Section: Obstetrics and Gynaecology

Original Research Article

CRL AND FHR AT 6-9 WEEKS OF PREGNANCY AND ITS ASSOCIATION WITH EARLY PREGNANCY FAILURE

Manjusha Hegde[1], Suman Umeshchandara[2], Meenakshi S Devarmani[3]

[1]*Post Graduate Resident, Department of Obstetrics and Gynaecology, Mahadevappa Rampure Medical College, Kalaburagi, Karnataka, India*
[2]*Professor, Department of Obstetrics and Gynaecology, Mahadevappa Rampure Medical College, Kalaburagi, Karnataka, India*
[3]*Professor and Head, Department of Obstetrics and Gynaecology, Mahadevappa Rampure Medical College, Kalaburagi, Karnataka, India*

Received *: 17/05/2025*
Received in revised form *: 06/07/2025*
Accepted *: 29/07/2025*

Corresponding Author:
Dr. Manjusha Hegde,
Post Graduate Resident, Department of Obstetrics and Gynaecology, M. R. Medical College, Kalaburagi, Karnataka, India
Email: manjushahegde96@gmail.com

DOI: 10.70034/ijmedph.2025.3.301

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (3); 1641-1645

ABSTRACT

Background: Early pregnancy assessment using ultrasonographic markers plays a pivotal role in predicting pregnancy viability. Among these, Crown-Rump Length (CRL) and Fetal Heart Rate (FHR) are critical parameters during the 6–9-week gestational window. Deviations in these metrics can be indicative of early pregnancy failure, yet their combined predictive value remains underexplored, especially in regional populations like Kalyana Karnataka. This study aimed to evaluate the relationship between CRL and FHR between 6 and 9 weeks of gestation and determine their association with early pregnancy failure.

Materials and Methods: A prospective observational study was conducted at the Department of Obstetrics and Gynecology, Basaveshwara Teaching and General Hospital, Kalaburagi, from December 2023 to October 2024. A total of 200 pregnant women with singleton pregnancies and reliable last menstrual periods were enrolled and followed via transvaginal ultrasound. CRL and FHR were recorded, and participants were monitored until 12 weeks gestation to identify pregnancy outcomes. Statistical analysis included independent t-tests, ANOVA, and chi-square tests using SPSS v22, with a significance threshold of $p<0.05$.

Results: Out of 200 participants, 37 (18.5%) experienced spontaneous abortion. These cases had significantly lower CRL and FHR compared to ongoing pregnancies. At 6–7 weeks, mean CRL was 4 ± 2 mm and FHR was 74 ± 12 bpm in spontaneous abortions versus 6 ± 2 mm and 98 ± 12 bpm in ongoing pregnancies. Similar significant differences were observed at 7–8 and 8–9 weeks ($p<0.001$ across all groups).

Conclusion: CRL and FHR are strongly associated with early pregnancy viability. Reduced values in early gestation are predictive of spontaneous abortion. Routine early ultrasound screening using these parameters is essential for timely risk stratification, counselling, and intervention in clinical practice.

Keywords: Crown-Rump Length, Fetal Heart Rate, Early Pregnancy Failure, Ultrasound, Spontaneous Abortion, Gestational Age, First Trimester.

INTRODUCTION

Early pregnancy assessment plays a crucial role in predicting pregnancy outcomes and guiding clinical decision-making. Among the most critical markers used in first-trimester ultrasounds are crown–rump length (CRL) and fetal heart rate (FHR), particularly between 6 to 9 weeks of gestation. CRL is a well-established biometric parameter for estimating gestational age and identifying growth anomalies, while FHR serves as a physiological indicator of embryonic viability.

Advances in ultrasonography have enhanced the sensitivity of detecting embryonic structures and cardiac activity as early as a CRL of 2 mm, allowing clinicians to assess embryonic health in pregnancies at high risk for failure, such as those with recurrent pregnancy loss.[1] A study on patients with recurrent early pregnancy loss found that both low CRL and bradycardia (reduced FHR) were significantly

associated with first-trimester miscarriage, with prediction accuracies exceeding 98% for both parameters.[1]

Furthermore, the visualization of a normal embryonic heart rate has been found to significantly increase the likelihood of a successful pregnancy outcome, even in the presence of common risk factors such as advanced maternal age or subchorionic hematomas.[2] These findings support the potential of early sonographic metrics like CRL and FHR as prognostic tools in prenatal care.

Despite this, the precise relationship between CRL and FHR, and their combined predictive value for early pregnancy failure between 6 and 9 weeks, remains underexplored. This study aims to investigate the correlation between these parameters and evaluate their association with early pregnancy loss, thereby enhancing the early diagnostic capabilities in obstetric practice.

Objectives: To study the relationship between CRL and FHR at 6-9 weeks of pregnancy and to know any association between these parameters and early pregnancy failure. Ultrasound helps in determination of any untoward occasion and its suitable management.

MATERIALS AND METHODS

This prospective observational study was conducted at the Department of Obstetrics and Gynecology, Basaveshwara Teaching and General Hospital, Kalaburagi, over a period spanning from December 2023 to October 2024. A total of 200 pregnant women presenting to the outpatient department (OPD) with a gestational age between 6 to 9 weeks were enrolled and referred for transvaginal ultrasonography. Following initial screening, participants were evaluated based on predefined inclusion and exclusion criteria.

Inclusion criteria for this study were: singleton pregnancies up to 9 weeks' gestation, including both spontaneous and assisted conceptions; women with a reliable last menstrual period (LMP), verified by at least three regular menstrual cycles prior to conception; and maternal age of 18 years or above. Exclusion criteria included: multiple gestations, pregnancies complicated by chronic medical conditions such as hypertension or diabetes, maternal age above 35 years (advanced maternal age), and consanguineous marriages.

Participants who met the criteria were monitored through weekly telephonic follow-ups until they either reached 12 completed weeks of gestation or experienced a spontaneous miscarriage. The outcomes of these follow-ups were recorded to correlate initial sonographic findings with pregnancy viability.

For statistical analysis, data were compiled using Microsoft Excel and analyzed using SPSS software version 22 (IBM Corp., Armonk, NY, USA) and Epi Info version 7.2.1 (CDC, Atlanta, USA). Categorical variables were summarized using frequencies and proportions. The Chi-square test was employed to determine the statistical significance of associations in categorical data. Continuous variables were expressed as means and standard deviations, and their distribution was assessed using the Kolmogorov–Smirnov and Shapiro–Wilk tests to test for normality. Comparative analysis between two groups for continuous variables was conducted using the independent t-test, while comparisons involving more than two groups utilized analysis of variance (ANOVA). Graphical representations, including bar charts and pie diagrams, were generated using Microsoft Excel and Word. A p-value of less than 0.05 was considered statistically significant, adhering to the standard assumptions of statistical testing.

RESULTS

A total of 200 women were referred at 6-9 weeks for ultrasound on an outpatient basis. However out of the 200 women included, 37 women had intrauterine foetal demise showing CRL measurements at lower limits from normal as per their gestational age and FHR of < 110bpm, whereas no intrauterine foetal demise was noted in 147 women who had normal CRL measurements according to their gestational age and FHR> 110bpm when followed until 12 weeks of gestation.

Table 1: Age distribution of subjects

	Age	Number (n =37)	Percentage
Age	<20 yrs	1	2.7 %
	21- 25 yrs	14	37.8 %
	26- 30 yrs	17	45.9 %
	> 30 yrs	5	13.5 %
Gravida	Nulligravida	11	29.7 %
	G2A1	2	5.4 %
	G2P1L1	16	43.2 %
	G3P1L1A1	8	21.6 %
Gestational Age	6-7 weeks	11	29.7 %
	7-8 weeks	17	45.9 %
	8-9 weeks	9	24.3 %
Indication	Abdominal pain	10	27.0 %
	Per vaginal spotting	17	45.9 %
	Previous miscarriage	6	16.2 %
	Dating	4	10.8 %

In the present study, the majority of subjects (45.9%) were in the age group of 26-30 years, followed by 21-25 years (37.8%). A smaller proportion of subjects were aged >30 years (13.5%), while only 2.7% were under 20 years of age.

Regarding gravidity distribution, 43.2% of the subjects were G2P1L1, followed by nulligravida cases (29.7%). G3P1L1A1 accounted for 21.6%, and the least common group was G2A1 (5.4%).

In terms of gestational age distribution, the highest percentage of cases were in the 7-8 weeks category (45.9%), followed by 6-7 weeks (29.7%) and 8-9 weeks (24.3%). When analysing the indications for early pregnancy failure, the most common symptom was per vaginal spotting (45.9%), followed by abdominal pain (27.0%), previous miscarriage (16.2%), and dating (10.8%).

Table 2: Crown to Rump Length comparison between Spontaneous abortion and Ongoing Pregnancy with respect to duration of pregnancy

Duration of pregnancy (in weeks)	No. of cases		Crown To Rump Length (mm)		P value $
	Spontaneous abortion (n = 37)	Ongoing Pregnancy (n = 147)	Spontaneous abortion (n = 37)	Ongoing Pregnancy (n = 147)	
6 - 7 weeks	13 (35.1%)	44(29.9%)	4 +/- 2	6 +/- 2	0.0025*
7 – 8 weeks	19 (51.3%)	16(10.8%)	6 +/- 3	12 +/- 3	<0.001*
8 -9 weeks	5 (13.5%)	87(59.1%)	12 +/- 3	18 +/- 2	<0.001*
P value	<0.001*#		<0.001*@	<0.001*@	

Chi-square test, @ ANOVA Test, $ Independent t test

Crown to rump length (CRL) was significantly lower in spontaneous abortion cases than in ongoing pregnancies across all gestational age groups. At 6-7 weeks, CRL was 4 ± 2 mm in spontaneous abortion cases compared to 6 ± 2 mm in ongoing pregnancies (p=0.0025). At 7-8 weeks, CRL was 6 ± 3 mm in spontaneous abortion cases versus 12 ± 3 mm in ongoing pregnancies (p<0.001). At 8-9 weeks, CRL was 12 ± 3 mm in spontaneous abortion cases compared to 18 ± 2 mm in ongoing pregnancies (p<0.001). The overall p-value for CRL differences between spontaneous abortion and ongoing pregnancies was highly significant (p<0.001).

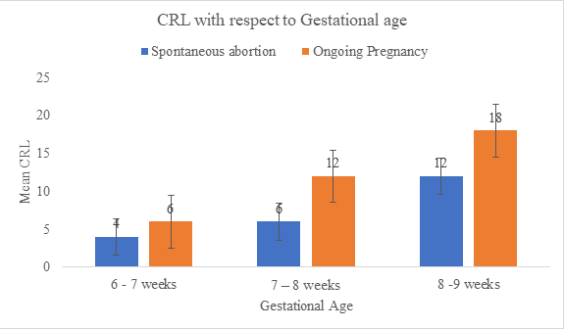

Figure 1: Bar diagram showing Crown to Rump Length comparison between Spontaneous abortion and Ongoing Pregnancy with respect to duration of pregnancy

Table 3: Fetal heart rate comparison between Spontaneous abortion and Ongoing Pregnancy with respect to duration of pregnancy

Duration in weeks (weeks)	No. of cases		Fetal heart rate (bpm)		P value$
	Spontaneous abortion (n = 37)	Ongoing Pregnancy (n = 147)	Spontaneous abortion (n = 37)	Ongoing Pregnancy (n = 147)	
6 – 7 weeks	13(35.1%)	44(29.9%)	74 +/- 12	98 +/- 12	<0.001*
7 – 8 weeks	19(51.3%)	16(10.8%)	92 +/- 8	134 +/- 10	<0.001*
8- 9 weeks	5(13.5%)	87(59.1%)	100 +/- 8	140 +/- 15	<0.001*
P value	<0.001*#		<0.001*	<0.001*	

Chi-square test, @ ANOVA Test, $ Independent t test

Fetal heart rate (FHR) was also significantly lower in spontaneous abortion cases compared to ongoing pregnancies. At 6-7 weeks, the mean FHR was 74 ± 12 bpm in spontaneous abortion cases versus 98 ± 12 bpm in ongoing pregnancies (p<0.001). At 7-8 weeks, FHR was 92 ± 8 bpm in spontaneous abortion cases compared to 134 ± 10 bpm in ongoing pregnancies (p<0.001). At 8-9 weeks, FHR was 100 ± 8 bpm in spontaneous abortion cases versus 140 ± 15 bpm in ongoing pregnancies (p<0.001). The differences in FHR between the two groups were statistically significant across all gestational ages (p<0.001).

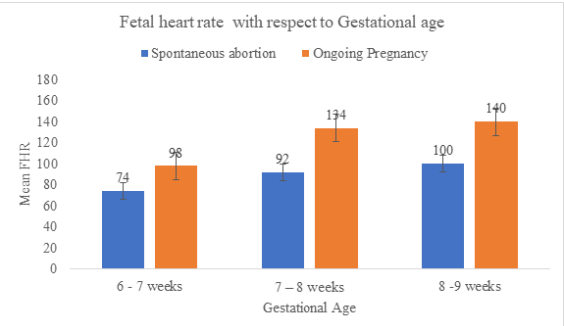

Figure 2: Bar diagram showing Fetal heart rate comparison between Spontaneous abortion and Ongoing Pregnancy with respect to duration of pregnancy

DISCUSSION

The present study reinforces the strong relationship between crown-rump length (CRL) and fetal heart rate (FHR) with early pregnancy viability. Specifically, CRL and FHR were significantly lower in pregnancies that ended in early pregnancy loss, across all gestational age groups from 6 to 9 weeks. These findings are consistent with a growing body of literature emphasizing the diagnostic value of early ultrasound parameters.

Detti et al. (2020) developed a logistic model to predict pregnancy loss and found that CRL and FHR are late markers of pregnancy failure, becoming abnormal around 7–8 weeks—consistent with our study where deviation in CRL and FHR became most evident at these gestational stages.[5]

Similarly, Hassan et al. (2022) validated that lower CRL and FHR values at 6 and 12 weeks were significantly associated with early pregnancy loss, supporting our study's findings where spontaneous abortion cases had lower CRL and FHR across all gestational brackets.[6]

Abed et al. (2022) also demonstrated that a CRL < 5 mm or FHR < 110 bpm significantly predicted pregnancy failure, matching our study criteria and thresholds [10]. Elsharkawy et al. (2024) extended this by showing that absence or delayed heart activity in embryos with CRL < 5 mm was a strong predictor of failed pregnancies, corroborating our findings that abnormal CRL and FHR were observed in all 37 spontaneous abortion cases.[1]

Burwinkel et al. (1993) reported similar conclusions where a single transvaginal ultrasound showing low CRL and FHR in early pregnancy (5–9 weeks) was predictive of adverse outcomes.[7]

Shah et al. (2016) and Arleo et al. (2011) emphasized that early bradycardia (<100 bpm) is a significant predictor of fetal demise, aligning with our finding that FHR < 110 bpm strongly associated with pregnancy loss.[8-11] Additionally, Cho et al. (2021) linked early pregnancy symptoms like per vaginal spotting and abdominal pain with suboptimal outcomes, which mirrored the most common symptoms observed in our study's early pregnancy failure group.[9]

Doubilet (2024) raised caution in overinterpreting isolated low FHR values, noting that once normal FHR is established, prognosis improves substantially. However, our data showed consistently low FHR across gestation in spontaneous abortion cases, affirming its prognostic value in persistently abnormal cases.[2]

The strong statistical significance of CRL and FHR as indicators of early pregnancy failure supports their use as primary metrics in early obstetric ultrasound. The pattern of deviation becoming more pronounced with advancing gestational age suggests that serial measurements provide higher prognostic accuracy. These results also highlight the clinical value of early ultrasound not only in confirming viability but also in guiding patient counselling and management plans, especially in symptomatic women or those with a history of miscarriage.

This study, while informative, presents several limitations that may influence the interpretation and generalizability of its findings. Being conducted at a single tertiary care center in Kalyana Karnataka, the results may not fully represent broader or more diverse populations, limiting external validity. The exclusion of high-risk groups, such as women with chronic medical conditions or advanced maternal age (>35 years), restricts the study's applicability to populations that often experience pregnancy complications, potentially underestimating the impact of CRL and FHR deviations in such groups. Furthermore, the study relied exclusively on ultrasonographic parameters and did not incorporate biochemical markers like β-hCG or progesterone, which could have offered a more comprehensive assessment of early pregnancy viability. Important confounding factors such as lifestyle, genetic anomalies, or environmental exposures were not accounted for, possibly affecting the outcomes independently of CRL and FHR values.

CONCLUSION

The findings of this prospective observational study provide robust evidence that both Crown-Rump Length (CRL) and Fetal Heart Rate (FHR) are significant early sonographic markers associated with pregnancy outcomes between 6 and 9 weeks of gestation. A statistically significant reduction in CRL and FHR was consistently observed among pregnancies that ended in spontaneous abortion, as compared to those that progressed normally ($p<0.001$ across all gestational age groups). These results highlight the diagnostic value of early ultrasound in predicting embryonic viability and support the use of CRL and FHR as reliable tools in obstetric practice. Importantly, the data underscore that early deviations from normative values in either parameter should prompt timely clinical intervention, especially in symptomatic patients or those with a history of pregnancy loss.

Based on the results, it is recommended that transvaginal ultrasound screening including CRL and FHR measurements be routinely implemented for pregnancies between 6 and 9 weeks of gestation, especially in women at increased risk of early pregnancy failure. Specific thresholds—such as CRL values below gestational age norms and FHR below 110 bpm—should be recognized as potential indicators of embryonic compromise and warrant close surveillance and follow-up assessments. In cases where initial values fall in a borderline range, serial ultrasound monitoring is advised to evaluate developmental trends and refine prognosis.

Additionally, clinical triage should be expedited for women presenting with symptoms like vaginal spotting or abdominal pain, as these are commonly

associated with early pregnancy loss. It is equally essential to ensure that healthcare providers, particularly in resource-limited areas like Kalyana Karnataka, are adequately trained in standardized ultrasound techniques and interpretation of early pregnancy markers. Finally, appropriate counselling and emotional support must be provided to women facing a diagnosis of nonviable pregnancy, emphasizing compassionate communication and individualized care planning.

REFERENCES

1. Elsharkawy AE, El-Mahdy AE, Ibrahim ME. Heart Activity Visualization in Embryos with Crown-Rump Length Shorter Than 5 mm and Its Role in Prediction of Early Pregnancy Failure. Egypt J Hosp Med. 2024; DOI:10.21608/ejhm.2024.384115.
2. Doubilet PM. Risk Factors Are Not Very Risky Once a Normal Embryonic Heart Rate is Seen in Early Pregnancy. J Ultrasound Med. 2024; DOI:10.1002/jum.16485.
3. Yan F, Robert M, Li Y. Statistical methods and common problems in medical or biomedical science research. Int J Physiol Pathophysiol Pharmacol. 2017;9(5):157-163.
4. Panos GD, Boeckler FM. Statistical Analysis in Clinical and Experimental Medical Research: Simplified Guidance for Authors and Reviewers. Drug Des Devel Ther. 2023;17:1959-1961.
5. Detti L, Francillon L, Christiansen ME, Peregrin-Alvarez I, Goedecke PJ, Bursac Z, Roman RA. Early pregnancy ultrasound measurements and prediction of first trimester pregnancy loss: A logistic model. Sci Rep. 2020;10:1545. doi:10.1038/s41598-020-58114-3.
6. Hassan MM, Ibrahim EM, AbdAllah AA, Yousif AM. A logistic model of early pregnancy ultrasound measurements and prediction of first-trimester outcome. MJMR. 2022;33(2):197-212.
7. Abed AN, Mohammad HF, Hameed LA. Evaluation of early pregnancy using ultrasound in relation to CRL and fetal heart rate in prediction of pregnancy outcome. Iraqi J Embryos Infertility Res. 2022;12(2):55–63.
8. Rotsztejn D, Rana N, Dmowski WP. Correlation between fetal heart rate, crown-rump length, and β-human chorionic gonadotropin levels during the first trimester of well-timed conceptions resulting from infertility treatment. Fertil Steril. 1993;59(6):1169-1173.
9. Arleo EK, Troiano RN. Outcome of pregnancies in which first-trimester sonography demonstrates a small crown-rump length for gestational age. J Ultrasound Med. 2011;30(3):333-337.
10. Shah KH, Bhatia P, Shah H, et al. Significance of fetal bradycardia in early pregnancy as a predictor of adverse pregnancy outcome. Int J Reprod Contracept Obstet Gynecol. 2016;5(8):2536–2541.
11. Cho K, Jang YJ, Park YS, Kim YR. The effect of subchorionic hematoma on pregnancy outcomes in women with threatened abortion. J Clin Med. 2021;10(9):2024.