

## Original Research Article

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# Correlation of gestational age assessed by last menstrual period and New Ballard's Score in pre term babies

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## ABSTRACT

**Background:** Gestational age is a critical factor in the management, decision making and follow up of new born infants. Identification of gestational age especially within 48 hours of life is crucial for new born. Since decades attempts have been made to find an alternative measurement for gestational age and birth weight estimation of the newborns. Last menstrual period is an inexpensive method and potentially efficient for calculating gestational age. Objective of this study was to the present study aims to compare the gestational age by New Ballards score with LMP, in pre term babies.

**Methods:** A total 150 pre term babies who are born to mothers remembering LMP were enrolled for the study group. During the study period new Ballard scoring was done for babies within 48hrs and Gestational age was compared with LMP. The collected data was analyzed by using SAS-6.50 version. Study design a prospective observational study was conducted over a period of one year from January 2018 till December 2018 at Rajarajeswari Medical College and Hospital, Bengaluru, India

**Results:** The New Ballard score is found to be significantly correlated with GA above 29 weeks ( $p<0.01$ ). The LMP mean was  $35\pm2.0$  weeks. Total 60.6 % of the childbirth is lead to normal vaginal delivery. The analysis shows LMP were found to be strongly correlated with GA ( $p<0.01$ ).

**Conclusions:** LMP alone can be reliably used in assessing the gestational age and can be assessed more accurately and be confirmed with new Ballard's scoring for preterm babies of  $>29$  weeks.

**Keywords:** Ballard's score, GA-gestational age, Last menstrual period, Preterm

## INTRODUCTION

The study was undertaken to correlate gestational age assessment using last menstrual period and New Ballard score in our patients. In this situation gestational age assessment based on the examination of neonate is essential to stratify the child into small for gestational age or prematurity to device treatment protocol appropriate for the neonate as the mortality and morbidity is different in these subgroups. Accurate assessment of gestational age is an essential component of good obstetric care. Many techniques of gestational estimation are available, ranging from calculations based on the date of the last normal menstrual period to sonographic measurements of

fetal parameters. Each method has advantages and disadvantages and a stage of pregnancy at which it is most reliable.<sup>1</sup>

Hence by this study an attempt is made to see if LMP can be used reliably to determine gestational age. This age-old method is still followed everywhere. It is simple and quite reliable. The expected date of delivery (EDD) and the gestational age of the infant are calculated by adding nine calendar months and seven days, to first day of the last menstrual period. This method may fail when the last menstrual period will not be available especially if the second pregnancy follows the first in the amenorrhoeic period.

### **Gestational age assessment by neonatal maturity scoring**

Ballard J et al, introduced a simplified method for clinically determining fetal maturation of newborn infants.<sup>1</sup> This included six physical and six neurological criteria. The physical criteria were skin, lanugo, plantar surface, breast, eye/ear, genitalia. Neuromuscular criteria were posture, square window, arm recoil, popliteal angle, scarf sign and heel to ear maneuver. She found that the reliability of this method was poor prior to 30 hours or after 42 hours of life. Also, the total score was more accurate and the accuracy was similar to that obtained by the previously employed, more complicated systems. In 1991 the Ballard maturational score was refined and expanded to achieve greater accuracy and to include extremely premature neonates.<sup>2</sup> The physical and neurological criteria were expanded to identify the neonates less than 26 weeks of gestational age. In this method, the foot length and fusion of eyelids were added. The difference of agreement between gestational age assessed by this method with the last menstrual period and ultrasound method was found to be less than two weeks.

The criteria used for estimating gestational age after birth may be divided into those which are based on physical maturation and those dependent on the development of the nervous system.<sup>2</sup>

#### **Physical criteria**

##### *Plantar crease*

Plantar surface before 28 weeks has no creases; between 28-32 weeks, a few faint red lines appear over the anterior aspect (forward) of the foot; between 34-37 weeks 1 to 2 anterior transverse creases appear; between 37-39 weeks creases cover the anterior 2/3 of the sole; at term creases cover the entire plantar aspect of the foot and involve the heel.

##### *Skin*

Skin before 28 weeks is gelatinous, red, translucent and friable; between 28-37 weeks skin over-the abdomen is thin, translucent pink with visible veins; between 37-39 weeks it is smooth, pink, increased thickness with rare visible veins over the abdominal wall; after 40 weeks vessels will disappear, skin may be parchment-like or leathery with deep cracking. Preterm babies' fingernails do not reach fingertips; at term nails reach fingertips; in post term babies nails pass finger tips and are firm.

##### *Vernix*

Vernix before 34 weeks is thick and covers the entire body; between 34 - 38 weeks it is absorbed gradually, vernix over shoulders and neck creases is absorbed last;

between 38-40 weeks it is now found only in skin folds; after 42 weeks it is not seen.

##### *Ear cartilage*

Cartilaginous development before 34 weeks is very immature, cartilage is not present in any part of the ear, the pinna is flat and formless, remains folded; between 34-37 weeks pinna curved, soft with slow recoil; between 34-40 weeks formed and firm with instant recoil; After 40 weeks thick cartilage is present and ear is stiff.

##### *Breast*

Breast development has two criteria; nipple formation and breast tissue development. Before 28 weeks nipples imperceptible; between 28-32 weeks nipples are barely visible, no areola; between 32-37 weeks well defined nipple is present and areola is stippled; between 38-40 weeks well defined nipple is present and fully raised areola is present; Breast tissue before 33 weeks, no-nipple bud can be palpated; between 33 to 36 weeks 1-2 mm between 36 to 38 weeks 3-4 mm and at 38 to 40 weeks it is 5-10 mm.

##### *Scalp hair*

Before 36 weeks scalp hair is fine and fuzzy, difficult to distinguish individual strands, seems to appear in clumps, often extends further down on forehead and on the side of the face than in term neonates; after 36 weeks it is coarse and silk strands present.

##### *Lanugo*

After 20 weeks lanugo begins to appear; at 28 weeks it is abundant; after 28 weeks lanugo vanishes first from face, then from remainder of the body; at 38 weeks, bald areas are present, a slight amount may remain over the shoulders.

##### *Genitalia*

In breech or difficult deliveries, the genitalia may become bruised or edematous in males. Before 28 weeks, scrotum is empty and flat; between 28-30 weeks, testes is undescended into the scrotal sac; between 30-36 weeks it is descending with few rugae over the scrotum, right testes usually descends first; between 36-39 weeks, it has descended into the scrotum and has become pendulous and rugation is complete.

In females before 28 weeks, clitoris is prominent, labia is flat, between 28-32 weeks prominent clitoris and enlarged labia minora is present; between 33-36 weeks, labia majora are widely separated and equally prominent labia minora present; between 36-39 weeks it extends over the labia minora but not over the clitoris; after 39 weeks it completely covers the labia minora and clitoris.

### ***Neuromuscular criteria***

#### ***Posture***

Posture is observed when neonate is quiet and in the supine position. The score is based on the degree of flexion of the arms, knees and hips including adduction of the hips. Before 30 weeks, neonate is hypotonic, little or no flexion is seen in the extremities; between 30-38 weeks varying degrees of flexed extremities are present; at 38-42 weeks neonate may appear hypertonic.

#### ***Square window***

Square window is measured by flexing the neonate's hand to the forearm using gentle pressure. The angle decreases with advancing gestational age. Before 26 weeks, wrist cannot be flexed to 90°; before 30 weeks wrist can be flexed no more than 90°; between 36-38 weeks, wrist can be flexed no more than 45°; between 38-40 weeks flexibility is maximized; palm can be brought to the forearm.

#### ***Scarf sign***

Scarf sign is assessed with the neonate in a supine position; head in the mid-line, the arm is gently pulled across the chest and posteriorly. Scores are based on the position of the elbow in relation to the chest structures.

Before 28 weeks elbow passes the torso when gently pulled; between 28-34 weeks elbow passes the opposite nipple line; between 34-36 weeks it can be pulled past the midline, offers no resistance; between 36-40 weeks it can be brought to midline, some resistance is noted; after 40 weeks it doesn't reach midline, maneuver is difficult or impossible to perform.

#### ***Heel-to-Ear maneuver***

Heel-to-Ear Maneuver is done when neonate is placed supine with the pelvis flat while the foot is pulled gently toward the ear. The score is based on the distance from the heel to ear. This maneuver is invalid in breech delivery. Before 34 weeks there is no resistance and can be performed without difficulty; after 40 weeks this maneuver is difficult to perform.

#### ***Arm recoil***

Arm recoil can be assessed by positioning the neonate in supine position, the arms are flexed for five seconds, and then the arms are fully extended and released.

The neonate is graded to the extent that the arms return rapidly to full flexion. Before 28 weeks there is no recoil; between 28-32 weeks slight recoil present; between 32-36 weeks recoil does not pass 90°; between 36-40 weeks recoil is up to 90°; after 40 weeks rapid full recoil is present.

### ***Popliteal angle***

Popliteal angle is measured with the neonate in supine position. The thigh is placed in the knee chest position. The leg is then extended and the popliteal angle is measured. Before 26 weeks angle is 180°; between 26-28 weeks angle is 160°; between 28-32 weeks angle is 140°; between 32 -36 weeks angle is 120°; 36-40 weeks angle is 100°; between 40-42 weeks angle is 90°, after 42 weeks angle of less than 90°.

#### ***Tone***

Before 30 weeks neonate is hypotonic lies in the same position in which he/she is placed and moves very little; between 30-34 weeks it begins in the lower extremities; between 34-36 weeks neonate draws his/her knees to a froglike position; between 36-40 weeks total flexion is noted. When it was recognized that infants of low birth weight could be small because of shorter gestation, or because of intra uterine growth retardation, methods to distinguish them on the basis of clinical assessment became important.

## **METHODS**

A Prospective Observational study was conducted at Raja Rajeswari Medical College and hospital from January 2018 to December 2018. As per the normative sampled procedure we recruited the babies and all babies were done Ballard's scoring to assess the gestational age (GA) within 48hrs of life. The inclusion and exclusion criteria has adopted for conducting the research,

#### ***Inclusion criteria***

Babies inborn cases and known LMP.

#### ***Exclusion criteria***

Babies whose mothers who do not know their LMP or multiple gestation (GA) or Congenital anomalies (CA) etc.

All selected babies Ballard's scoring was done and compared with LMP to assess the predictors of the study hypothesis. The GA when she delivered, was observed. The neonates was examined for the exact GA on the day of delivery and their maturity was assessed by the pediatrician using New Ballard's score. This available data was co-related for further evaluation.

#### ***Statistical analysis***

Data was collected in a pretested, semi structured standard proforma, collected data was entered in MS-excel and analysis was done using Special package for Social Sciences (SPSS) version 16. The continuous variables were expressed in mean and categorical variables were expressed in proportions etc. Karl Pearson

correlation coefficient and logistic regression test was used to test the hypothetical results. The results were considered significant at 0.01 level of significance ( $p=0.001$ ).

## RESULTS

In this study male babies (58.6%) are more than female babies (41.3%) as given in Table 1. The mean Gestational age (GA) according to LMP was 35+2 weeks. According to New Ballard score was 36+2 weeks. Total 60.6% of the childbirth is Normal vaginal delivery.

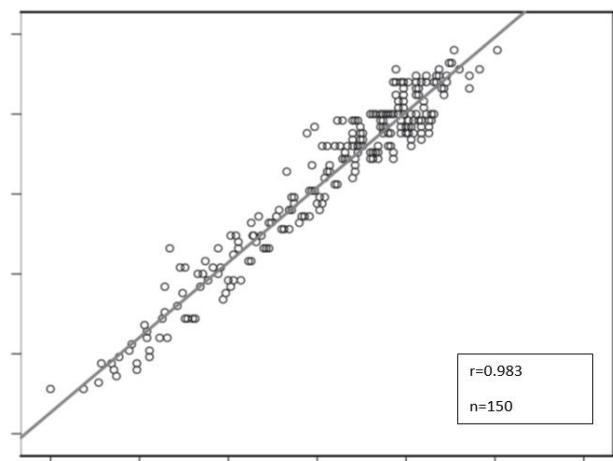
**Table 1: Basic characteristics of subjects.**

Characteristics	No	Percentage
Male	88	58.6%
Female	62	41.3%
Normal vaginal delivery	91	60.6%
LSCS	59	39.3%
<1000g	9	6%
1000g-1400 g	121	80.6%
1499g -2399 g	20	13.3%

This study shows that New Ballard score correlates more with gestational age according to LMP ( $r=0.983$ ) with  $p$  value less than 0.01 as in Table 2.

**Table 2: Distribution of subjects based on gestational age.**

Gestational age (weeks)	LMP (150)	New Ballard Score (150)	Pearson correlation	p value
28-29	15	12	0.75	>0.05
30-31	17	16	0.983	<0.01
32-33	18	18	0.983	<0.01
34-36	100	92	1	<0.05



**Figure 1: Correlation of gestational age between LMP and New Ballard Score.**

The average duration of menstrual cycle was taken and the corresponding GA were determined according to intermenstrual period multiplied by 10. The mean birth weight was 3.26 with SD 0.35 and it was found to be statistically significant ( $p<0.01$ ). This statistically significant correlation was also seen in study done by Hutchison DJ et al, Ballard et al, Kutz A et al and Whitehouse et al.<sup>1-4</sup>

## DISCUSSION

Our entire adult lives pregnancy is 40 weeks. In many literatures clearly stated that the duration of pregnancy in homosapiens is ten times intermenstrual interval the GA age of patients was calculated from the routine Naegele's formula. As per Naegele's formula, nine calendar months and seven days are added to the last menstrual period date. Alternatively, 10 lunar months or 280 days or 40 weeks can be used to calculate the approximate expected dates. The maturity of neonates was assessed by using new Bellard's score. The Ballard maturational assessment, Ballard score or scale is commonly used techniques of GA assessment. It assigns a score to various criteria, the sum of all of which is then extrapolated to the GA of the baby. These criteria are divided into physical and neurological criteria. This scoring allows for the estimation of age in the range of 26 weeks 44 weeks. The new Ballard score is an extensive of the above include extremely pre term babies i.e. up to 20 weeks of GA. The scoring relies on the intra uterine changes that the fetus undergoes during its maturation. Whereas the neurological criteria depend mainly upon the muscle tone, the physical ones rely on anatomical changes, the parameters of physical criteria viz skin appearance, presence of lanugo, hair, plantercreases, breast tissues, ear formation and external genital formation and neuromuscular criteria viz., posture, square window, arm Recoil, politeangle, scarf sign and heel toe etc. Koga et al, concluded that New Ballard's score is a valuable method of assessing gestational age.<sup>5</sup> Vik T et al, concluded that gestational age assessment by New Ballard's score may be useful in assessing gestational age, in particular when biparietal diameter and last menstrual period is uncertain.<sup>6</sup>

Inter-observer variation in estimating by New Ballard score and bias in assessment of gestational age when obstetric age is known by last menstrual period were studied thoroughly by Ballard et al, Gagliardi et al, and Smith et al, have concluded that there is no possibility of bias or interobserver variation in estimation.<sup>2,7,8</sup> In a recent review published by Opara P it is found that estimation of gestational age by New Ballard score is reliable.<sup>9</sup> Most methods of calculating gestational length are based upon 28 day cycle. If a woman has a cycle which is significantly shorter than 28 days and she delivers before her due date calculated by her LMP, this arises an anticipation of a premature baby, but the fetus is mature by all criteria of maturity assessment.<sup>10</sup>

## CONCLUSION

Gestational age assessment by New Ballard Score (GA\_NBS) correlated with high level of significance (P value less than 0.01) with gestational age assessment by Last menstrual period (GA\_LMP) in preterm babies. Birth weight of the neonate or sex of the baby does not influence the age assessment by New Ballard score. Mode of delivery or the gravida does not influence the assessment of gestational age by New Ballard Score. So we can use New Ballard score to assess the gestational age with 95% confidence limits when no other means of knowing gestational age is available with the neonate.

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