

## Ultrasound Assessment of Fetal Biometry in Iranian Normal Pregnancies

### Abstract

**Background:** The objective of this study was to provide biometric charts for Iranian fetuses. **Methods:** One thousand four hundred and twenty-two women enrolled. Four hundred and eighty-four were in the second trimester of pregnancy and 940 were in the third trimester. Data were presented as mean  $\pm$  standard deviation for continuous variables. Percentiles (5<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup>, and 90<sup>th</sup>) reported. **Results:** Mean femoral length ranged from 16 to 53 mm in our study in the second trimester and 55–79 mm in the third trimester. Mean biparietal diameter (BPD) for fetuses with in the second trimester was between 14 and 71 and for fetuses in the third trimester was between 74 and 98 mm. Mean abdominal circumference (AC) in our cases with gestational age between 14 and 41 ranged between 86 and 365 mm. **Conclusions:** We have provided normal reference ranges and percentiles for BPD, AC, femur length, and weight during the second and third trimester of pregnancy in an Iranian population.

**Keywords:** Fetus, Iran, pregnancy

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### Introduction

One of the most important parts of prenatal sonography is fetal biometry which has ethnical differences. Antennal ultrasound assessment of fetus in routine examination is essential for surveillance survey.<sup>[1]</sup> Reference charts and equations are the gold standards for fetus evaluation. For instance, applications of reference charts and equations for fetal size would impact fetal biometry interpretation.<sup>[2]</sup>

Application of customized fetal biometric charts provides better distinction between pathological growth abnormalities and physiological extremes.<sup>[1]</sup>

Local biometric charts meet the needs for recurrent re-revisions of normal charts by considering characteristics of local population. For instance, shorter femur length (FL) which is a soft marker of down syndrome.<sup>[3]</sup> Kovac *et al.* reported less than expected FL in Asian population.<sup>[4]</sup>

In another study, fetal FL in Hong Kong Chinese fetuses reported shorter than UK and French population.<sup>[5]</sup>

Definitely, in fetus screening for certain purposes such as down syndrome, ethnic differences in fetal FL should be considered.

Physicians mostly seek for patterns of typical growth and cutoffs that may show abnormal growth.<sup>[6]</sup> Head circumference below the 3<sup>rd</sup> centile is a marker of brain restriction growth and fetal weight under the 10<sup>th</sup> or 5<sup>th</sup> centile has been considered as fetal growth restriction.<sup>[6,7]</sup>

As there is no biometric chart for Iranian fetuses, we designed this study to provide biometric charts for Iranian fetuses. In this way, predicting cases with anomalies will be more reliable and applicable.

### Methods

This study conducted in women's hospital (affiliated hospital of Tehran University of Medical Sciences) between October 2015 and July 2016.

Inclusion criteria were both parents ethnically Iranian, no reported maternal medical disease, singleton pregnancy, regular menstrual cycles, no more than 4 days difference of gestational age between last menstrual period, and by measurement of crown–rump length or biparietal diameter (BPD).

Exclusion criteria were congenital abnormalities, gestational diabetes, hypertensive disorders in pregnancy, and previous preterm deliveries.

All sonographic examinations were done by an expert perinatologist by means of Siemens Accusan Antares, Germany.

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All cases asked to fill informed consent forms. The study had been approved by local Ethics Committee.

BPD was measured by considering the leading edge of the echo from the proximal fetal skull to the leading edge of the echo from the distal fetal skull.<sup>[1]</sup> FL measurement done on a plane showing the entire femoral diaphysis, with both ends clearly visible and an angle of  $<45^\circ$  to the horizontal.<sup>[2]</sup>

On a transverse section through the fetal abdomen as described by Campbell and Wilkin, abdominal circumference (AC) measured.<sup>[8]</sup>

BPD and HC were measured on an axial image of the fetal head on the level of paired thalami, third ventricle, and cavum septum pellucidum, by placing the caliper near to the transducer at the outer edge of bony calvarium while the capiler farther from the transducer was placed on the inner edge of bony calvarium.

Data regarding gestational age, neonatal age, neonatal weight, BPD, AC, FL recorded for all cases.

All data were analyzed using SPSS software version 22 (SPSS Inc., Chicago, IL, USA). Data were presented as mean  $\pm$  standard deviation (SD) for continuous variables. Percentiles 5<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup>, and 90<sup>th</sup> were reported.

## Results

One thousand four hundred and twenty-two women enrolled in this study. Four hundred and eighty-four were in the second trimester of pregnancy and 940 were in the third trimester [Tables 1-4].

Mean BPD for fetuses with gestational age between 14 and 40 weeks was between 27 and 98 mm.

Mean AC in our cases with gestational age between 14 and 41 ranged between 86 and 365 mm.

Mean femoral length ranged from 16 to 53 mm in our study in the second trimester and 55 to 79 mm in the third trimester.

Mean AC, FL and weight in each gestational week are shown in Figures 1-4.

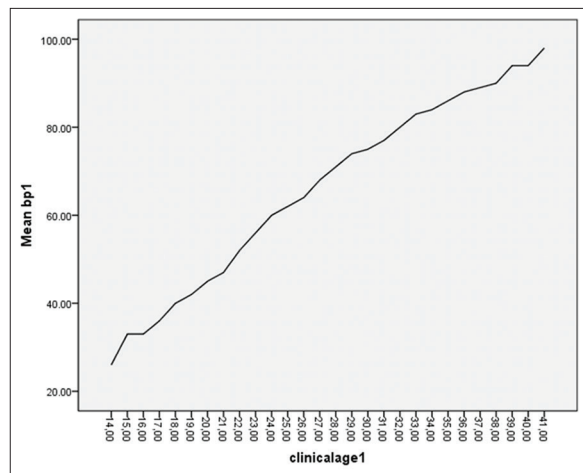


Figure 1: Mean biparietal diameter of each gestational week

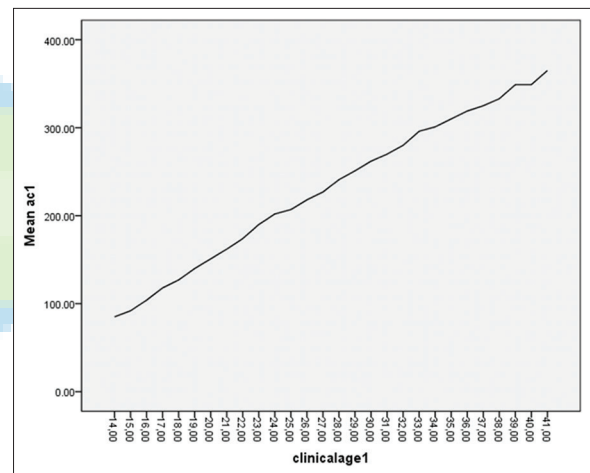


Figure 2: Mean abdominal circumference of each gestational week

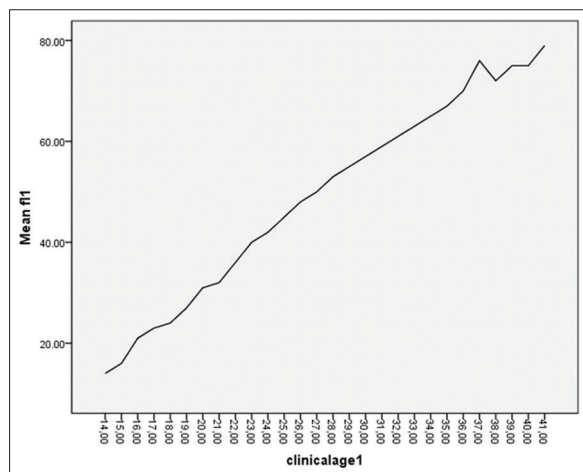


Figure 3: Mean femur length of each gestational age

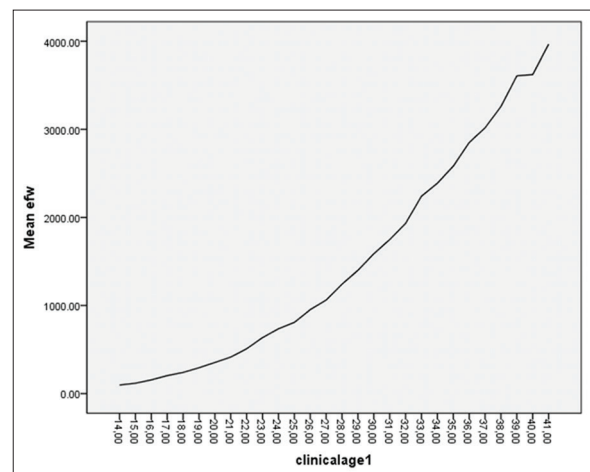


Figure 4: Mean weight of each gestational age

**Table 1: Values for biparietal diameter of different gestational ages**

| Gestational age | n   | Mean±SD   | 5 <sup>th</sup> percentile | 50 <sup>th</sup> percentile | 75 <sup>th</sup> percentile | 95 <sup>th</sup> percentile |
|-----------------|-----|-----------|----------------------------|-----------------------------|-----------------------------|-----------------------------|
| 14              | 9   | 27±2      | 23.9                       | 26.9                        | 28.7                        | -                           |
| 15              | 16  | 33.5±15.5 | 26.3                       | 29.6                        | 31.1                        | -                           |
| 16              | 44  | 33.7±2.4  | 28.5                       | 34.3                        | 35.6                        | 37.4                        |
| 17              | 52  | 36.9±3.7  | 30.6                       | 31.8                        | 40                          | 41.5                        |
| 18              | 99  | 40±9.1    | 30.8                       | 40.1                        | 41.1                        | 44.4                        |
| 19              | 77  | 42.5±3.2  | 40                         | 40.6                        | 44.7                        | 48.7                        |
| 20              | 51  | 45±4.5    | 40.5                       | 44.7                        | 49.2                        | 51.9                        |
| 21              | 35  | 47±7.6    | 20.9                       | 50                          | 50.6                        | 53.7                        |
| 22              | 46  | 52.7±3.3  | 49.6                       | 52.3                        | 55.4                        | 58.4                        |
| 23              | 30  | 56.7±3.3  | 50.7                       | 56.7                        | 60.2                        | 61.2                        |
| 24              | 23  | 60.8±6.3  | 50.2                       | 60.1                        | 62.5                        | 77.8                        |
| 25              | 31  | 62.9±2.6  | 57.5                       | 63.1                        | 64.9                        | 67.2                        |
| 26              | 24  | 64.8±3    | 57                         | 65.1                        | 66.7                        | 69.6                        |
| 27              | 42  | 68.4±4.1  | 60.6                       | 68.8                        | 71.1                        | 72.2                        |
| 28              | 28  | 71.3±3.5  | 63.6                       | 71.2                        | 73.9                        | 77.9                        |
| 29              | 34  | 74±2.5    | 69.4                       | 74.3                        | 76.4                        | 77.7                        |
| 30              | 42  | 75.9±3.8  | 70.6                       | 75.8                        | 78.5                        | 81.8                        |
| 31              | 50  | 77.7±4.5  | 70.4                       | 78.2                        | 80.8                        | 83.6                        |
| 32              | 78  | 80.3±3.9  | 72.4                       | 80.9                        | 83                          | 85                          |
| 33              | 67  | 83±3.5    | 77.4                       | 83.1                        | 85.8                        | 88.4                        |
| 34              | 86  | 84.3±6.2  | 80.1                       | 85.2                        | 87                          | 89.7                        |
| 35              | 91  | 86.3±4.7  | 77.7                       | 87                          | 88.7                        | 92                          |
| 36              | 119 | 88.3±3.8  | 80.9                       | 89                          | 90.4                        | 95.5                        |
| 37              | 106 | 89.5±5.2  | 81.5                       | 90.2                        | 92.5                        | 95.7                        |
| 38              | 59  | 90.7±4.2  | 81.5                       | 91.1                        | 92.3                        | 98.9                        |
| 39              | 45  | 94±2.9    | 89.2                       | 94.4                        | 96.1                        | 98.5                        |
| 40              | 31  | 94±2.9    | 89.3                       | 94.7                        | 96                          | 99                          |
| 41              | 7   | 98.2±2    | 94.9                       | 98                          | 100                         | -                           |

SD=Standard deviation

**Table 2: Values for abdominal circumference of different gestational ages**

| Gestational age | n  | Mean±SD    | 5 <sup>th</sup> percentile | 50 <sup>th</sup> percentile | 75 <sup>th</sup> percentile | 95 <sup>th</sup> percentile |
|-----------------|----|------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|
| 14              | 9  | 86.5±8.9   | 71.5                       | 88.7                        | 94.8                        | -                           |
| 15              | 16 | 92±7.6     | 81.7                       | 93.4                        | 97.8                        | -                           |
| 16              | 44 | 104.4±15.1 | 84.9                       | 107.8                       | 111.5                       | 117.6                       |
| 17              | 52 | 118.8±15.3 | 106.6                      | 120.2                       | 125.4                       | 133.9                       |
| 18              | 99 | 127.7±9.6  | 110.9                      | 128.2                       | 132.5                       | 142.9                       |
| 19              | 77 | 140.3±9.9  | 129.7                      | 140.4                       | 144.2                       | 157.5                       |
| 20              | 51 | 151.4±9.8  | 138                        | 150.6                       | 160.5                       | 168.8                       |
| 21              | 35 | 162.2±11.9 | 140.8                      | 160.5                       | 170.6                       | 190.2                       |
| 22              | 46 | 174.7±11.5 | 153.4                      | 172.2                       | 183.1                       | 195.6                       |
| 23              | 30 | 190.2±8.6  | 175                        | 190.7                       | 195.5                       | 208.1                       |
| 24              | 23 | 202.22.2   | 163.7                      | 198.8                       | 211                         | 263.2                       |
| 25              | 31 | 207.5±12.5 | 176.3                      | 208                         | 213.3                       | 226.5                       |
| 26              | 24 | 218.9±22.2 | 152.2                      | 218.9                       | 228.4                       | 267.7                       |
| 27              | 42 | 227.7±16   | 192.7                      | 232.2                       | 240.8                       | 247.6                       |
| 28              | 28 | 241.5±14   | 214.2                      | 241.6                       | 247.4                       | 271.3                       |
| 29              | 34 | 251.8±14.6 | 209.9                      | 254.3                       | 259.9                       | 273.6                       |
| 30              | 42 | 262.5±18.7 | 221.5                      | 262.6                       | 274.3                       | 294.2                       |
| 31              | 50 | 270.4±15.7 | 234                        | 270.7                       | 276.6                       | 298.4                       |
| 32              | 78 | 280.4±21.8 | 238.1                      | 284                         | 291.1                       | 312.9                       |
| 33              | 67 | 296.1±20.2 | 262.1                      | 295.5                       | 307.6                       | 328.3                       |

Contd...

Table 2: Contd...

| Gestational age | n   | Mean±SD    | 5 <sup>th</sup> percentile | 50 <sup>th</sup> percentile | 75 <sup>th</sup> percentile | 95 <sup>th</sup> percentile |
|-----------------|-----|------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|
| 34              | 86  | 301.1±24.9 | 270.7                      | 304.2                       | 311.4                       | 330.1                       |
| 35              | 91  | 310.2±20.9 | 261.1                      | 312                         | 321.2                       | 337.6                       |
| 36              | 119 | 319±18.7   | 291.3                      | 320.3                       | 328.5                       | 348.9                       |
| 37              | 106 | 325.6±23   | 293.7                      | 328.3                       | 339.9                       | 355.7                       |
| 38              | 59  | 333.4±21.4 | 300.6                      | 332.7                       | 345.7                       | 376.4                       |
| 39              | 45  | 349.2±18.5 | 319.2                      | 351.9                       | 359.1                       | 378.2                       |
| 40              | 31  | 349.2±23.5 | 289.1                      | 355.1                       | 369.4                       | 377.8                       |
| 41              | 7   | 365.4±4.5  | 361.5                      | 364.2                       | 374.1                       | -                           |

SD=Standard deviation

Table 3: Values for femur length of different gestational ages

| Gestational age | n   | Mean±SD   | 5 <sup>th</sup> percentile | 50 <sup>th</sup> percentile | 75 <sup>th</sup> percentile | 95 <sup>th</sup> percentile |
|-----------------|-----|-----------|----------------------------|-----------------------------|-----------------------------|-----------------------------|
| 14              | 9   | 14.9±1.8  | 11.3                       | 15.6                        | 16.2                        | -                           |
| 15              | 16  | 16.4±1.9  | 12.6                       | 16.7                        | 18.1                        | -                           |
| 16              | 44  | 21.8±12.4 | 13.4                       | 20.4                        | 21.6                        | 23.9                        |
| 17              | 52  | 23.1±2.5  | 20.2                       | 23.4                        | 24.8                        | 28                          |
| 18              | 99  | 24.2±3.7  | 20.4                       | 23.8                        | 27.1                        | 30                          |
| 19              | 77  | 27.4±4.3  | 20.7                       | 29.4                        | 30.1                        | 33.5                        |
| 20              | 51  | 31±2.5    | 28.4                       | 30.3                        | 32.4                        | 36                          |
| 21              | 35  | 32.1±6.5  | 17.4                       | 32.5                        | 35.5                        | 40.7                        |
| 22              | 46  | 36.9±4    | 30.4                       | 38.4                        | 39.7                        | 42.1                        |
| 23              | 30  | 40.8±2.6  | 35                         | 40.3                        | 42.5                        | 44.8                        |
| 24              | 23  | 42.6±4.7  | 31.7                       | 42.2                        | 43.9                        | 54.1                        |
| 25              | 31  | 45.1±2.9  | 40.2                       | 45.5                        | 47.8                        | 49.7                        |
| 26              | 24  | 48±4.9    | 31.2                       | 49.8                        | 50.5                        | 51.9                        |
| 27              | 42  | 50.7±5.4  | 41.2                       | 50.5                        | 53                          | 55.9                        |
| 28              | 28  | 53.1±3.4  | 44                         | 53.9                        | 55.3                        | 57.7                        |
| 29              | 34  | 55.2±2.6  | 50.1                       | 55                          | 57.9                        | 59                          |
| 30              | 42  | 57.2±4.5  | 46.8                       | 57.8                        | 60.3                        | 62.7                        |
| 31              | 50  | 59.1±3.6  | 50.3                       | 60.2                        | 61.3                        | 63.3                        |
| 32              | 78  | 61.7±4.2  | 54.2                       | 62.3                        | 64.1                        | 67.2                        |
| 33              | 67  | 63.7±3.1  | 57.3                       | 64.3                        | 65.7                        | 68                          |
| 34              | 86  | 65.8±5.3  | 60.3                       | 66.3                        | 68.7                        | 69.9                        |
| 35              | 91  | 67.4±4    | 60.6                       | 68                          | 70.1                        | 72.8                        |
| 36              | 119 | 70.1±2.9  | 65                         | 70.3                        | 71.7                        | 75                          |
| 37              | 106 | 76.5±59.2 | 64.8                       | 71                          | 73.2                        | 75.5                        |
| 38              | 59  | 72.3±3.4  | 66.3                       | 72.7                        | 74.9                        | 77.7                        |
| 39              | 45  | 75.2±2    | 71.3                       | 75.7                        | 76.8                        | 77.8                        |
| 40              | 31  | 75.2±3    | 72.1                       | 75.3                        | 77.1                        | 80.5                        |
| 41              | 7   | 79.1±1.7  | 77                         | 78.5                        | 80.9                        | -                           |

SD=Standard deviation

## Discussion

This study provides national ranges for biometric parameters in Iranian singleton fetuses. The goal of determining these values is to avoid misdiagnosis of fetus abnormalities due to application of other population values. This could help prevent improper miscarriages and unnecessary interventions such as amniocentesis.

For instance, shorter femur and humerus are indicative of down syndrome which are evident in Iranian fetuses.<sup>[9]</sup> Tahmasebpour *et al.* evaluated femoral and humeral lengths in

Iranian fetuses with gestational age between 15 and 28 weeks. The median femoral length ranged from 18 to 52 mm (15–28 weeks).<sup>[9]</sup> Mean femoral length ranged from 16 to 53 mm in our study in the second trimester and 55–79 mm in the third trimester. Our results were consistent with their results.

Beige and Zarrinkoub measured FL and BPD of 15,693 of normal fetuses and reported mean BPD range from 28 to 93 mm for fetuses with gestational age between 14 and 40. In our study, mean BPD for fetuses with gestational age between 14 and 40 weeks was between 27 and 98 mm which were less than Western population.<sup>[3]</sup>

Table 4: Values for weight (g) of different gestational ages

| Gestational age | n   | Mean±SD      | 5 <sup>th</sup> percentile | 50 <sup>th</sup> percentile | 75 <sup>th</sup> percentile | 95 <sup>th</sup> percentile |
|-----------------|-----|--------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|
| 14              | 9   | 98.6±12.7    | 78                         | 101                         | 109.7                       | -                           |
| 15              | 16  | 118.7±15     | 95                         | 121                         | 129                         | -                           |
| 16              | 44  | 156.2±18.7   | 114.2                      | 158.5                       | 168.7                       | 187.2                       |
| 17              | 52  | 204.6±26.4   | 157                        | 205                         | 216                         | 247                         |
| 18              | 99  | 240.4±32.5   | 192                        | 233                         | 257                         | 296                         |
| 19              | 77  | 294±38.5     | 234                        | 287                         | 317                         | 371                         |
| 20              | 51  | 353.6±41.5   | 293.6                      | 353                         | 377                         | 433.2                       |
| 21              | 35  | 415.9±61.4   | 328.6                      | 407                         | 459                         | 580                         |
| 22              | 46  | 509±73       | 405.3                      | 497                         | 556                         | 633.6                       |
| 23              | 30  | 636.6±68.3   | 519                        | 637                         | 688.5                       | 745.4                       |
| 24              | 23  | 736±261.6    | 288.2                      | 712                         | 777                         | 1497.4                      |
| 25              | 31  | 808.2±103.3  | 591.7                      | 804.5                       | 864.7                       | 990.8                       |
| 26              | 24  | 953.1±178.6  | 407                        | 961                         | 1057.7                      | 1221.5                      |
| 27              | 42  | 1069.2±191.2 | 688.9                      | 1097                        | 1209                        | 1298.7                      |
| 28              | 28  | 1242.2±162.1 | 959                        | 1254                        | 1310                        | 1575.8                      |
| 29              | 34  | 1400±168     | 1002                       | 1410.5                      | 1514.7                      | 1664                        |
| 30              | 42  | 1587.5±290   | 9131                       | 1610                        | 1750                        | 2001                        |
| 31              | 50  | 1749.9±227.7 | 1254                       | 1767.5                      | 1864.7                      | 2146.9                      |
| 32              | 78  | 1932.2±343.4 | 1268.7                     | 1966                        | 2108                        | 2503                        |
| 33              | 67  | 2241.1±349.4 | 1705                       | 2229                        | 2431                        | 2868.8                      |
| 34              | 86  | 2388.8±476.2 | 1959.4                     | 2416.5                      | 2604.5                      | 2995                        |
| 35              | 91  | 2582±417.7   | 1733.5                     | 2606                        | 2820                        | 3260.5                      |
| 36              | 119 | 2850.7±382.1 | 2328.4                     | 2850                        | 3053.5                      | 3487                        |
| 37              | 106 | 3017.7±442.3 | 2332.7                     | 3041                        | 3300.5                      | 3663                        |
| 38              | 59  | 3259±447.2   | 2505                       | 3249                        | 3492                        | 4212                        |
| 39              | 45  | 3607.7±379.2 | 2909                       | 3691                        | 3856                        | 4169.6                      |
| 40              | 31  | 3622.5±511.5 | 2480                       | 3672                        | 4007                        | 4442                        |
| 41              | 7   | 3967.1±306   | 3308                       | 4026                        | 4191                        | -                           |

SD=Standard deviation

Kalantari *et al.* evaluated BPD, AC, and FL in 114 singleton pregnancies with gestational age between 36 and 42 weeks. They reported mean values of 92, 336, and 73 mm for BPD, AC, and FL.<sup>[10]</sup>

Mean AC in our cases with gestational age between 36 and 41 ranged between 319 and 361 mm.

Previous studies from Asian population showed that Asian fetuses have a smaller FL in comparison with white fetuses.<sup>[3,11-13]</sup>

In the current study along with mean and SD values, we reported percentiles of different biometries.

Due to results of different study, it seems that length and diameter of biometries should be calculated for each ethnic group to reduce misdiagnosis.

Each population should use its own reference ranges because of the interpopulation differences.<sup>[3]</sup>

Ethnicity, maternal height, maternal weight, parity, and smoking have been considered to affect fetus biometries.<sup>[14]</sup>

This study provides normal ranges for biometries in an Iranian population which could be used as reference values for Iranian fetal measurements.

This study had some limitations. First, it was not multicentric. Second, hc (head circumference) was not included. Multicentric studies are recommended.

## Conclusions

We have provided normal reference ranges and percentiles for BPD, AC, FL, and weight during the second and third trimester of pregnancy in an Iranian population.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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