

DOI: <http://dx.doi.org/10.18203/2320-1770.ijrcog20194867>

Original Research Article

## The pattern of variations in the first trimester fetal heart rate in Indian population: a pilot study

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**Received:** 18 June 2019

**Revised:** 03 October 2019

**Accepted:** 09 October 2019

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### ABSTRACT

**Background:** Fetal heart rate is an indicator of fetal viability. During third trimester and labour the normal range of fetal heart rate is between 110-160 bpm as recommended by the international guidelines. Unlike this, the first trimester embryonic heart rate does not lie in the same range. During the first trimester the normal embryonic heart rate varies between each week of gestation, as determined by a few western studies. Indian studies on the same are not available. Objective of this study was to determine the trend of the fetal heart rate in first trimester of pregnancy in South Indian women.

**Methods:** Transvaginal scan was done in 51 pregnant women with singleton pregnancy attending the antenatal clinic in a medical college hospital. Crown rump length and fetal heart rate were measured and plotted on a graph. Also, the fetal heart rate at different gestational age of our study was compared with the fetal heart rates at the same gestational age from the studies in the western population.

**Results:** The range of fetal heart rate at different weeks of gestation was comparable to the heart rate variations as seen in the western population. The maximum heart rates at 9 weeks of gestation in our study was higher than the heart rate in the western population.

**Conclusions:** Possibility of variation in the fetal heart rates in the first trimester in different populations cannot be ruled out until confirmed by studies with large sample size.

**Keywords:** Embryonic heart rate, First trimester fetal heart rate, Indian population

### INTRODUCTION

Fetal heart pulsations are the determinants of viability of pregnancy. The normal fetal heart rate ranges from 110-160bpm as recommended by the international guidelines. During the third trimester and labour rates less than 110 and more than 160 bpm are considered as markers of fetal distress. In the first trimester fetal heart rate varies with every week of gestation. The fetal heart pulsations can be picked up as early as 34 days of gestation.<sup>1</sup> The embryonic heart rate is considered to be normal if it is

more than 100 bpm at 6 to 6+3 weeks and more than 120 bpm at 6+4 to 7 weeks of pregnancy.<sup>1</sup> The heart rate progressively rises to reach a peak of up to 170 bpm by the 9-10 week of pregnancy and then decreases gradually to 130-140 bpm by term. There have been studies on the embryonic heart rate since 1988 in the Western population but none from India. The study by Hertzberg et al was the earliest on determining the fetal heart rate in 1988.<sup>2</sup> Tezuka et al and Britten et al recorded a fetal heart rate of 97.7 bpm and 94 bpm at a very early gestation of 5 weeks.<sup>3,4</sup> Stefos et al showed that the heart

rate could differ in a particular gestational week depending on the initial half or the latter half of the week.<sup>4</sup> The study by Tannirandorn et al, from Thailand is the only study from south east Asian population.<sup>5</sup> The Hanprasert study showed that at 6-7 weeks of gestation the heart rates are lesser, reached a maximum at 8 weeks gestation and decreased gradually to 161 bpm at 14 weeks of gestation.<sup>6</sup> The Hamela-olkowsk study is the latest of all the studies done in 2009.<sup>7</sup> The present study was designed to determine the fetal heart rate variation in early pregnancy in Indian population and to compare it with the previous studies.

**METHODS**

This was a prospective descriptive cross-sectional study involving the pregnant women attending the antenatal clinic in a medical college attached hospital over a period of 30 days. The study period extended from July 1-30 in 2015. 51 pregnant women with gestational age ranging from 5 week to 13 weeks were offered a transvaginal viability scan. All pregnant women with singleton pregnancies were included in the study. Pregnant women with twin gestation were excluded from the study. The scan was performed using a Philips HD machine and fetal heart rate recorded using M mode.<sup>6</sup> Crown rump length was measured to determine the fetal age. The mean fetal heart rate at the particular gestational age was plotted on a graph to depict the variation of the fetal heart with gestational age.

The angle between the ultrasound beam and direction of blood flow was maintained below 45° for umbilical artery. The umbilical artery was studied in a free loop. Umbilical artery (UA) systolic diastolic ratio >2SD above mean or absent or reversed end diastolic flow in umbilical artery was taken as abnormal. UA PI and UA RI were measured and value >2SD was taken as abnormal. The middle cerebral artery was visualised at the circle of Willis and was insonated soon after its origin from internal carotid artery and the angle of insonation kept close to 0°. The pulsatility index was measured and cerebroumbilical PI ratio calculated. MCA-RI was considered abnormal if measurement was 2 SD below the mean. All the ultrasound evaluations were done by a single obstetrician with expertise in doppler sonography.

**Statistical analysis**

Data was entered in Microsoft excel and was analysed using descriptive statistics like mean and proportions.

**RESULTS**

In the distribution of women according to their gestational age we see that majority were between 6-9 weeks of gestation (n=44) and only 7 women were seen in the other gestational weeks. There were no women in their 11 weeks of gestation as shown in Table 1.

**Table 1: The distribution of the number of women according to their gestational age is as follows.**

Gestational age (weeks)	5-5+6	6-6+6	7-7+6	8-8+6	9-9+6	10-10+6	11-11+6	12-12+6	13-13+6
No. of women	1	14	13	11	6	4	0	1	1

**Table 2: The embryonic/fetal heart rates at the respective gestational age and the mean fetal heart rate is as follows.**

Gestational age (weeks)	Fetal heart rate range (Beats per minute)	Mean fetal heart rate (Beats per minute)
5 - 5+6	109 (n=1)	-
6 - 6+6	104 - 199	136
7 - 7+6	99 - 173	148
8 - 8+6	140 - 194	166.4
9 - 9+6	158 - 183	174
10 - 10+6	163 - 183	177.4
11 - 11+6	-	-
12 - 12+6	162 (n=1)	-
13 - 13+6	168 (n=1)	-

Mean fetal heart rate for 5,12 and 13 week of gestation could not be calculated since (n=1) in those gestations.

The women were distributed into different gestational ages from 5 weeks to 13 weeks as shown in Table 2. Fetal heart rates noted in a particular week of gestation were taken as a range between the highest and the lowest rate noted in that particular week of gestation. Mean

value of the heart rate was calculated for a particular week of gestation where n > 1.

The mean fetal heart rate at each gestational week were plotted on a graph as shown below in Figure 1. In case of the gestational weeks where the mean could not be

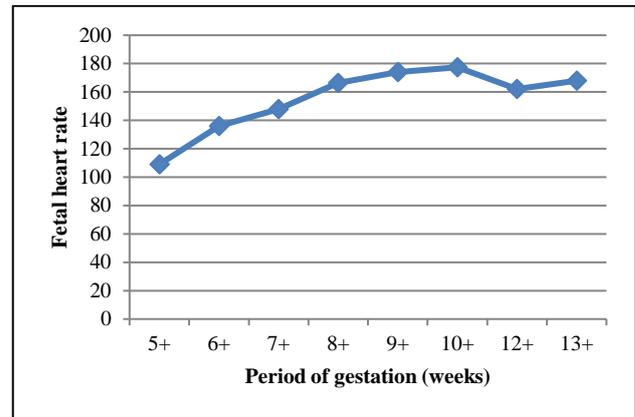
calculated (n=1), the only available value was plotted on the graph. The graph depicts the changes of the fetal heart rate with increasing gestational age. The embryonic heart rate rises gradually from 109 bpm at 5 weeks of gestation to reach a peak at the 10 weeks of gestation and there after gradually falls to a plateau. This graph is a pilot endeavour of the study.

**DISCUSSION**

Fetal heart pulsations serve as the criteria for confirmation of fetal viability. Fetal heart rate pulsations in early pregnancy were studied since 1988. The embryonic heart rate can be seen as early as 34 days of gestation<sup>1</sup>. Subsequently it rises steeply to reach a peak by 9 to 10 weeks of gestation, followed by a gradual fall to 161 beats per minute at 14 weeks of gestation.<sup>6</sup> The embryonic heart rate is considered to be normal if it is more than 100 bpm at 6 to 6+3 weeks and more than 120bpm at 6+4 to 7 weeks of pregnancy.<sup>1</sup>

Determining what rate is normal for a particular gestation in early pregnancy is very important. The clinical benefit of this is that embryonic heart rates lesser than the expected can prognosticate the pregnancy outcome. Few studies have shown that bradycardia in early pregnancy

leads to miscarriage.<sup>8</sup> So, thorough knowledge of the changes in the fetal heart rate week by week is essential to the treating clinician.



At 5,12 and 13 weeks of gestation since n=1, mean could not be calculated and the same values were used for constructing the graph.

**Figure 1: Variation of the mean fetal heart rate with respect to gestation in our study.**

**Table 3: Fetal heart rates at different gestational ages by different authors.**

Period of gestation in weeks	Hertzberg et al <sup>2</sup>	Tezuka et al <sup>3</sup>	Britten et al <sup>1</sup>	Stefos et al <sup>4</sup>	Tannirandom et al <sup>5</sup> (Thai study)	Hanprasertpong et al <sup>6</sup>	Hamela-Olkowska et al <sup>7</sup>	Present study
5	101	97.7	94					109
6				111±14 (42-45 days) 125±15 (46-49 days)	124 (40-44 days)		116±21	136
7				145±14 (50-52 days) 157±13 (53-56 days)				148
8	143	174.7	166					166.4
9	137-144				177 (60-64 days)			174
10							172±9	177
11							165±7	
12								162
13					159 (95-99 days)			168
14						161		

Various studies determining the embryonic heart rates and their findings have been tabulated in Table 3. All the studies were based on western population except the one by Tannirandom et al which is based on south east Asian population.<sup>6</sup> The study by Hertzberg et al was the earliest on determining the fetal heart rate in 1988.<sup>2</sup> It recorded a

heart rate of 101 bpm at 5 weeks of gestation while Tezuka et al and Britten et al recorded a fetal heart rate of 97.7 bpm and 94 bpm (the lowest heart rate among all studies including the present study) at 5 weeks of gestation.<sup>3,4</sup> Stefos et al determined fetal heart rates between 6-7 weeks of gestation and showed that the heart

rate could differ in a particular gestational week depending on the initial half or the latter half of the week.<sup>4</sup> The Thai study and the present study at 9 weeks of gestation recorded a heart rate of 177 bpm and 174 bpm respectively which is relatively higher when compared with the Hertzber study showing 137-144 bpm

at the same gestation.<sup>4</sup> The Hanprasert<sup>6</sup> study showed a rate of 161 bpm at 14 weeks of gestation indicating that the fetal heart rate touches the standard 110-160 bpm by 14 weeks. The Hamela-olkowsk study which is the latest in the series recorded values which are comparable with the present study.<sup>7</sup>

**Table 4: Comparison of the fetal heart rates of different studies and the mean heart rate of present study at different gestational ages.**

POG (weeks)	Lowest heart rate of all studies	Present study mean heart rate	Highest heart rate of all studies
5	941	109	101 <sup>2</sup>
6	111 <sup>4</sup>	136	125 <sup>4</sup>
7	145 <sup>4</sup>	148	157 <sup>4</sup>
8	143 <sup>2</sup>	166.4	174.7 <sup>3</sup>
9	137 <sup>2</sup>	174	177 <sup>5</sup>
10	-	177	172 <sup>7</sup>
13	-	168	159 <sup>5</sup>

Superscripts indicate the references.

In the present study mean fetal heart rate at a particular gestation was compared between the findings of the western studies by compiling them into the lowest and the highest heart rate at a particular gestation as depicted in Table 4.

From Table 4, it is seen that during 5 weeks and 6 weeks of gestation the mean heart rate from our study was higher than the highest heart rate among the various studies at that gestation. The maximum heart rate is reached at the 9 weeks 5 and 10 weeks 7 of gestation in 2 different studies and in our study the maximum rate was at the 10 weeks of gestation. The trend of the fetal heart rate in our study is similar to the other studies during the 7, 8 and 9 weeks. Only the study by Hertzberg et al shows lesser heart rate at 8 and 9 weeks of gestation reaching a maximum of only 144 bpm at the 9 weeks in comparison to other studies. The study on the Thai population which is the only study on the South Asian population the maximum heart rate is reached at the 9 weeks unlike in our study at the 10 weeks and at the 13 week the fetal heart rate was lesser than in our study indicating a much steeper fall.<sup>5</sup>

This study is the first of its kind on Indian women to create a population specific graph of fetal heart rate in the first trimester and studies with large sample size are warranted to create a fetal heart rate normogram specific to Indian population.

## CONCLUSION

Fetal heart rate in early pregnancy is not similar to the heart rate in term gestation. It follows a steep rise followed by a plateau and then gradually decreases to reach the term fetal heart. Knowledge of this is important

to prevent unwanted fear about the prognosis of the pregnancy. In our study the pattern of fetal heart variation in the first trimester was comparable to that of the Caucasian women. Variation in the maximum heart rate at 9 weeks of gestation was seen among different populations. So, we can conclude that there could be some difference in the fetal heart rate pattern among different populations which needs a large study to confirm the finding and to establish a population based normogram.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee*

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**Cite this article as:** Hethyshi R. The pattern of variations in the first trimester fetal heart rate in Indian population: a pilot study. *Int J Reprod Contracept Obstet Gynecol* 2019;8:4419-23.