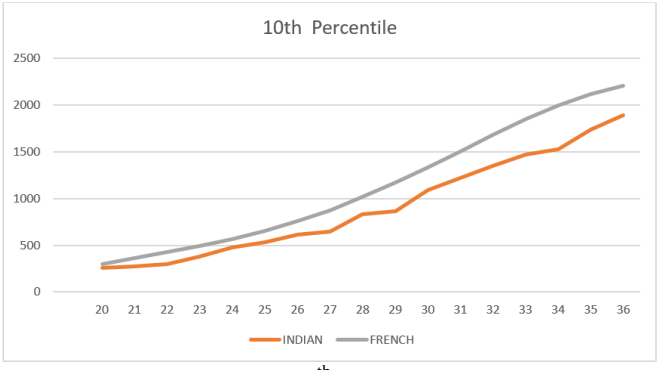
		50th Percentile
GA	INDIAN	FRENCH
20	271.91	343
21	373.24	419
22	393.56	493
23	495.45	572
24	621.97	662
25	734.64	767
26	761.29	890
27	886.33	1031
28	1064.41	1192
29	1237	1369
30	1308.81	1561
31	1447.846	1761
32	1633.35	1964
33	1798.49	2162
34	1993	2345
35	2131.7	2503
36	2316.17	2624



Graph 2: Graph showing 50th percentile values for EFW in Indian and French at each respective gestation age.

Table 4: Table showing 10th percentile values for EFW in Indian and French at each respective gestation age

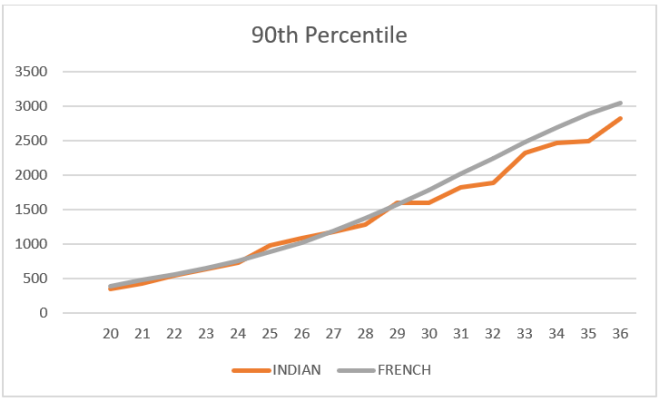
		10TH percentile
GA	INDIAN	FRENCH
20	255.22	296
21	271.21	362
22	295.79	424
23	379.16	489
24	476.09	564
25	535.49	651
26	615.35	755
27	646.54	876
28	833.71	1014
29	864.86	1168
30	1089.6	1333
31	1220.74	1506
32	1351.81	1680
33	1469.67	1847
34	1524.18	1997
35	1733.42	2121
36	1889.74	2205



Graph 3: Graph showing 10th percentile values for EFW in Indian and French at each respective gestation age

Table 5: Table showing 90th percentile values for EFW in Indian and French at each respective gestation age

		90TH percentile
GA	INDIAN	FRENCH
20	345.68	389
21	426.38	476
22	542	562
23	635.59	655
24	734.44	760
25	977.44	882
26	1089.49	1024
27	1180.62	1187
28	1284.61	1369
29	1592.84	1571
30	1602.46	1788
31	1823.885	2016
32	1887.87	2248
33	2320.71	2477
34	2472.38	2693
35	2493.14	2886
36	2820.75	3042



Graph 4: Graph showing 90th percentile values for EFW in Indian and French at each respective gestation age

4. Discussion

Professor Ian Donald in Glasgow first used ultrasound scanning for obstetrical purpose in late 1950s. Later in 1960s, fetal cephalometry was employed for fetal biometry, ultrasound remains the mainstay in assessment of fetal well-

being because it is non-invasive, cost effective and has no radiation risks [14, 15, 16]

From 14 weeks onwards, biometric parameters like BPD, FL, HC, AC are used for routine assessment of fetal well-being.

BPD is a measure of the maximum distance between the two parietal bones taken from the leading edge of the skull to the leading edge i.e. outer to inner [17] at the level of the cavum septum pellucidum.

HC is measured at the same level at which the BPD is taken by using the ellipsoid mode of the machine and adjusting the elliptical calipers to the outer margin of the skull table [18].
AC is used for monitoring the fetal weight. The abdominal circumference is taken at the level where the umbilical vein enters the left branch of portal vein; alternatively, a scan at a slightly lower level showing a short segment of the umbilical vein may be taken. The outline of the abdomen should be as circular as possible [19].

Femur length shows linear growth throughout gestation and is best measured after 14 weeks [20]. The diaphysis is measured from the greater trochanter above to the lateral condyle below. The outer border of femur is straight and the inner border is curved normally [21].

Various studies carried out in the developing countries have showed significant differences in the biometric parameters in different populations, thus signifying the need for targeted populationbase parameters and growth charts [22-27].

WHO has also therefore requested new fetal growth charts based on multiple populations to be made available for general use. [6]

Another recently published multinational study by the Intergrowth-21st Project presented biometric growth but not EFW data [7].

Bajracharya et al [28] found significant difference in the estimated fetal weight and actual fetal weight when EFW was calculated using Hadlock charts in an Indian population. Warrier et al [29] concluded that newborn in India weighs <3 kg, whereas Western newborns weigh 3.6 kg in an average. Hence toward term, there is a discrepancy in all fetal biometric parameters between Indian babies and their Western counterparts.

As is evident from the graphs obtained, the Indian fetuses fall short of the French values. This can be due to various genetic, environmental, nutritional and socio-economic factors. The difference in values is further more marked in the later trimester.

The use of these western values will therefore lead to an erroneous diagnosis of growth restriction in north Indian fetuses. This can further lead to unnecessary medical intervention, in an already overburdened Indian healthcare. So, we propose the 10th percentile values obtained by this study to be used as a reference in north Indian population to diagnose IUGR.

5. Conclusion

The Indian fetuses fall short in the fetal weight especially in the later weeks of gestation as compared to the western population. This may be due to multiple factors including socio-economic status, nutrition, higher order births and genetic causes. Therefore, use of the western values will lead to erroneous diagnosis of Intra-uterine growth restriction. We propose use of the values obtained by this study for use in north Indian population.

References

[1] Leon DA, Moser KA. Low birth weight persists in South Asian babies born in England and Wales regardless of maternal country of birth: slow pace of acculturation, physiological constraint or both? Analysis of routine data. J Epidemiol Community Health 2012;66:544-551.
[2] Yajnik CS, Fall CH, Coyaji KJ, Hirve SS, Rao S, Barker DJ, et al. Neonatal anthropometry: the thin-fat Indian baby: the Pune Maternal Nutrition Study. Int J ObesRelatMetabDisord2003;27:173-180.
[3] Kinare AS, Chinchwadkar MC, Natekar AS, Coyaji KJ, Wills AK, Joglekar CV, et al. Patterns of fetal growth in a rural Indian cohort and comparison with a Western European population: data from the Pune maternal nutrition study. J Ultrasound Med 2010;29:215223.
[4] Rao S, Yajnik CS, Kanade A, Fall CH, Margetts BM, Jackson AA, et al. Intake of micronutrient-rich foods in rural Indian mothers is associated with the size of their babies at birth: Pune Maternal Nutrition Study. J Nutr2001;131:1217-1224.
[5] Buck Louis GM, Grewal J, Albert PS, Sciscione A, Wing DA, Grobman WA, et al. Racial/ethnic standards for fetal growth: the NICHD Fetal Growth Studies. Am J ObstetGynecol2015;213:449.e441.
[6] TorvidKiserud et al, The World Health Organization Fetal Growth Charts: A Multinational Longitudinal Study of Ultrasound Biometric Measurements and Estimated Fetal Weight PLOS Medicine | DOI:10.1371/journal.pmed.1002220
[7] Papageorghiou A, Ohuma E, Altman D, Todros T, Cheikh Ismail L, Lambert A, et al. International standards for fetal growth based on serial ultrasound measurements: the Fetal Growth Longitudinal Study of the INTERGROWTH-21st Project. Lancet. 2014; 384(9946):869–79. doi: 10.1016/S0140-6736(14) 61490-2 PMID: 25209488
[8] Hiwale S, Misra H, Ulman S. Fetal weight estimation by ultrasound: development of Indian population-based models. Ultrasonography 2018 Apr 14 [Epub]. https://doi.org/10.14366/usg.18004
[9] Hiwale SS, Misra H, Ulman S. Ultrasonography-based fetal weight estimation: finding an appropriate model for an Indian population. J Med Ultrasound 2017;25:24-32
[10] Yajnik CS, Fall CH, Coyaji KJ, Hirve SS, Rao S, Barker DJ, et al. Neonatal anthropometry: the thin-fat Indian baby: the Pune Maternal Nutrition Study. Int J ObesRelatMetabDisord2003;27:173-180.

[11] Mathai M, Thomas S, Peedicayil A, Regi A, Jasper P, Joseph R. Growth pattern of the Indian fetus. Int J GynaecolObstet1995;48:21-24.
[12] Hadlock et al, Sonographic estimation of fetal weight. The value of femur length in addition to head and abdomen measurements, Radiology 1984 150:2, 535-540
[13] French- L. J. Salomon, j. P. Bernard et al Estimation of fetal weight: reference range at 20–36 weeks' gestation and comparison with actual birth-weight reference range, Ultrasound ObstetGynecol 2007; 29: 550–555, DOI: 10.1002/uog.4019
[14] Campbell S. An improved method of fetal cephalometery by ultrasound. J ObstetGynaecol Brit Cwelth 1968; 75:568-76.
[15] Campbell S. The prediction of fetal maturity by ultrasonic measurement of biparietal diameter. J ObstetGynaecol Brit Cwelth 1969; 76:603-9.
[16] Campbell S, Newman G B. Growth of fetal biparietal diameter during normal pregnancy. J ObstetGynaecol Brit Cwelth 1971; 78:513-9.
[17] Hadlock FP, Deter RL, Harrist RB, Park SK. Fetal biparietal diameter: a critical re-evaluation of the relation to menstrual age by means of real–time ultrasound. J ultrasound Med 1982; 1(3): 97-104.
[18] Campbell S, Thomas A. Ultrasonic measurement of fetal head to abdominal circumference in the assessment of growth retardation. Br J ObstetGynaecol 1977; 84:165.
[19] Kurmanavicius J, Eileen M, Royston P, Zimmermann R, Huch R, Huch A et al. Fetal ultrasound biometry: 2. Abdomen and femur length reference values. Br J ObstetGynaecol 1999; 106:136-143.
[20] Sharlon L, Filly RA. Curvature of the fetal femur: A normal sonographic finding. Radiology 1985; 156:490.
[21] Honarver M, Allahyari M, Dhebashi S. Assessment of gestational age based on ultrasonic femur length after the first trimester: a simple mathematical correlation between gestational age (GA) and femur length (FL). Int J GynecolObstet 2000; 70(3): 335-40.
[22] Machado LSM, Vaclavinkova V, Gibb H. Evaluation of applicability of standard growth curves to healthy Omani women by fetal biometry at selected gestational ages. SQU Journal for Scientific Research-Medical Sciences 2000; 2:97-104.
[23] Zukam TD, Ayuk NL, Kenla A, Shu D, Doh A, Kouam L, et al. Fetal ultrasound biometry in a Cameroonian population: study of femur length. Med Trop 2002; 62(5): 521-4.
[24] Ashrafunnisa, Jehan AH, Chowdhury SB, Sultana F, Haque JA, Khatun S, et al. Construction of fetal charts for biparietal diameter, fetal abdominal circumference and femur length in Bangladeshi population. Bangladesh Med Res Counc Bull 2003; 29(2): 67-77.
[25] Shohat T, Romano-Zelekha O. Ultrasonographic measurement of fetal femur length and biparietal diameter in an Israeli population. Isr Med Assoc J 2001; 3 (3): 166-8.
[26] Pal JA. Intrauterine fetal growth profile in Pakistan. Specialist. Pak J Med Sci 1992; 8 (4):5-12.
[27] Bajracharya J, Shrestha NS, Karki C. Accuracy of Prediction of Birth Weight by Fetal Ultrasound. Kathmandu Univ med J 2012;38(2):74-76.
[28] Warrier HG, Ashokan KM. Fetal Biometry in Late 3rd Trimester for Gestational Age Indian Standards. Int J Sci Stud 2016;3(12):295-298