# A comparative study on Third trimester Fetal biometric parameters with Maternal age

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**Background:** Advanced maternal age is an important parameter associated with increased risk of feto-maternal complications and it is an evolving trend in the society for the women to plan for pregnancy in late ages. However there are no studies done whether advanced maternal age has its effects on expression of growth pattern in the fetus. So this study was done to compare the maternal age with the third trimester fetal biometric parameters. **Methods:** This study was done in 100 antenatal women and divided into two groups Group 1: optimal maternal age group between 21- 19 years of age and Group 2: Advanced maternal age 30 and above. The pre-pregnant maternal weight, gestational age and third trimester fetal biometrics using ultrasound are noted and compared between the groups. **Results**: The maternal weight gain between the groups was optimal but the third trimester fetal parameters were significantly less in advanced maternal age. The abdominal circumference in optimal age group and head circumference in advanced mater age group was closer to calculated EDD and would be specific in calculating the gestational age. **Conclusions**: Though there is no significant difference in maternal weight gain, there are fetal growth restrictions in advanced maternal age group due to which the third trimester fetal parameters are lesser than the optimal age group. Head circumference would be specific in calculating the estimated date of delivery in advanced maternal age group.

2

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**maternal age**

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## Abstract

**Background:** Advanced maternal age is an important parameter associated with increased risk

of feto-maternal complications and it is an evolving trend in the society for the women to plan

for pregnancy in late ages. However there are no studies done whether advanced

41    maternal age

42    has its effects on expression of growth pattern in the fetus. So this study was done to
43    compare the

44    maternal age with the third trimester fetal biometric parameters.

45    **Methods:** This study was done in 100 antenatal women and divided into two groups
46    Group 1:

47    optimal maternal age group between 21- 30 years of age and Group 2: advanced maternal
48    age

49    above 30 years. The pre-pregnant maternal weight, gestational age and third trimester fetal

50    biometrics using ultrasound are noted and compared between the groups.

51    **Results**: The maternal weight gain between the groups was optimal but the third trimester
52    fetal

53    parameters were significantly less in advanced maternal age. The abdominal
54    circumference in

55
56
57       optimal age group and head circumference in advanced maternal age group were closer
58   to
59       calculated EDD and would be specific in calculating the gestational age.
60       **Conclusions**: This study concludes there is some significant fetal growth difference in

61       optimal and advanced maternal age group. There are some fetal growth restrictions in
62   advanced

63        maternal age group fetal parameters but not significant. These findings can open an
64   insight in

65       age related fetal growth and its related complications in future.

66       **Keyword**: Biometry, fetal development, gestational age,  prenatal ultrasonography and
67   third trimester

68

## Introduction

70       A full term pregnancy lasts upto around 40 weeks from the first day of mother's last
71   menstrual

72       period (LMP) to the birth of the baby. It is divided into three stages, called
73   trimesters:  first

74       trimester, second trimester, and third trimester. Conception to about the 12th week of
75   pregnancy

76       marks the first trimester. The second trimester is 13 to 27 weeks, and the third
77       trimester starts

78       about 28 weeks and lasts until birth. In obstetric practice, Antenatal ultrasonography
79   plays a very

80       important role in assessing the fetal growth by determining the gestational age using
81       biparietal

82       diameter (BPD), head circumference (HC), abdominal circumference (AC) and
83       femur length

84        (FL). Hadlock values were commonly being used as reference charts in the ultrasound
85        machine

86       and most widely accepted for biometry measurements to calculate estimated fetal weight
87       (*Lalitha*

88       *et. al., 2016)*.

89  Fetal growth is influenced by many factors such as race, socioeconomic status,
90  genetics,

91  geographical location, maternal diseases, and number of babies (*Adiri et al., 2015*). The
92  maternal

93  pre-pregnancy weight is important for fetal growth indicating body mass index (BMI)
94  and parity

95  determines fetal weight and growth (*Kirchengast., 2009*). Studies have been done
96  and

97  showed an association between pre-pregnancy maternal weight and fetal growth
98  with

99  mothers of less pregnancy weight gain linked to smaller second and third trimester
100  placental

101  weight and fetal size especially between 28 to 32 weeks. It is understood that
102  development of

103  fetal body structures such as head, femur and abdomen correlates with the general fetal
104  size and

105  weight (*Erezih et al., 2017)*. Maternal age is very important parameter because
106  childbirth at a

107  young age (adolescent) and advanced age is associated with increased risk of adverse
108  maternal

109  perinatal outcomes, such as postpartum hemorrhage, eclampsia, and cephalopelvic
110  disproportion,

111  as well as adverse infant outcomes including preterm birth, poor fetal growth, low birth
112  weight,

113

114

115  and neonatal mortality (*Khalil et al., 2013*). Thus the advanced maternal age antenatal
116  women

117  needed complete m a t e r n a l a n d  fetal surveillance for any birth related or fetal

118  complications.  Most  complications  remain  independent  of  important  known
119  confounders

120  such as poverty, inadequate prenatal care and/or weight gain during pregnancy

121  (*Cavazos-Rehg et al., 2015*). All these  previous  findings  show  an  importance  of
122  maternal age

123  in general fetal growth p a t t e r n  and its related complications. However there are lots
124  of studies

125  done to correlate complications related to advanced maternal age but there are no

126  studies  to  compare  the  s i g n i f i c a n t  f e t a l  g r o w t h  differences in a d v a n c e d
127  antenatal

128  women without any complications. If there are significant differences in babies born to

129  advanced maternal age that may have an  impact  on  growth  and  its  well  being  in  the
130  society.

131  So  this  study  was  done  to  compare the  third  trimester  fetal  biometric  parameters,
132  gestational age

133  and weight gain between the maternal ages.

134

135  **Materials & Methods**

136  This cross sectional study was  conducted  in  the  100  third  trimester  antenatal
137  women  32-34

138  weeks gestational age attending the Obstetrics O.P.D in All India Institute of Medical
139  Sciences,

140  Mangalagiri,  Andhra  Pradesh,  India  during  the  period  of  February  2021  to
141  August  2021

142  (AIIMS/MG//IEC/2020-21/71). The samples were divided into two groups; Group 1
143  Optimal age

144  group (n=77) maternal age between 20 to 30years and group 2 advanced age (n=23)
145  with

146  Maternal age 30years and above attending AIIMS, Mangalagiri O.P.D during their
147  routine

148  follow up. The antenatal women with natural conception of pregnancy who had
149  previous

150  regular menstrual cycles and well known last menstrual period (LMP) willing to
151  participate

152  in this study were included. The antenatal women not willing to participate and with
153  any

154  medical and surgical conditions associated with pregnancy like diabetes, hypertension
155  etc.,

156  consumption of alcohol, chewing of tobacco, smoking, assisted reproductive techniques
157  were

158  excluded from the study. The details of the study were explained and written consent
159  was

160  Obtained. Gestational age, pre-pregnant maternal weight and trans-abdominal

161  ultrasound measurements of head circumference, abdominal circumference, femur
162  length,

163  biparietal diameter and estimated fetal weight were noted and tabulated. If the pre-
164  pregnant

165  weight is not known then first trimester weight is noted as pre-pregnant weight and
166  weight gain

167  is calculated accordingly. The maternal age and fetal parameters were summarized as
168  mean and

169  standard deviation.The student t test was utilized for mean
170  comparisons

171  and categorical variables like maternal education and occupation status were

172
173

174 summarized as frequency and proportion. The comparison between maternal age
175 and fetal

176 parameters were analyzed using Pearson or spearman's correlation based on normality. P
177 value less

178 than 0.05 is taken as significant.

179

## Results

181 The mean (SD) age of the antenatal women were 23 (3.1) years and 32.8 (1.8)
182 years in

183 optimal and advanced maternal age group respectively. Most of the study
184 participants were

185 primigravida in both groups 48% and 43%, followed by second gravida (31.2%) in
186 optimal

187 maternal age group and third gravid (34.8%) in advanced maternal age group. This
188 difference

189 does not have statistical significance (Table 1).

190 **Maternal weight gain**:

191 The mean (SD) first trimester weight of study participants was 62.6 (6.6) Kg in optimal
192 maternal

193 age group and 58.6 (11.2) Kg in advanced maternal age group. The mean (SD) weight
194 gain in

195 both groups were 8.5 (3.5) Kg and 8.7 (3.5) Kg respectively. The weight gain
196 was not

197 statistically different between the study groups. The mean (SD) gestational age as per
198 LMP of

199 optimal maternal age was 32.6 (1.7) which was statistically (p value=0.015) lower than
200 the mean

201 (SD) gestational age of advanced maternal age 33.6 (1.6) (Table 1) (Figure 1 & 2).

202 **Third trimester fetal parameters and gestational age estimation**:

203 The mean (SD) of head circumference, abdomen circumference, femoral length,
204 biparietal

205 diameter and estimated fetal weight were significantly lesser in advanced maternal
206 age group

207 (Table 2). The mean (SD) gestational age as per LMP was 228.2(12.2) days, as
208 per head

209        circumference 239.5(12.2) days, as per abdomen circumference 231.8(13.1) days, as per
210   femoral

211        length 233.7(12.1) days and as per biparietal diameter was 233.1(11.8) days in optimal
212   maternal

213        age. Among the advanced maternal age the mean (SD) gestational age as per
214   LMP was

215        235.3(11.6) days, as per head circumference 231.7(12.7) days, as per abdomen
216   circumference

217        223.7(13.2) days, as per femoral length 226.4(13.1) days and as per biparietal
218   diameter

219        225.7(9.9) days (Table 3). The gestational age as per LMP was statistically higher
220   (p-value=

221        0.016) in advanced maternal age group compared to optimal maternal age group.
222   Whereas the

223        gestational age as per fetal third trimester parameters were statistically lower in
224   advanced

225        maternal age years group.

226        The median (IQR) difference in gestational age estimation using LMP and as
227   per head

228        circumference, abdomen circumference, femoral length, biparietal diameter was -
229   12.5(-22.5 to

230
231

232     1.0) days, -3(-16.5 to 10.5) days, -5(-19 to 8) days and -7(-17 to 6) days respectively in
233     maternal

234     age <30 years group. The median (IQR) difference in gestational age estimation using
235     LMP and

236     as per head circumference, abdomen circumference, femoral length, biparietal diameter
237     was 5(-

238     15 to 17) days, -314 (-1 to 25) days, 10(-3 to 23) days and 12(-3 to 20) days
239     respectively in

240     maternal age g30 years group (Table 4). The difference in age estimation using LMP
241     and fetal

242     parameter were significantly different between both groups.

243

## Discussion

245     Female fertility in the entire reproductive life span differs with ages, during adolescent
246     ages there

247     will be anovulatory cycles followed by peak ovulatory cycles between 20 to 30 years
248     and finally

249     declining slowly after thirties (*Balasch., 2010*). The probability of successful pregnancy
250     is

251     low at the beginning and slowly decreases after the increasing age after a period of
252     optimal

253     fertility. There are various studies showing advanced maternal age associated with
254     range of

255     adverse outcomes in pregnancy like low birth weight (*Jolly et al., 2000*), pre-term birth,
256     still birth

257     (*Flenady et al., 2011*), small for gestational age (*Virginia et al., 2001*),
258     macrosomic babies

259     (*Kenny LC et al., 2013*), increased rates of caesarean section (*Janssens et al., 2008*),
260     hypertensive

261     syndromes and gestational diabetes (*Hsieh et al., 2010*).   Evidences from these
262     previous studies

263     shows the optimal age for child bearing in between 21-29 years of age with high
264     consumption

265     rate and lowest adverse events. There is a trend in recent working women to
266     postpone the

267  pregnancy to mid thirties despite of these facts and evidences had laid importance in
268  finding

269  significant fetal growth pattern in normal pregnancies. This is the first study to
270  analyze the

271  impact of maternal age with the fetal growth patterns using third trimester fetal
272  measurement.

273  Also the fetal growth is associated with maternal somatic parameters like pre-pregnant
274  weight

275  and gestational weight gain have been recorded in this study.

276  **Fetal biometry and Gestational age:**

277  The mean gestational age for optimal maternal age group and advanced age group was
278  32 weeks

279  and 33 weeks respectively **(Table 1).** There were significant differences in the third
280  trimester

281  fetal biometric measurements between the two maternal age groups **(Table 2).**
282  The fetal

283  parameters like  head circumference, abdominal circumference, femur length, biparietal
284  diameter

285  and fetal weight was significantly more in optimal maternal age group and
286  significantly less in

287  advanced age group**.** These findings are in accordance with (*Metcalfe et al. 2013*)
288  where the

289
290

291  mean crown rump length in first trimester was significantly less in advanced maternal
292  age and

293  (*Blomberg et al. 2014*) where mean birth weight was significantly decreased in
294  advanced

295  maternal age group. The appropriate biological explanation for this less fetal
296  biometry in

297  advanced maternal age may be due to accelerated placental aging and increased
298  oxidative stress

299  (*Lean et al., 2014*) leading to changes in placental vasculature and myometrial spiral
300  arteries

301  leading to decreased blood flow to placenta, uteroplacental under perfusion and placental
302  infarcts

303  making difficult for the older women to adapt the increased demands of
304  pregnancy. Also

305  increasing maternal age is associated with increased placental weight which may be
306  due to

307  compensatory mechanism for placental dysfunction to balance the reduced
308  uteroplacental blood

309  flow to prevent fetal hypoxia (*Care et al., 2017, Torres et al., 2015*). Head
310  circumference of the

311  fetus is very important fetal biometry which indirectly correlates with the brain
312  development.

313  This association of advanced maternal age with significantly less head circumference
314  suggests

315  significant less brain growth and further the child neurodevelopment profile has to be
316  studied.

317  The exact mechanism of different fetal growth pattern in optimal and advanced
318  maternal age

319  group has to study further and analyzed. It has been speculated that lower fetal growth
320  pattern in

321  advanced maternal age may be due to less effective nutrient partitioning or transfer of
322  nutrients

323  to the fetus (*Fall et al., 2015*).

324  **Maternal weight gain:**

325  In this study there was weight gain upto 8 Kg in both the groups indicating optimal

326 weight gain

327 during the entire pregnancy and there were no significant differences in both the groups

328 (**Table**

329 **1**) (**Figure 1 & 2**). The mean first trimester weight was around 62kg in optimal age

330 group and 58

331 kg in advanced age group and all the antenatal women were of normal Indian women

332 weight.

333 The optimal weight gain during the entire pregnancy is between 7 to 15 kg if it is more

334 than 15

335 kg it is excess weight gain leading to macrosomia and preterm birth and if it is less

336 than 7 kg

337 leads to low birth weight and preterm delivery (*Luke et al., 2007*). Even though there

338 was no

339 significant difference in the maternal weight gain between the groups the fetal

340 biometry and

341 growth was significantly less in advanced maternal age group extending further to

342 leans about

343 various factors that might lead to uteroplacental insufficiency resulting in this findings.

344 Maternal

345 age is the important risk factor for the pregnancy weight gain which may lead to

346 overweight and

347 this may trigger gestational diabetes mellitus, macrosomia leading to preterm birth

348 and other

349 adverse pregnancy outcomes (*Yang et al., 2015*).

350
351

352     **Estimated gestational age:**

353     According to calculated estimated date of delivery (EDD) from last menstrual period
354     (LMP) and

355     the estimated gestational age from various third trimester fetal biometric
356     parameters were

357     compared for any significant differences (**Table 3 & 4**). In this study there were
358     significant

359     differences with all third trimester fetal parameters in calculating the gestational age
360     between the

361     groups. The abdominal circumference was very much significant and approximate
362     to  LMP

363     calculated EDD in the optimal maternal age and head circumference was very much
364     near  to

365     calculated EDD in advanced maternal age group. So the abdominal circumference in
366     optimal age

367     group and head circumference in advanced mater age group would be specific in
368     calculating the

369     gestational age and to plan for parturition in cases where the LMP is not known.
370     Karki et al.,

371     2006 conducted study in antenatal women starting from first trimester till the birth and
372     found

373     during first trimester crown rump length (CRL) is the best fetal parameter
374     correlating

375     with the gestational age and in second trimester abdominal circumference best
376     correlating

377     with the gestational age. During third trimester it is the head circumference that
378     correlates best

379     with the gestational age (*Karki et al., 2006*). However that study was not specific
380     to

381     maternal age correlating the fetal gestational age. Considering all these facts advanced
382     maternal

383     age can have complications starting from fertility, first trimester, third trimester,
384     labor,

385     perinatal mortality, postpartal mortality and chromosomal and genetic disorders of the
386     fetus and

387     appropriate care and diagnostic test must be done at regular period of time to prevent all
388 these

389     complications (*Ales et al., 1990*)

390

391     **Conclusion:**

392     This study had compared the third trimester fetal biometric parameters and weight
393 gain  of

394     antenatal women between the maternal age group. This study concludes that
395 there  were

396     significant restrictions in fetal growth parameters of advanced maternal age group.
397 This could

398     result a great impact in the further growth and development of child in the society.
399 Also there

400     were no significant differences in weight gain between the antenatal women of
401 different  age

402     groups. Furthermore the abdominal circumference in the  optimal  maternal  age
403 and  head

404     circumference in the advanced maternal age were  more  near  to  gestational  age
405 and  to  the

406     expected date of delivery. Thus not only maternal weight determines the fetal growth,
407 maternal

408     age is important in healthy fetal growth.

409

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503

504

505

# Figure 1

Figure 1: Maternal weight in first and trimester of study participants in maternal age <30 years group

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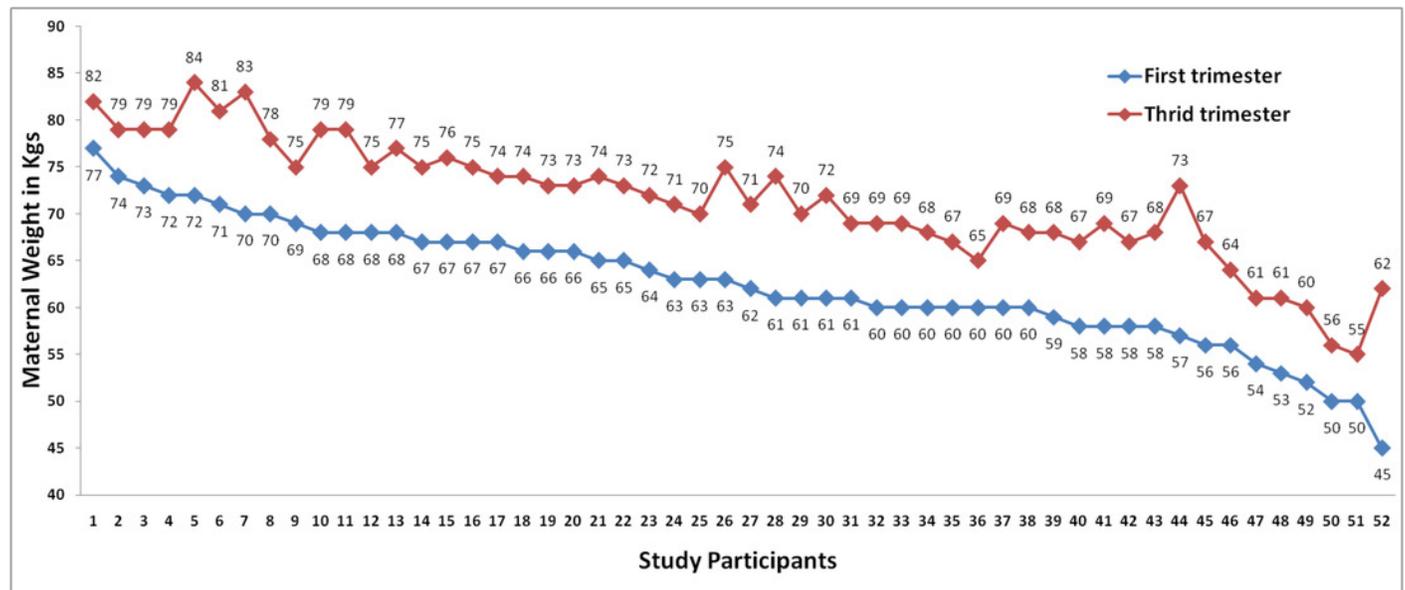
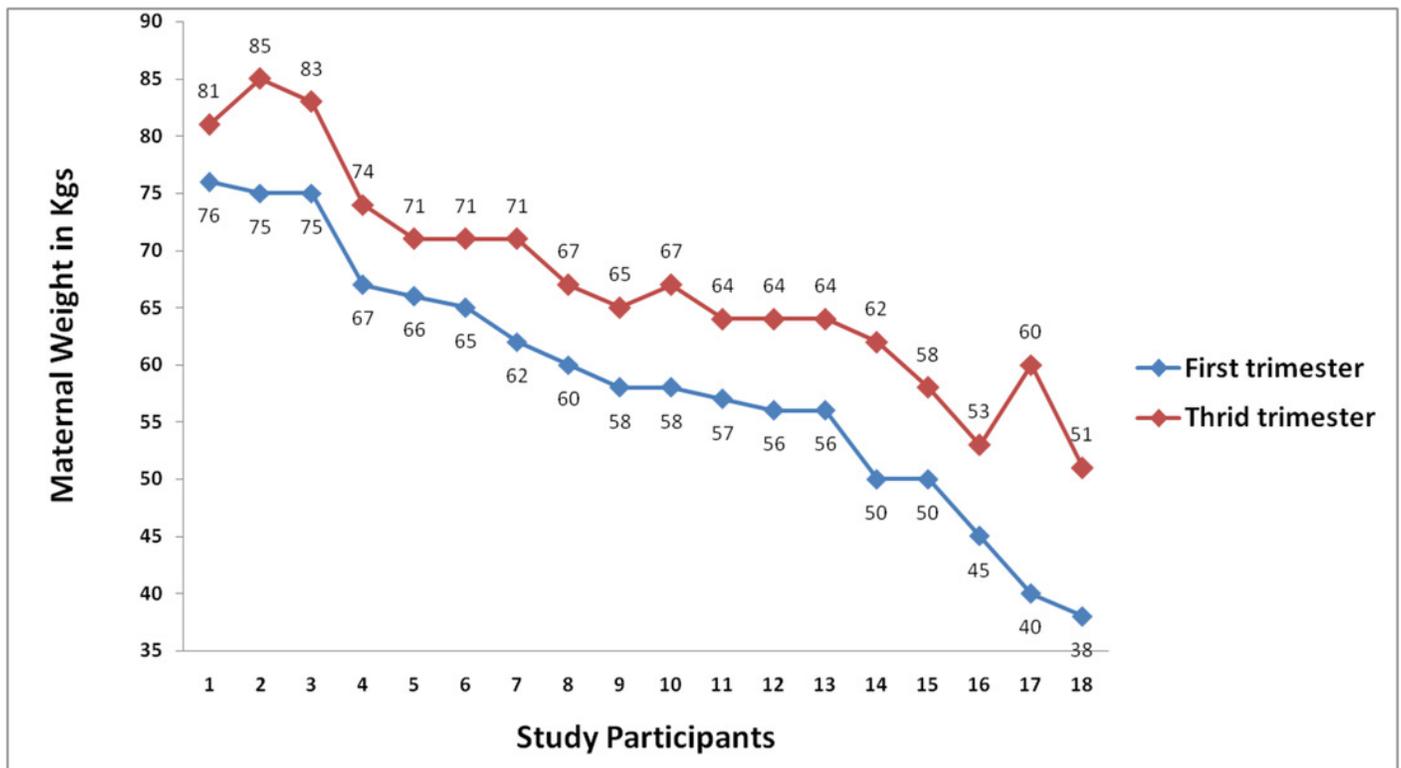

# Figure 2

Figure 2: Maternal weight in first and trimester of study participants in maternal age ≥30 years group

-

Maternal age, Parity, weight gain and Gestational age between the two groups.

**Distribution of basic details of study participants**

1             **Distribution of basic details of study participants**

| Item | | Maternal Age <30 years Group N=77 | Maternal Age ≥30 years Group N=23 | p-value |
|---|---|---|---|---|
| Maternal Age in years | Mean(SD) | 23.2(3.1) | 31.8(1.8) | **<0.001***  |
| Birth Order N(%) | 1 | 37(48.1) | 10(43.5) | 0.355 |
| | 2 | 24(31.2) | 5(21.7) | |
| | ≥3 | 16(20.8) | 8(34.8) | |
| First Trimester weight | Mean(SD) in Kg | 62.6(6.6) | 58.6(11.2) | 0.074 |
| Weight Gain | Mean(SD) in Kg | 8.5(3.5) | 8.7(3.5) | 0.789 |
| Gestational age As Per LMP | Mean(SD) in weeks | 32.6(1.7) | 33.6(1.6) | **0.015***  |

4    **Table 1: Maternal age, Parity, weight gain and Gestational age between the two groups.**

Comparison of third trimester fetal biometric parameters between the two maternal age groups.

Fetal Parameter of study participants

N

1  **Fetal Parameter of study participants**

| Fetal Parameters | Maternal Age <30 years Group N=77 | Maternal Age ≥30 years Group N=23 | p-value |
|---|---|---|---|
| Head Circumference Mean(SD) Millimeter | 306.6(12.5) | 298.2(13.6) | 0.007* |
| Abdomen Circumference Mean(SD) Millimeter | 290.4(19.8) | 278(19.7) | 0.017* |
| Femoral Length Mean(SD) Millimeter | 64.6(3.7) | 62.4(4.1) | 0.019* |
| Biparietal Diameter Mean(SD) Millimeter | 82.9(3.9) | 80.4(3.4) | 0.006* |
| Estimated Fetal Weight Mean(SD) Gram | 2191.2(385.8) | 1944(382.2) | 0.010* |

4  **Table 2: Comparison of third trimester fetal biometric parameters between the two**
5  **maternal age groups.**
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Gestational age estimation using fetal biometric parameters and comparison between maternal age group.

**Gestational age estimation using various parameters of Study participants**

1         **Gestational age estimation using various parameters of Study participants**

| Gestational age | Maternal Age <30 years Group N=77 | Maternal Age ≥30 years Group N=23 | p-value |
|---|---|---|---|
| As Per LMP Mean(SD) Days | 228.2(12.2) | 235.3(11.6) | **0.016*** |
| As per Head Circumference Mean(SD) Days | 239.5(12.2) | 231.7(12.7) | **0.008*** |
| As per Abdomen Circumference Mean(SD) Days | 231.8(13.1) | 223.7(13.2) | **0.009*** |
| As Per Femoral Length Mean(SD) Days | 233.7(12.1) | 226.4(13.1) | **0.010*** |
| As Per Biparietal Diameter Mean(SD) Days | 233.1(11.8) | 225.7(9.9) | **0.015*** |

4    **Table 3: Gestational age estimation using fetal biometric parameters and comparison**
5    **between maternal age group**.

Differences between gestational age of EDD and fetal biometry and compared between the maternal ages

Difference in Gestational age estimation of Study participants

1                     **Difference in Gestational age estimation of Study participants**

| Difference in Gestational age | Maternal Age <30 years Group N=77 | Maternal Age ≥30 years Group N=23 | p-value |
|---|---|---|---|
| Head Circumference Median(IQR) Days | -12.5(-22.5 to 1.0) | 5(-15 to 17) | **<0.001*** |
| Abdomen Circumference Median(IQR) Days | -3(-16.5 to 10.5) | 14(-1 to 25) | **<0.001*** |
| Femoral Length Median(IQR) Days | -5(-19 to 8) | 10(-3 to 23) | **<0.001*** |
| Biparietal Diameter Median(IQR) Days | -7(-17 to 6) | 12(-3 to 20) | **<0.001*** |

4   **Table 4: Differences between gestational age of EDD and fetal biometry and compared**
5   **between the maternal ages**
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