A study of fetal weight and various fetal biometric parameters during the mid-gestational period (14-26 week) for the Gujarati population by autopsy method.

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Abstract:

Introduction: The study of the measurement of various morphometric parameters of the developing fetus is of immense importance to monitor the adequate fetal growth. Various literature regarding the standard reference fetal biometric charts and table for the monitoring of the fetal growth is available which is dependent upon different races, demographic characteristics and nutrition. The aim of the present study was to establish a reference range of the fetal weight and various fetal biometric parameters in the fetuses of the Gujarati population. **Material and Methods**: This study was conducted in the department of Anatomy, B.J. Medical College, Ahmedabad, Gujarat, in collaboration with Department of Obstetrics and Gynecology of Civil hospital, Ahmedabad, Gujarat on 28 fetuses at gestational age from 14 to 26 weeks. The fetuses were studied for various parameters like fetal weight, CRL, CHL and head circumferences. **Results**: There was increase in body weight and CRL, CHL and HC with increasing gestational age. CRL and HC increases at similar rate. CRL and CHL ratio is roughly 2:3. The growth of various parameters were linear. The fetuses of 14 – 18 weeks of gestational age were found to have mean weight, CRL, CHL and HC to be 158.5gm, 138, 212.42 and 153.17 mm respectively whereas the means of the same parameters for the age group of 19 – 26 weeks were 522.94 gm, 206.44, 318.94 and 218.63 mm respectively. **Conclusion**: The present study establishes the standard reference values of fetal weight and various fetal biometric parameters like CRL, CHL and HC for the Gujarati population for second trimester of pregnancy. This could be a very useful tool to gynecologist to have a reference for the age estimation during the antenatal examination as well as to pathologists while performing the fetal autopsies.

Key words: CRL, CHL,Fetal biometry, Fetal weight, Head Circumference (HC).

Introduction:

Fetal biometry is measurement of various morphometric parameters of the developing fetus. A close watch on the development of fetus at various time interval is of utmost importance to monitor the adequate fetal growth. The clinical use of ultrasonography in obstetrics was introduced by Ian Donald in 1958 which has become gold standard now for the dating of the pregnancy during all three trimesters.[1]

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Though it is said to be not a reliable method for the age estimation.[1] Obstetricians use weight as well as various morphometric parameters to calculate the age of the fetus like Crown to Rump Length (CRL), Crown to Heel Length (CHL) and Head Circumference (HC).[2]

Autopsy is the gold standard method of examination for the confirmation of the exact pathology responsible for the death of the fetus. A standard autopsy examination includes various measurements of morphometric parameters as well as weight the internal organs.[3] The establishment of accurate standard reference range for various parameters are of immense importance in order to either monitor the maturation, growth and development of the developing fetus or to find out any pathological abnormalities or intrauterine growth retardation.[4]

Many worker have provided the standard reference fetal biometric charts and table for the monitoring of the fetal growth. These references were dependent upon different races, demographic characteristics and nutrition. The present study was conducted in order to determine fetal weight as well as various morphometric fetal parameters in the fetuses of the Gujarati population during 14 - 26 weeks of gestation. The aim of the present study was to establish a reference range of the fetal weight and various fetal biometric parameters in the fetuses of the Gujarati population.

Material and methods:

This study was conducted in the department of Anatomy, B.J. Medical College, Ahmedabad, Gujarat, in collaboration with Department of Obstetrics and Gynecology of Civil hospital, Ahmedabad, Gujarat after obtaining due permission from the ethical committee, medical superintendent and concern head of the department. Fetuses were also collected from semi-government, corporation and private hospitals, after getting necessary permissions from local ethical committee, the concerned heads of the hospitals.

A total of 28 fetuses at gestational age from 14 to 26 weeks were collected. All the fetuses with 14-28 weeks of gestational age, with normal obstetric history, available clinical history, free from observable and detectable abnormalities and willingness to participate in study were included in the study. Aborted fetuses below the gestational age of 14 weeks, fetus with any observable and detectable congenital anomalies, no clinical history, formalin fixation before examination, hydrops fetalis, known abnormal karyotype or any other genetic disease, macerated fetuses, presence of congenital malformation, maternal or fetal infection, multiple pregnancies and patients not willing to participate in the study were not included in the present study.

Consent form (Annexure) was prepared in three different languages (Gujarati, Hindi and English) for better understanding of the parents and near relatives. On requirement, the team of three including principle researcher, secondary researcher and one laboratory technician trained in histopathology lab who is aware about handling of freshly received specimen would go to the parent for informed consent.

Fetus collected in sterilized container after cutting umbilical cord. Fetus collected from the labor room were brought to department of Anatomy and immediately washed in to tap water. After washing plastic coin with embossed number, had been attached to the

specimen. Each specimen has been provided with unique ID e.g. S-18-001, which is consist of three components. First character says 'Specimen', second and third character identify the year in which specimen collected and last three character for numbering of the specimen.

Anthropometric measurements:

Length and circumference measurements were made using standard metric rulers, tapes and calipers and recorded in millimeters. No systematic assessment of measurement error was attempted, although spot checks indicated a 1-2% variation on repeat measurement by the same observer. Specifics on measurement technique and sample preparation are as follows.

Fetal weight (FW):

Before the body was weighed, excess umbilical cord (to 1 cm), cord clamps, tubes, catheters, tape, identification bands, and similar extraneous items were removed (or weighed separately later and subtracted). Fetal weights refer to fetuses that have been fixed for about 2 weeks in 10% formalin. Fresh specimens usually weigh about 5% less.

Crown rump length (CRL):

To measure the crown-rump length, the fetus was placed on its back with the hips flexed at 90^0 and the spine straightened as much as possible.[5]

Crown heel length (CHL):

The CHL, which corresponds to distance between crown of the head to the heel was recorded with the foetus in supine position with straightening lower extremities and trunk without traction.[6]

Head circumference (HC):

HC was measured from glabella to the most prominent point posteriorly; Head circumference is less affected by the compression of the head.[7]

Results:

The present study comprised of 28 fetuses ranging in gestational weeks (GW) from 14 - 26. Maximum number of cases were in GW of 17, 18 and 25 weeks (5 cases each) and minimum number of cases were in GW of 21, 23 and 26 weeks (1 case each). Samples were divided into 2 groups based on the age of the fetus.

Table 1: Classification of specimen on the basis of Gestational week

Group	Age of fetus	Total No	Percent
1	14-18 week	12	22.64
2	19-26 week	16	30.19

Weight of fetus, gestational age, crown-rump length, crown-heel length and head circumference were recorded for comparison in our study. Table 2 shows weight of fetus, gestational age, crown-rump length, crown-heel length and head circumference of each

specimen collected for present study.

Table 2: Group wise data of Weight of fetus, Gestational age, Crown-rump length, Crown-heel length and head circumference

AGE in Week	Fetal weight (FW) in gm	CRL in mm	CHL in mm	HC in mm
16	104	106	154	108
16	102	104	152	110
17	142	130	200	136
17	146	132	204	139
17	144	134	202	138
17	135	137	204	140
17	187	152	245	157
18	185	150	220	152
18	190	152	250	224
18	190	155	248	155
18	186	153	221	156
18	191	151	249	223
19	246	172	242	180
19	242	170	245	174
19	245	174	250	180
21	364	170	275	194
22	432	188	325	188
22	361	171	276	190
23	432	190	324	187
24	590	230	320	236
24	590	231	324	240
24	693	234	388	276
25	692	235	390	275
25	690	233	360	220
25	665	220	335	238
25	668	220	330	242
25	695	235	359	223
26	762	230	360	255

Table 2 shows various external parameters recorded in present study. Fetal weight, recorded in gm of fresh specimen, was recorded on electronic weigh machine immediately after receiving specimen from labor room. Crown rump length (CRL), crown heel length (CHL) and head circumference measured in mm by measuring tape. Chart 1 & 2 respectively shows relation of CRL, CHL & HC with FW and GW. The weight of the fetuses at different gestational age and the corresponding crown rump length, crown heel length, head circumference were recorded in grams and mms respectively. It was observed that, there was increase in body weight and crown rump length, crown heel length, head circumference with increasing gestational age. CRL and HC increases at similar rate. CRL and CHL ratio is roughly 2:3.

Graph 1: Comparison of fetal weight with CRL, CHL and HC
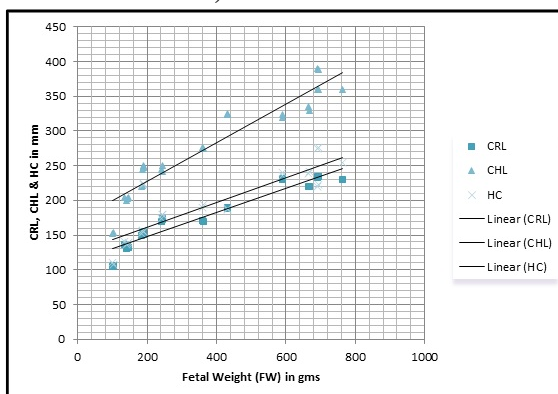
Graph 2: Comparison of Gestational week with CRL, CHL and HC
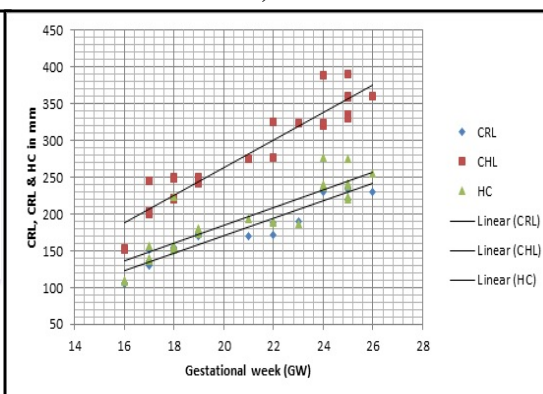
Table 3 shows the means of fetal weight and various morphometric parameters according to the age of the fetuses.

GW	NS	Mean FW	Mean CRL	Mean CHL	Mean HC
16	2	103	105	153	109
17	5	150.8	137	211	142
18	5	188.4	152.2	237.6	182
19	3	244.33	172	245.67	178
21	1	364	170	275	194
22	2	396.5	179.5	300.5	189
23	1	432	190	324	187
24	3	624.33	231.67	344	250.67
25	5	682	228.6	354.8	239.6
26	1	762	230	360	255

Table 4: Group wise mean of FW, CRL, CHL and HC

GROUP	FW in gm	CRL in mm	CHL in mm	HC in mm
1	158.5	138	212.42	153.17
2	522.94	206.44	318.94	218.63

All the samples were divided into two groups as mentioned previously which comprised of fetuses of the gestational ages between 14 – 18 and 19 – 26 weeks respectively. The fetuses of group 1 were found to have mean weight, CRL, CHL and HC to be 158.5gm, 138, 212.42 and 153.17 mm respectively. The means of the same parameters for the group 2 were 522.94 gm, 206.44, 318.94 and 218.63 mm respectively. (Table 4)

Discussion:

This study is based on the examination and measurement of autopsied non macerated fetuses, which provides the standards of the fetal weight as well as various morphometric parameters in the fetuses of 14 – 26 weeks of gestational age in the Gujarati population. Many researcher have presented the fetal biometric data and fetal weight for the age group of 14 – 26 weeks. Table 5 shows the comparative analysis of fetal weight amongst various researchers.

Table 5: Fetal weight by various researchers

Worker	Population	Age group (wk)	Mean fetal weight (gm)
Ajita R[13]	Imphal India	14 – 18	207.77
		20 – 25	768.47
De Paepe ME[8]	Rhode Island	16 – 19	188
		20 – 27	549.5
Cussen L[9]	Australia	20 – 27	634.3
Mukhia R[12]	Nepal	14 – 18	112.28
		20 – 26	537.86
Guihard-Costa AM[10]	France	15 – 18	142.35
		19 – 26	498.47
Maroun LL[11]	Denmark	14-18	115.7
		19-26	523.5
Phillips JB[5]	Australia	14-18	124.46
		19-26	552.69
Hansen K[4]	USA	14-18	115.2
		19-26	483.87
Present study	Gujarat India	14-18	158.5
		19-26	522.94

The fetal weight for the fetuses of the gestation age of 14 – 18 weeks and 19 – 26 weeks were found to be 158.5 gm and 522.94 gm respectively in the present study. This finding was closely comparable with the finding of De Paepe ME et al[8] in the population of Rhode Island for the fetuses of the similar age group. Cussen L et al[9] reported the fetal weight to be higher for the fetuses of 20 – 27 weeks of gestational age in Australian population as compared to Gujarati population.

Guihard-Costa AM[10] and Maroun LL et al[11] studied the fetal weight in the French and the Dennis population respectively. It was observed that the weight of the fetuses of the French population were closely comparable with the same of the Gujarati population, whereas the fetal weight was lower as compared in the Dennis but during the later stage of the second trimester it was comparable with the Gujarati population.

Phillips JB et al[5] also studied the fetal weight in Australian who found that the fetal weight during early stage of second trimester to be slightly lower than the present study which became comparable as the end of the second trimester approached. This finding was contradictory to the previous findings of Cussen L et al[9] in the Australian population. Hansen L et al[4] reported the fetal weight in the American population to be lower than the Gujarati population in the second trimester. Mukhia R et al[12] also reported the fetal weight of the

Nepali population during early second trimester to be lower than the Gujarati population which was comparable towards the end of it. In India, Ajita R et al[13] reported the fetal weight during the second trimester in the east Indian population to be higher than the same from the Gujarati population.

Table 6: Comparison of various fetal morphological parameters by various workers

Worker	Population	Age group (wk)	CRL (cm)	CHL (cm)	HC (cm)
Szpinda M14	Poland	16 – 18	12.33	-	-
		19 – 25	18.59	-	-
Cussen L9	Australia	20 – 27	21.03	30.85	21.2
Guihard-Costa AM10	France	15 – 18	12.89	18.89	12.97
		19 – 26	20.05	29.22	20.11
Maroun LL11	Denmark	14-18	12.32	17.44	12.34
		19-26	19.81	28.71	19.9
Phillips JB5	Australia	14-18	12.40	17.80	12.05
		19-26	20.17	29.13	20.01
Hansen K4	USA	14-18	12.04	17.28	-
		19-26	19.34	28.11	-
Babuta S15	Rajasthan, India	14 – 18	-	-	11.81
		19 – 26	-	-	19.55
Singhal P16	Ghaziabad, India	14 – 18	-	-	12.8
		19 – 26	-	-	20.0
Present study	Gujarat India	14-18	13.8	21.24	15.32
		19-26	20.64	31.89	21.86

Szpinda M et al[14] studied the CRL in the Polish who reported it to be slightly lesser as compared to the Gujarati population. Cussen L et al[9] found the CRL, CHL and HC to be closely comparable in the Australian population for the later part of the second trimester. Interestingly, Guihard-costa[10] reported the CRL during the second trimester in the French to be closely comparable to the Gujarati but CHL was reported to be lower, which may indicate shorter lower limbs as compared to Gujarati population in the French. Similarly, HC in the French fetuses was also found to be lower than the present study. All the fetal morphometric parameters in the Gujarati population was found to be higher as compared to the Dennis fetuses during the second trimester.

Contradictory to previous findings by Cussen L et al[9], Phillips JB et al[5] reported the fetal morphometric parameter during the second trimester in the Australian fetuses to be slightly lower than the same from the Gujarati population. Hansen K et al[4] reported the same parameters to be lesser in the Americans as compared to the Gujarati population.

Babuta S et al[15] studied the ultrasonographic measurements of head circumference in the fetuses of the Rajasthani population who reported it be lower than the same from the present study during the second trimester. This difference may be due to the method of the examination. Similarly, Singhal P et al[16] conducted the ultrasonographic assessment of the HC of the fetuses from the Ghaziabad who also reported the same to be lower than the present study. The results of the present study can be on a slightly higher side as compared to those conducted with the use of ultrasonography.

Conclusion:

The present study establishes the standard reference values of fetal weight and various fetal biometric parameters like CRL, CHL and HC for the Gujarati population for second trimester of pregnancy. This could be a very useful tool to gynecologist to have a reference for the age estimation during the antenatal examination as well as to pathologists while performing the fetal autopsies. This study also presents the comparative analysis of these parameters amongst different population. However, large scale studied are recommended to establish a more roboust reference values for the same.

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