

## Can First Trimester Crown-Rump Length Measurement predict Macrosomia at birth?

Samia Eid<sup>1</sup>, Mohammed Galal Nasr<sup>1</sup>, Alaa Hamed Al Arshal<sup>1</sup> and Marwa Ali<sup>2</sup>

<sup>1</sup>Obstetrics and Gynaecology Department, Faculty of Medicine, Al-Azhar University (Damietta Branch), Egypt

<sup>2</sup>Obstetrics and Gynaecology Department, Damietta General Hospital, Egypt

[Mohammed.30028@yahoo.com](mailto:Mohammed.30028@yahoo.com)

**Abstract: Background:** First-trimester ultrasound measurements of crown-rump length (CRL) have also been demonstrated to be accurate predictors of birth weight; fetal growth impairment begins in the first trimester and had been shown to result in adverse pregnancy outcomes. **Aim of the work:** was to evaluate the correlation between first trimester CRL and macrosomia at birth. **Patients and Methods:** This was a prospective study included 152 pregnant women with gestational age of first trimester divided into 2 groups according to ultrasound measurement of Crown-rump length and the association between CRL and macrosomia at birth was recorded and statistically analyzed. **Results:** There were statistical significant correlation between Actual birth weight and first trimester Crown rump length where (0.288, p-value= 0.0002). **Conclusion and recommendation:** The result of the present study showed if CRL more than expected, birth weight will be more than normal, so measurement of first trimester CRL is useful as a predictor of birth weight.

[Samia Eid, Mohammed Galal Nasr, Alaa Hamed Al Arshal and Marwa Ali. **Can First Trimester Crown-Rump Length Measurement predict Macrosomia at birth?** *Life Sci J* 2019;16(3):95-100]. ISSN: 1097-8135 (Print) / ISSN: 2372-613X (Online). <http://www.lifesciencesite.com>. 13. doi:[10.7537/marslsj160319.13](https://doi.org/10.7537/marslsj160319.13).

**Key Words:** Crown-rump length (CRL), birth weight, First-trimester.

### 1. Introduction

The prediction and management of abnormal fetal growth are an important aim of antenatal care, the small-for-gestational age (SGA) fetus may suffer from fetal growth restriction and thus is at risk of increased morbidity and mortality and adult morbidity. On the other hand, the large for- gestational age (LGA) fetus is at risk of birth trauma and perinatal morbidity such as brachial plexus injuries and meconium aspiration (1).

Fetal weight has often been estimated during the second trimester to predict pregnancy outcomes, but it can also be estimated during the first trimester using different variables and indices (2).

The accurate estimation of fetal weight, size, growth rate, and gestational age can lead to the diagnosis of several perinatal conditions, and therefore have an important role in reducing perinatal morbidity and mortality (3). Since growth patterns in the first trimester are among the chief factors determining birth weight, a fetus small for gestational age in the first trimester will still be small for gestational age at delivery (4).

Crown- rump length (CRL) is the measurement of length of human embryos & fetuses from top of head (crown) to bottom of buttocks (Rump). And it is typically determined from ultrasound image & can be used to estimate gestational age (5).

First-trimester ultrasound measurements of crown-rump length (CRL) have also been demonstrated to be accurate predictors of birth weight, and CRL can be easily measured (after enlarging the

image to life size and identifying the embryonic echo within the gestational sac on the longitudinal scan) The measurement allows the obstetrician to calculate gestational age with accuracy from the 6th to the 14th gestational week (6).

Measuring CRL in the first trimester is a much simpler procedure, and a shorter-than-expected value is also significantly associated with low birth weight. Fetal growth impairment begins in the first trimester and had been shown to result in adverse pregnancy outcomes. The difference in size for gestational age of a preterm newborn with that of a newborn at term can therefore be predicted in the first trimester (6).

Significant discordance in CRL is associated with higher risk of adverse perinatal outcomes including fetal loss, weight discordance, fetal anomalies, preterm delivery and even perinatal death (7) Variations in CRL measurement may greatly affect the risk assessment of chromosomal anomalies within the first trimester (8). The aim of the present study was designed to study the Correlation between first trimester CRL and macrosomia at birth.

### 2. Patients and Methods

This a prospective, cohort study was done in the department of obstetrics and gynecology, Al-azhar University (New Damietta), during the period from December 2016 to January 2018 and included 179 pregnant women divided into 2 groups according to abdominal ultrasound measurement of Crown-rump length.

Group 1 (Normal CRL): included 76 pregnant women.

Group 2: (Larger than expected CRL): included 76 pregnant women.

Normal CRL was defined as a value one day or less above or below the expected value (-1 to +1).

Larger-than-expected CRL was defined when the observed CRL was larger than expected by 2–6 days.

At birth: Newborns were divided into 2 groups according to birth weight.

Normal birth weight: 2500-4000 g.

Macrosomia: weight greater than 4000 g.

After explanation of the nature of the study to all participants, an informed written consent were taken, Also approval from the local committee was taken.

#### Inclusion criteria:

Singleton living fetus, gestational age between 11 and 13 weeks, term delivery.

#### Exclusion criteria:

Pregnant women with unreliable menstrual history. Multiple pregnancies, Sub chorionic hematoma, Pregnant women with chronic diseases as cardiac, chronic hypertension and presentational diabetes, Pregnant women who become affected by preeclampsia, gestational diabetes, preterm delivery, still birth, Pregnant women with discrepancy of more than 6 days with the gestational age based on the last menstrual period, history of genetic or congenital malformation, Pregnant women with BMI less than 18.5 or more than 25 kg/m<sup>2</sup>.

For All pregnant women in the study, the following were done.

Thorough history taking with special emphasis on menstrual history to be sure of LMP as a method for calculation of gestational age.

General examination (Blood pressure, Pulse and Lower limb edema)

Measurement of CRL by ultrasound: The fetal CRL obtained at 11- 13 weeks was done by obtaining a longitudinal section of the uterus, then sweep the probe horizontally to the sides to get a longitudinal view of the fetus obtaining a true, unflexed or extended mid sagittal view of the embryo showing fetal heart, with visualization of the end-points of the embryo clearly seen, and then placing the calipers correctly on these defined end-points (crown- rump) excluding the limbs and yolk sac.

The average maximal straight line (CRL) was measured in mm which was taken from 3 satisfactory images and Correlation between actual and expected CRL was done to categorize patients into 2 groups.

Follow up the participant in the study until delivery and birth weight were recorded and correlated statistically with CRL.

#### Statistical analysis

The collected data were coded, fed to computer, organized and statistically analyzed using computer programs: Microsoft excel version 10 and Statistical Package for Social Science (SPSS) for windows version 25.0. quantitative data were presented by mean  $\pm$  SD, chi square test and analysis of variance (ANOVA) were used.

### 3. Result

There is no statistically significant differences between groups as regard Age, gravidity, history of abortion and educational level  $p > 0.05$ . while there is statistically significant differences between both groups as regard parity (**Table 1**).

**Table (1) Demographic data of the studied pregnant women**

Character		Group 1 (Normal CRL)		Group 2 (Larger than expected CRL)		Significant test	P value
Age	Min-Max	17-38		18-43		0.944	0.391 <sup>ns</sup>
	Mean $\pm$ SD	26.60 $\pm$ 5.57		27.62 $\pm$ 5.99			
Gravidity	Min-Max	1-6		1-7		3.772	0.152 <sup>ns</sup>
	Mean $\pm$ SD	2.92 $\pm$ 1.25		3.30 $\pm$ 1.38			
Parity	Min-Max	0-3		0-4		6.336	0.042 <sup>S</sup>
	Mean $\pm$ SD	1.45 $\pm$ 0.91		1.88 $\pm$ 1.13			
		N	%	N	%	Chi square	P value
History of Abortion	No	51	67.1	55	72.4	1.128	0.569 <sup>ns</sup>
	Yes	25	32.9	21	27.6		
Educational level	Faculty	9	11.8	11	14.5	12.887	0.116 <sup>ns</sup>
	Secondary	42	55.3	24	31.6		
	Preparatory	6	7.9	17	22.4		
	Primary	7	9.2	10	13.2		
	Not educated	12	15.8	14	18.4		

ns = non-significant at  $p$ -value  $> 0.05$ , S= significant at  $p$  value  $p \leq 0.05$

There is no statistically significant differences between both groups regarding gestational age by last menstrual period ( $p > 0.05$ ), and highly significant difference between both groups regarding gestational age by ultrasound, Crown rump length in mm (**Table 2**).

There is no statistically significant differences between both groups as regard gestational age at delivery, while highly statistically significant difference between both groups as regard actual weight (**Table 3**).

There is highly statistically significant differences between both groups as regard birth weight,  $p \leq 0.001$  (**Table 4**).

There were statistically significant differences between neonatal birth weight groups regarding Crown rump length / mm ( $p \leq 0.05$ ) (**Table 5**).

There is a statistically significant correlation between Actual birth weight and first trimester Crown rump length. (**Table 6**).

**Table (2): Comparison between both groups regarding gestational age by last menstrual period, ultrasound and Crown rump length in mm**

Character	Group1 (Normal CRL)	Group 2 (Larger than expected CRL)	F ratio	P value
Gestational age by LMP in days	83.99±3.75	82.95±4.29	8.523	0.243 <sup>ns</sup>
In weeks	11 weeks+ 6.99 d ±3.75	11 weeks+5.95 d ±4.29		
Gestational age by ultrasound in days	82.70±8.33	86.74±4.34	16.583	0.0001 <sup>HS</sup>
In weeks	11 weeks+5.70 d ±8.33	12 weeks+2.74 d ±4.34		
Crown rump length in mm	50.89±7.11	57.28±8.45	32.163	0.0001 <sup>HS</sup>

ns = non-significant at  $p$  value  $> 0.05$ , HS = Highly significant at  $p$  value  $\leq 0.001$

**Table (3): Comparison between groups regarding fetal outcomes**

Character		Group1 (Normal CRL)	Group 2 (Larger than expected CRL)	F ratio	P value
Gestational age at delivery in weeks	Mean	38.46±0.97	38.63±0.96	0.764	0.467 <sup>ns</sup>
	Range	37-40	37-40		
Actual weight in grams	Mean	3218.42±530.33	3643.42±570.69	33.134	0.0003 <sup>HS</sup>
	Range	2200-4400	2300-4800		

ns= non-significant at  $p$  value  $> 0.05$ , HS = Highly significant at  $p$  value  $\leq 0.001$

**Table (4): Comparison between groups regarding birth weight**

Character		Group1 (Normal CRL)	Group 2 (Larger than expected CRL)	Chi square	P value
Birth weight	Normal (2500-4000 gm)	N	67	27.391	0.0001 <sup>HS</sup>
		%	88.2%		
	Macrosomia (above 4000 gm)	N	3		
		%	3.9%		

HS = Highly significant at  $p$  value  $\leq 0.001$

**Table (5): Comparison between neonatal birth weight groups regarding Crown rump length in mm:**

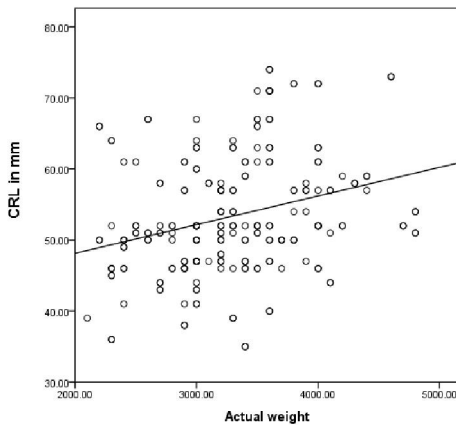
	Actual birth weight		F ratio	P value
	Normal (2500-4000)	Macrosomia (Above 4000)		
Crown rump length in mm	53.60±8.32	55.57±7.23	4.338	0.014 <sup>s</sup>

s = significant at  $p$  value  $\leq 0.05$

**Table (6): Correlation between Actual birth weight and first trimester Crown rump length:**

Items	Actual birth weight at delivery.	
	Pearson correlation coefficient (r)	P. value
1 <sup>st</sup> trimester Crown rump length	0.288	0.0002

Correlation is significant at the 0.01 level



**Figure (1):** Linear correlation between Actual birth weight and first trimester Crown rump length and there is statistical positive correlation between Actual birth weight and first trimester Crown rump length

#### 4. Discussion

Fetal growth impairment begins in the first trimester and could result in adverse pregnancy outcomes (9).

The present study was designed to investigate the association between first trimester CRL and macrosomia at birth.

In the present study the mean age of the studied groups were  $26.60 \pm 5.57$  years, versus  $27.62 \pm 5.99$  years for Group 1 (Normal CR) L and Group 2 (Above expected CRL) respectively with no significant statistical differences between both groups which is consistent with studies done by (10) where the mean age of the studied groups were 30.4 years with no statistically significant differences, (4), where the mean age of studied groups were 32.8 years with no significant differences, and (11) where the mean age were  $27.5 \pm 6$  years with no significant difference between groups.

The present study is inconsistent with study done by (12) where the mean age showed statistically significant differences.

In the present study there are no significant differences between both groups regarding history of abortion which is consistent with study done by (12) who found no significant differences between groups regarding history of therapeutic and spontaneous abortion.

In the present study there was significant differences between both groups regarding parity which are inconsistent with studies done by (12) and (2) where they concluded that there was no significant differences between groups regarding parity.

In the present study the mean gestational age by LMP were 11 weeks+ 6.99 days  $\pm 3.75$ , and 11

weeks+5.95 days  $\pm 4.29$  for Group1, Group 2 respectively, there were no significant differences regarding gestational age by LMP. This is consistent with the study done by (10) where the mean GA for the groups were 12.2 weeks  $\pm 0.60$  with no significant difference, and inconsistent with the study done by (12) which showed significant difference between groups regarding gestational age (GA).

In the present study the mean gestational age by US were 11 weeks+5.70 days  $\pm 8.33$  and 12 weeks+2.74 days  $\pm 4.34$  for Group1, Group respectively, there were significant differences between groups regarding GA by US, the mean CRL were 52.89 mm, and 58.28 mm for Group1, Group2, respectively and there were statistically significant differences between groups regarding CRL. This is consistent with study done by (2) who found significant differences between groups regarding gestational ages (GA) by US and CRL.

In the present study the mean gestational age at delivery for the two groups were 38.5 weeks and there was no significant differences regarding GA at delivery which is consistent with study done by (4) which showed no significant differences between groups regarding GA at delivery with the mean GA of 38 weeks+4 days and this inconsistent with the outcome of the study done by (2) where there were significant differences between groups regarding GA at delivery. Also, the present study is inconsistent with (10) study where there were significant differences between groups regarding GA at delivery.

In the present study the mean actual birth weight were (3218 gram), and (3643 gram) for Group1, Group2 respectively, there were highly statistically significant differences between groups regarding actual birth weight which are consistent with (10) study that found significant differences between groups regarding birth weight. Also (12) found significance difference between groups regarding actual birth weight.

In the present study the percentage of macrosomia was (9.2%) from all full term delivery most of them were in Group 2 (6.5%), and normal birth weight was (79.3%) most of them in Group1 (29%) and there is a positive correlation between CRL and birth weight where  $p=0.228$ .

This is consistent with study which was retrospective cohort study done on 521 pregnant women by (10) and found positive correlation between CRL and birth weight, also observed that macrosomic babies were characterized by larger-than expected CRL measurements, the study done on pregnant women with singleton pregnancy at 11 to 14 weeks, they found about 9.6 % high birth weight, 7.3% low weight at birth and 83.1% normal weight.

(11) observed that significant greater difference between the measured and expected CRLs at 11 to 14 weeks' gestation led to severely macrosomic neonates (birth weight  $\geq 97$ th percentile) compared with controls and concluded that severe macrosomia may manifest as early as 11 to 14 weeks' gestation which is consistent with the present study. The study was a case control study and included 120 neonates divided into 30 macrosomic baby and 90 normal weight neonates as a control group.

(13) study is consistent with the present study and found that crown-rump length of the fetus in the age between 10 to 13 weeks of pregnancy was associated with the birth weight. The effect of size of the fetus in the first trimester on the duration of pregnancy responsible for mostly half of the association, and the second half of pregnancy was responsible for the other half of the growth. That study was inconsistent with our study in that it included 976 pregnant women who conceived by assisted reproductive technology not by spontaneous pregnancy to be sure about gestational age.

(6) had a prospective cross-sectional study, where CRL was measured in 544 healthy pregnant women undergoing ultrasound assessment at the age of 9 to 14 weeks of gestation. Weight at birth, mode of delivery and gestational age at delivery were studied for these cases. They found that Low (2500 g) and high (>4000 g) birth weights were correlated with the difference between actual and expected CRL expressed in days of gestation, but no correlation was found between the difference between actual and expected CRL and preterm delivery, low birth weight ( $P=0.005$ ) and abortion ( $P=0.03$ ) were also correlated with the difference between actual and expected CRL, this result is consistent with the present study but differs in the GA of CRL measurement. (1) who studied the embryonic growth rate at 7 weeks and 3 days in a prospective observational study, the study resulted in that there was a positive correlation between slow rate of growth in the first trimester and SGA. Smokers tend to have a smaller CRL at presentation compared to non-smokers. The sample size was 415 pregnant women. They calculate expected CRL according to LMP and exclude discrepancies of more than 7 days. They scanned pregnancies by transvaginal US. It depended on serial CRL measurements at least 2 times and this differs from the present study in its design.

(14) had a retrospective study on 8978 pregnant women which was consistent with the present study as it detected a significant relationship between CRL z-scores and the incidence of SGA and low birth weight.

In another cross-sectional retrospective study by (15) also noted a significant correlation between the CRL z-scores and the birth weight z-scores in an

assisted reproductive pregnancy population, the mean gestational age of their sample was 12 weeks and 5 days gestation. The study resulted in that CRL that was two to six days smaller than the expected was associated with an increased risk (as compared with a normal or larger-than-expected crown-rump length) of a birth weight below 2500 g. Also CRL greater than expected by 2-6 days had greater incidence for macrosomia than other groups.

Another prospective cohort study which is consistent with the present study done by serial measurements of CRL from 9 to 13 weeks determined the relation between early embryonic growth and birth weight. It found a relation between growth in first trimester and birth weight (16).

Inconsistent with the present study, (17) study, there was no significant correlation between CRL discrepancy and birth weight discordance in both IVF and fertility treatment-conceived pregnancies. The study was on dichorionic twin pregnancy. Studying the discordance in CRL between twins and recording their birth weight. They divided the study sample into two groups. One fertilized spontaneously and the other had IVF. The reason for inconsistency of the findings and the present study could be attributed to determining the precise gestational age per the time of intrauterine insemination (IUI) or IVF.

### Conclusion and Recommendation

The result of the present study showed a significant correlation between first trimester crown rump length measurement and macrosomia at birth weight, So measurement of first trimester CRL is useful as a predictor of macrosomia at birth, so better early evaluation of fetal weight abnormalities to predict and prevent hazards & complications that may accompany macrosomia, this will lead to decrease in fetal morbidity and mortality.

### References

1. Mongelli M, Lu C, Reid S, et al. (2016): Is there a correlation between aberrant embryonic crown-rump length growth velocities and subsequent birth weights? *J Obstet and Gynae*; Vol 36. Issue 6: 726-730.
2. Ustunyurt E, Simsek H, Korkmaz B, et al. (2014): First-trimester crown-rump length affects birth size symmetrically. *J Matern Fetal Neonatal Med*, Vol. 28, issue 17: 2070-2073.
3. Shabanian S, Hajirhimi M, Ganji F, et al. (2016): The Relationship between fetal Crown-rump length in the early first trimester and growth parameters at birth. *Inter J of Anatomy, Radiology and Surgery*, Vol-5(3): RO47-RO51.
4. Kang JY, Park EJ, Yang YS, et al. (2013): Crown-rump length measured in the early first

- trimester as a predictor of low birth weight. *Yonsei Med J*; 54(4):1049-52.
5. Doublet PM, Benson CB, Nadel AS, et al (1997): "Improved birth weight table for neonates developed from gestations dated by early ultrasonography." *Journal of Ultrasound Medicine*. 16:241-245.
  6. Vafaei H, Samsami A, Zolghadri J, et al. (2012): Correlation of first-trimester fetal crown-rump length with outcome of pregnancy and birth weight. *Inte J of Gyneco and Obstet*; 119: 141-144.
  7. Miller J, Chauhan SP, Abuhamad AZ (2012): Discordant twins: diagnosis, evaluation and management. *Am J Obstet Gynecol.*; 206(1):10-20.
  8. Kagan KO, Hoopmann M, Baker A, et al (2012): Impact of bias in crown-rump length measurement at first trimester screening for trisomy 21. *Ultrasound Obstet Gynecol.*; 40(2):135-39.
  9. Gardosi J, Francis A (2000): Early pregnancy predictor of preterm birth. The role of prolonged menstruation- conception interval. *BJOG*; 107(2):228-237.
  10. Pardo JMD, Peled YMD, Yogev YMD, et al., (2010): Association of Crown-Rump Length at 11 to 14 Weeks' Gestation and Risk of a Large-for-Gestational-Age Neonate. *J Ultrasound Med*; 29: 1315-1319.
  11. Hackmon R, Le Scale KB, Horani J, et al. (2008): Is severe macrosomia manifested at 11-14 weeks' gestation?. *Ultrasound Obstet Gynecol*; 32:740-743.
  12. Smith GCS, Smith MFS, McNay MB, et al. (1998): First trimester growth and the risk of low birth weight. *N Engl J Med*; 339: 1817-1822.
  13. Bukowski R, Smith GC, Malone FD, et al. (2007): Fetal growth in early pregnancy and risk of delivering low birth weight infant: prospective cohort study. *BMJ*; 334:836-839.
  14. Tuuli MG, Cahill A, Stamilio D, et al. (2011): Comparative efficiency of measures of early fetal growth restriction for predicting adverse perinatal outcomes. *Obstetrics & Gynecology*; 117: 1331-1340.
  15. Salomon LJ, Hourrier S, Fanchin R, et al. (2011): Is first trimester crown-rump length associated with birth weight? *BJOG* 118:1223-1228.
  16. Nakamura M, Hasegawa J, Arakaki, et al. (2015): Repeated Measurement of Crown-Rump Length at 9 and 11-13 Weeks' Gestation: Association with Adverse Pregnancy Outcome. *Fetal Diagn Ther*; 38: 262-268.
  17. Ben-Ami I, Sheena L, Svirsky R, et al. (2014): The association of crown rump length discrepancy with birth weight discordance in spontaneous versus assisted conception dichorionic twins. *Prenat Diag*; 34(8): 748-752.

3/25/2019