

The study of fetal weight and various fetal parameters during the late gestational period (27–40 weeks) in the Gujarati population by autopsy method

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ABSTRACT

Background: 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 are available which is dependent on different races, demographic characteristics, and nutrition. **Objectives:** The aim of the present study was to establish a reference range of the fetal weight (FW) and various fetal biometric parameters in the fetuses of the Gujarati population. **Materials and Methods:** This study was conducted in the Department of Anatomy, B.J. Medical College, Ahmedabad, Gujarat, in collaboration with the Department of Obstetrics and Gynecology of Civil Hospital, Ahmedabad, Gujarat, on 25 fetuses at gestational age from 27 to 40 weeks. The fetuses were studied for various parameters such as FW, crown to rump length (CRL), crown to heel length (CHL), and head circumferences (HC). **Results:** There was increase in body weight and CRL, CHL, and HC with increasing gestational age. CRL and HC increase at similar rate. CRL and CHL ratio is roughly 2:3. The growth of various parameters was linear. The fetuses of 27–32 weeks of gestational age were found to have mean weight, CRL, and HC to be 1099.42 g, 267, 432.5, and 273.17 mm, respectively, whereas the means of the same parameters for the age group of 33–40 weeks were 2474.61 gm, 321.61, 461.92, and 330.54 mm, respectively. **Conclusion:** The present study establishes the standard reference values of FW and various fetal biometric parameters such as CRL, CHL, and HC for the Gujarati population for the 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: Fetal Biometry; Fetal Weight; Crown-rump Length; Crown-heel Length; Head Circumference

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] Although 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 such as 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

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various measurements of morphometric parameters as well as weighs the internal organs.^[3] The establishment of accurate standard reference range for various parameters is of immense importance 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 workers have provided the standard reference fetal biometric charts and table for the monitoring of the fetal growth. These references were dependent on different races, demographic characteristics, and nutrition. The present study was conducted to determine fetal weight (FW) as well as various morphometric fetal parameters in the fetuses of the Gujarati population during 27–40 weeks of gestation. The aim of the present study was to establish a reference range of the FW and various fetal biometric parameters in the fetuses of the Gujarati population.

MATERIALS AND METHODS

This study was conducted in the Department of Anatomy, B.J. Medical College, Ahmedabad, Gujarat, in collaboration with the 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 25 fetuses at gestational age from 27 to 40 weeks were collected. All the fetuses with 27–40 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. 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 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 laboratory 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 was brought to the 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, for example, 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 1–2% variation on repeat measurement by the same observer. Specifics on measurement technique and sample preparation are as follows.

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). FWs refer to fetuses that have been fixed for about 2 weeks in 10% formalin. Fresh specimens usually weigh about 5% less.

CRL

To measure the CRL, the fetus was placed on its back with the hips flexed at 90° and the spine straightened as much as possible.^[5]

CHL

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

HC

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

RESULTS

The present study comprised 25 fetuses ranging in gestational weeks (GWs) from 27 to 40. Maximum number of cases were in the age group of 28 weeks of gestational age (4 cases) and minimum number of cases were in the age group of 39 weeks of gestational age (1 case). Samples were divided into two groups based on the age of the fetus [Table 1].

Weight of fetus, gestational age, CRL, CHL, and HC were recorded for comparison in our study. Table 2 shows weight of

fetus, gestational age, CRL, CHL, and HC of each specimen collected for the present study.

Above table shows various external parameters recorded in the present study. FW, recorded in gram of fresh specimen, was recorded on electronic weigh machine immediately after receiving specimen from labor room. CRL, CHL, and HC measured in mm by measuring tape. Figures 1 and 2, respectively, show relation of CRL, CHL, and HC with FW and GW. The weight of the fetuses at different gestational age and the corresponding CRL, CHL, and HC were recorded in grams and mm, respectively. It was observed that there was increase in body weight and CRL, CHL, and HC with increasing gestational age. CRL and HC increase at similar rate. CRL and CHL ratio is roughly 2:3.

Table 1: Classification of specimen on the basis of GW

| Group | Age of fetus | Total no. |
|-------|--------------|-----------|
| 1 | 27–32 weeks | 12 |
| 2 | 33–40 weeks | 13 |

GW: Gestational week

Table 2: Group-wise data of weight of fetus, gestational age, CRL, CHL, and HC

| Age in week | FW in g | CRL in mm | CHL in mm | HC in mm |
|-------------|---------|-----------|-----------|----------|
| 27 | 890 | 270 | 425 | 280 |
| 27 | 894 | 255 | 420 | 260 |
| 27 | 900 | 257 | 425 | 262 |
| 28 | 1010 | 282 | 454 | 285 |
| 28 | 995 | 280 | 450 | 294 |
| 28 | 891 | 277 | 427 | 281 |
| 28 | 1005 | 260 | 429 | 264 |
| 30 | 1250 | 262 | 430 | 268 |
| 30 | 1290 | 264 | 434 | 270 |
| 30 | 1223 | 265 | 431 | 270 |
| 31 | 1450 | 265 | 430 | 270 |
| 31 | 1395 | 267 | 435 | 274 |
| 33 | 1850 | 292 | 432 | 300 |
| 33 | 1890 | 295 | 440 | 302 |
| 33 | 1982 | 297 | 444 | 299 |
| 35 | 2300 | 316 | 450 | 330 |
| 35 | 2289 | 315 | 449 | 331 |
| 35 | 2256 | 320 | 449 | 332 |
| 36 | 2540 | 332 | 478 | 345 |
| 36 | 2599 | 336 | 481 | 346 |
| 36 | 2548 | 337 | 481 | 349 |
| 37 | 3000 | 335 | 475 | 340 |
| 37 | 2967 | 334 | 476 | 342 |
| 37 | 3011 | 339 | 490 | 346 |
| 39 | 2938 | 333 | 460 | 335 |

CRL: Crown-rump length; CHL: Crown-heel length; HC: Head circumference; FW: Fetal weight

Table 3 shows the means of FW and various morphometric parameters according to the age of the fetuses.

All the samples were divided into two groups as mentioned previously which comprised fetuses of the gestational ages between 27–32 and 33–40 weeks, respectively. The fetuses of Group 1 were found to have mean weight, CRL, CHL, and HC to be 1099.42 gm, 267, 432.5, and 273.17 mm, respectively. The means of the same parameters for Group 2 were 2474.61 gm, 321.61, 461.92, and 330.54 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 FW as well as various morphometric parameters in the fetuses of 27–40 weeks of gestational age in the Gujarati population. All the samples were divided into two groups which comprised fetuses of the gestational ages between 27–32 and 33–40 weeks, respectively. The fetuses of Group 1 were found to have mean weight, CRL, CHL, and HC to be 1099.42 g, 267, 432.5, and 273.17 mm, respectively. The means of the same parameters for Group 2 were 2474.61 g, 321.61, 461.92, and 330.54 mm, respectively.

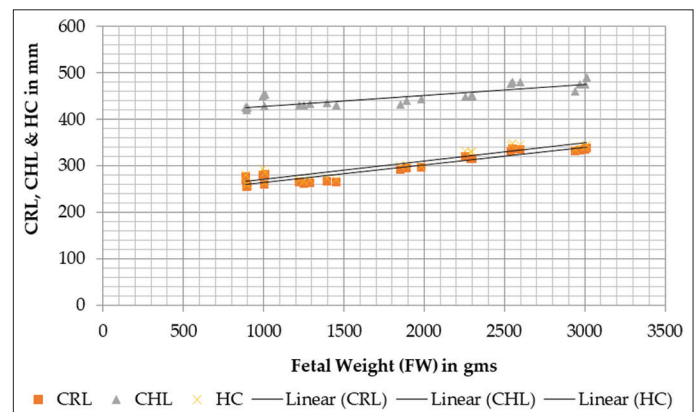


Figure 1: Comparison of fetal weight with crown-rump length, crown-heel length, and head circumference

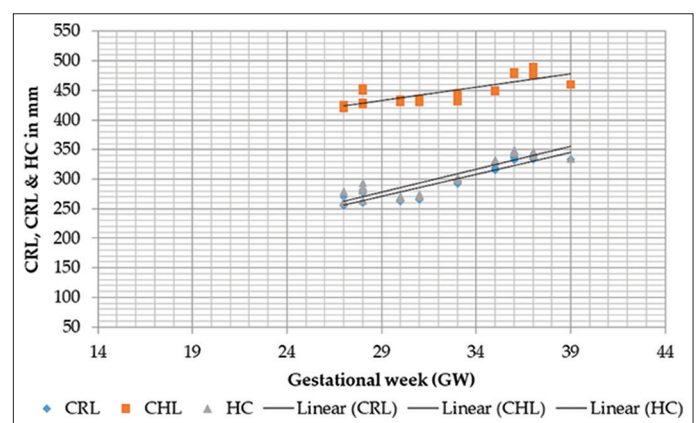


Figure 2: Comparison of gestational week with crown-rump length, crown-heel length, and head circumference

Many researchers have presented the fetal biometric data and FW for the age group of 27–40 weeks [Table 5].

The FW for the fetuses of the gestation age of 27–32 weeks and 33–40 weeks was found to be 1099.42 g and 2474.61 g, respectively, in the present study. The FW of the gestational age of 27–32 weeks in the Gujarati population was found to

Table 3: The fetal anthropometric measurements and their mean

| GW | NS | Mean FW | Mean CRL | Mean CHL | Mean HC |
|----|----|---------|----------|----------|---------|
| 27 | 3 | 894.7 | 260.7 | 423.3 | 267.3 |
| 28 | 4 | 975.3 | 274.8 | 440.0 | 281.0 |
| 30 | 3 | 1254.3 | 263.7 | 431.7 | 269.3 |
| 31 | 2 | 1422.5 | 266.0 | 432.5 | 272.0 |
| 33 | 3 | 1907.3 | 294.7 | 438.7 | 300.3 |
| 35 | 3 | 2281.7 | 317 | 449.3 | 331.0 |
| 36 | 3 | 2562.3 | 335 | 480.0 | 346.7 |
| 37 | 3 | 2992.7 | 336 | 480.3 | 342.7 |
| 39 | 1 | 2938 | 333 | 460 | 335 |

CRL: Crown-rump length; CHL: Crown-heel length; HC: Head circumference; FW: Fetal weight; GW: Gestational week

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 | 1099.42 | 267 | 432.5 | 273.17 |
| 2 | 2474.61 | 321.61 | 461.92 | 330.54 |

CRL: Crown-rump length; CHL: Crown-heel length; HC: Head circumference; FW: Fetal weight

Table 5: The comparative analysis of FW among various researchers

| Worker | Population | Age group (wk) | Mean FW (g) |
|---|---------------|----------------|-------------|
| Ajita ^[8] | Imphal India | 27–31 | 1606.81 |
| | | 33–36 | 2671.98 |
| De Paepe <i>et al.</i> ^[9] | Rhode Island | 28–31 | 1317 |
| | | 32–41 | 2582 |
| Cussen <i>et al.</i> ^[10] | Australia | 28–31 | 1323.7 |
| | | 32–37 | 2116 |
| Mukhia ^[11] | Nepal | 28–32 | 1312.5 |
| | | 34–38 | 2450.2 |
| Guihard-Costa <i>et al.</i> ^[12] | France | 27–32 | 1363.7 |
| | | 33–40 | 2612.3 |
| Maroun and Graem ^[13] | Denmark | 27–32 | 1310.83 |
| | | 33–40 | 2501.25 |
| Phillips <i>et al.</i> ^[5] | Australia | 27–32 | 1363.23 |
| | | 33–40 | 2572.26 |
| Present study | Gujarat India | 27–32 | 1099.42 |
| | | 33–40 | 2474.61 |

FW: Fetal weight

be lesser than the observation of all the previous workers in various population. The FW of this age group in the Gujarati population was 2/3rd of the results reported by Ajita^[8] in the population of East India (1606.82 g). However, weight of the fetuses of the Gujarati population toward the end of gestation was comparable with the findings of Phillips *et al.*,^[5] Maroun and Graem,^[13] and Mukhia^[11] in the Australian, the Dennis, and the Nepali population, respectively. Guihard-Costa *et al.*^[12] observed the FW in the same age groups who reported the FW in 33–40 weeks of age to be higher than the present study. It shows that the French fetuses weigh higher than the Gujarati fetuses during the whole late gestational period. Cussen *et al.*^[10] reported the FW in the second group to be lesser than the present study. This result was contradictory to the same from the study of Phillips *et al.*^[5] who also reported the FW in the Australian population. De Paepe *et al.*^[9] also found the weight of the fetuses of the Rhode Island to be higher than the same form the Gujarati population of the second group.

Ajita^[8] reported the FW in the second group to be higher than the present study. This shows the fetuses of the Eastern Indian population weight higher than the Gujarati fetuses during the whole of the later gestational period.

Cussen *et al.*^[10] reported the CRL and HC of the Australian fetuses to be closely comparable to the present study, whereas the CHL was lower as compared to the Gujarati fetuses of the 28–31 weeks of gestational age. Whereas during the lasts weeks of the gestational period, all the morphological parameters were lower than the present study in the Australian population [Table 6].

As compared to the French, the Gujarati fetuses were seen to be slightly shorter in CRL during the late gestations period. Whereas the head circumference was closely comparable in the fetuses of both the population. Similar trend was observed in the Dennis fetuses also. Phillips *et al.*^[5] also studied the similar parameters in the Australian fetuses who reported the CRL to be slightly higher than the same from the Gujarati fetuses. The HC reported by Phillips *et al.*^[5] was slightly lower than the present study. The CHL during 27–32 weeks of gestational age was lower than the Gujarati fetuses but during the last weeks of the gestational period, it was slightly higher comparatively.

Babuta *et al.*^[14] 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 late gestational period. This difference may be due to the method of the examination. Similarly, Singhal *et al.*^[15] conducted the ultrasonographic assessment of the HC of the fetuses from the Ghaziabad who also reported the same to be closely comparable with the present study.

This study also presents the comparative analysis of these parameters amongst different population. However,

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

| Worker | Population | Age group (wk) | CRL (cm) | CHL (cm) | HC (cm) |
|---|------------------|----------------|----------|----------|---------|
| Cussen <i>et al.</i> ^[10] | Australia | 28–31 | 26.55 | 38.8 | 27.4 |
| | | 32–37 | 30.83 | 44.57 | 31.33 |
| Guihard-Costa <i>et al.</i> ^[12] | France | 27–32 | 27.36 | 39.65 | 27.00 |
| | | 33–40 | 33.37 | 48.09 | 32.13 |
| Maroun and Graem ^[13] | Denmark | 27–32 | 27.2 | 39.35 | 26.77 |
| | | 33–40 | 33.84 | 48.2 | 32.16 |
| Phillips <i>et al.</i> ^[5] | Australia | 27–32 | 27.54 | 39.57 | 26.8 |
| | | 33–40 | 33.77 | 47.96 | 31.52 |
| Babuta <i>et al.</i> ^[14] | Rajasthan, India | 27–32 | | | 26.70 |
| | | 33–40 | | | 31.46 |
| Singhal <i>et al.</i> ^[15] | Ghaziabad, India | 27–32 | | | 26.91 |
| | | 33–38 | | | 33.19 |
| Present study | Gujarat India | 27–32 | 26.7 | 43.25 | 27.32 |
| | | 33–40 | 32.16 | 46.19 | 33.05 |

large-scale studies are recommended to establish a more robust reference values for the same.

CONCLUSION

The present study establishes the standard reference values of FW and various fetal biometric parameters such as CRL, CHL, and HC for the Gujarati population for last gestational period of the 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 among different population. However, large-scale studies are recommended to establish a more robust reference values for the same.

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