Determination of the Diagnostic Accuracy of Simplified Gestational Age Assessment Score in Assessment of Gestational Age in Neonate More than 28 Weeks – A Cross-Sectional Study

[1]Dr. (Lt Col) Umesh Kumar Singh, [2]Dr Shweta Singh, [3]Dr. Amit Naresh

[1]Dept. of Pediatrics, MH Golconda, Hyderabad,

2Dept of Oral Medicine & Radiology, BBD College of Dental Sciences, Faizabad Road, Lucknow, UP

[3]Dept. of Pediatrics, Command Hospital, Lucknow, UP

DOI: https://doi.org/10.51244/IJRSI.2025.120700127

Received: 08 July 2025; Accepted: 15 July 2025; Published: 06 August 2025

ABSTRACT

Introduction: Gestational age assessment is not only a vital step in management of mother but also important for fetus and newborn. Measuring gestational age is utmost important during antenatal period for numerous interventions and for prevention of troublesome pregnancies. Hence the aim of this study is to determine the diagnostic accuracy of SGAS in assessment of gestational age at birth.

Method: A cross-sectional study was performed with 399 neonates > 28 weeks to determine the diagnostic accuracy of SGAS in assessment of gestational age at birth and to it to best obstetric estimate (BOE) in identifying preterm newborn >28weeks. New Ballard score and SGAS scoring was done for the same.

Results: The positive correlation between gestational age, NBS, and SGA is significant (p-value <0.00). A strong correlation of gestational age for days and weeks is observed, as both were calculated using the LMP. Similarly, moderate levels of positive correlations between NBS and gestational age were observed at several weeks and weeks of gestational age. The positive correlation between NBS and SGA is strong with a correlation coefficient of 0.752, and the correlation between SGA and gestational age is moderate (r = 0.485).

Conclusion: Tertiary care should focus on improving dating during pregnancy by ultrasound and improving validity in growth-restricted populations. Where ultrasound is not possible, multiple methods for newborn assessment are used of which Simplified gestational age assessment score plays an important role in assessing gestational age in neonate more than 28 weeks.

Keywords; Simplified gestational age, New Ballard Score, Last monthly period, Best obstetric estimate, USG

INTRODUCTION

Preterm delivery is the important cause of under 5 mortalities, causes approximately ten lakh neonatal deaths annually [1],[2]. Most of the death, approximately 99% occurs in low- and middle-income country (LMICs). Mortality among preterm in LMICs occurs seven-fold more than in term neonate. In these settings, preterm are commonly unrecognized and unable to receive care as required [3],[4]. Gestational age assessment is not only a vital step in management of mother but also important for fetus and newborn. It is period which is traditionally defined as the time or duration of pregnancy from 1st day of last menstrual period when menstrual cycle is regular. Accurate assessment of gestational age is not only important during antenatal period for various interventions and for prevention of untoward outcome of pregnancy but also required for labeling the newborn as early preterm, late preterm or term and to decide upon level of care required during perinatal and neonatal period. There are various methods for knowing gestational age during antenatal and postnatal period. Prenatal gestational age assessments are usually done by last menstrual period, antenatal ultrasonography, clinical examination [5]-[8] and postnatally it is done by various clinical methods like Dubowitz scores, New Ballard

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VII July 2025

score, Meharban Singh score, Perkins scores and simplified gestational age score (SGAS) [9]-[16]. Gold standard among these is 1st trimester ultrasound [8]. Although prenatal assessment of GA is more reliable but many of the times mother conceives during lactation amenorrhea or menstrual cycle are very irregular or break through bleed during first trimester taken by mother as menstrual cycle and sometime mother may not remember exact 1st day of LMP [15] [16]. Antenatal sonography may not available at grass roots level where most of the delivery occurs. In some situation mother may present late in third trimester or during labor for first time. In such situation antenatal assessment of GA is not available. Clinician need to depend upon postnatal assessment of GA. More commonly used reliable methods like Dubowitz scores, New Ballard score is available but it requires training and is suitable for trained health care specialist [17][18]. SGAS is developed in India (Nagpur) is simple clinical pictorial app-based method of examination which include only 4 parameters posture, skin, breast, genitals which can be easily done by health care worker at periphery with short period of training [18]-[20]. Objective of this study is to determine the diagnostic accuracy of SGAS score for identifying preterm neonates at birth.

Aim & Objectives:

The aim of the study is to determine the diagnostic accuracy of SGAS in assessment of gestational age at birth. The objectives of study are classified under primary and secondary which is as follows:

Primary- To determine the diagnostic accuracy of SGAS as compared to best obstetric estimate (BOE) in identifying preterm newborn >28weeks.

Secondary- To determine the agreement between BOE and SGAS in classifying early neonate into very preterm, moderate preterm and late preterm. To determine the correlation between New Ballard Scores and SGAS in assessment of gestational age in neonate. To determine the agreement between NBS and SGAS in classifying early neonate into very preterm, moderate preterm and late preterm.

METHODS

This cross-sectional study was taken place at Command Hospital Lucknow in the Department of Pediatrics having study population of neonates> 28 weeks which are born at tertiary care center. The calculated sample size was 400. Neonates born >28 weeks at 24-72 hours of life are included in the study. Following are the exclusion criteria for the study:

1. Neonates with birth asphyxia or who were resuscitated
2. Neonates with major congenital anomalies or signs of neurological depression
3. BOE not available
4. Mother and baby are clinically unstable
5. Multiple gestation
6. Refusal to consent

All neonates >28 weeks born at Command Hospital, Lucknow are screened and written informed consent had obtained from parents of eligible neonates. Best obstetric estimate (BOE) (1st trimester USG and/or LMP), baseline antenatal and birth data were recorded as per Performa. New Ballard score and SGAS scoring was done for the same. Total score for both scoring systems was recorded. BOE is based on the known date of fertilization.

1. Very preterm: Born at gestation age 28^{+1} to 32 weeks as per BOE
2. Moderate Preterm: Born at gestation age 32^{+1} to 34 weeks
3. Early preterm: Very preterm and moderate preterm.
4. Late Preterm: Born at gestation age 34^{+1} to 36^{+6} weeks.

Statistical analysis was done in number and percentage (%) and continuous variables will be presented as mean ± SD and median. Pearson correlation coefficient/Spearman Rank correlation coefficient was used to correlate New Ballard Scores and T-SGAS with gestational age.

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Sensitivity, specificity, NPV, PPV and diagnostic accuracy were also assessed. Chi square test was used to compare diagnostic accuracy and Mcnamer test was used to compare sensitivity and specificity. A p value of less than .05 was considered as significant.

RESULTS

Background characteristics of the neonates:

A total of 399 neonates were enrolled in the study. The mean age expressed as hours of life was 47.5 hours (Figure 1).

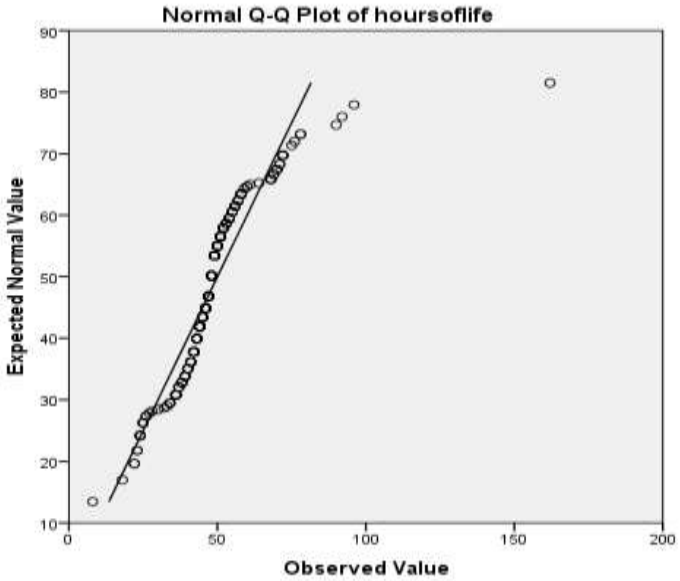

Figure 1: Normal Q- Q Plot of age in hours

The mean gestational age of the mothers at the time of delivery in days was 264.98 days (+ 14.79) and in weeks it was, 37.7 weeks (+ 2.00). According to New Ballard Score (NBS), the mean gestational age was estimated as 35.5 weeks (+3.6). The normality of quantitative variables was assessed by visual inspection of Q-Q diagrams. Explicit age indicates that the data follows the normal curve, except for one outlier. It can be observed in Figures 2 and 3.

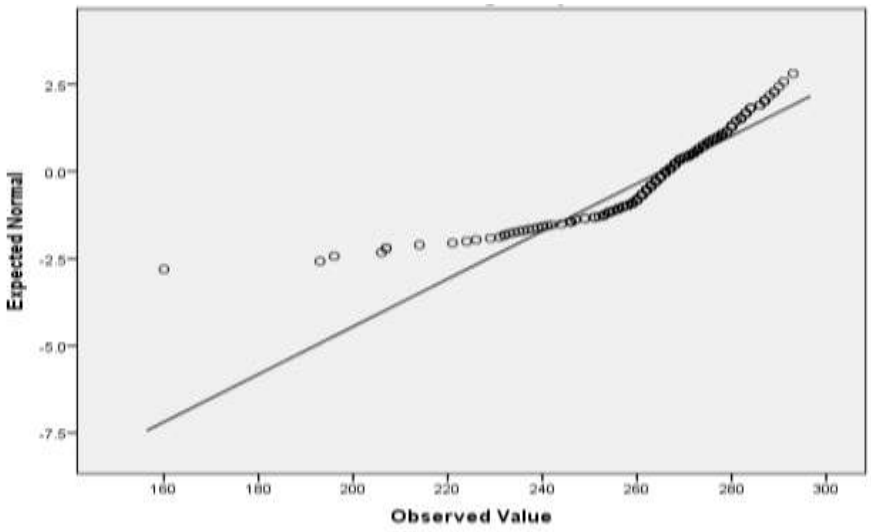

Figure 2: Normal Q- Q Plot of Gestational age in days

Except for some outliers, the data appears to be normal gestational age within days and weeks. However, the

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data do not appear normal in NBS and simple gestational age (SGA) (Figures 4 and 5).

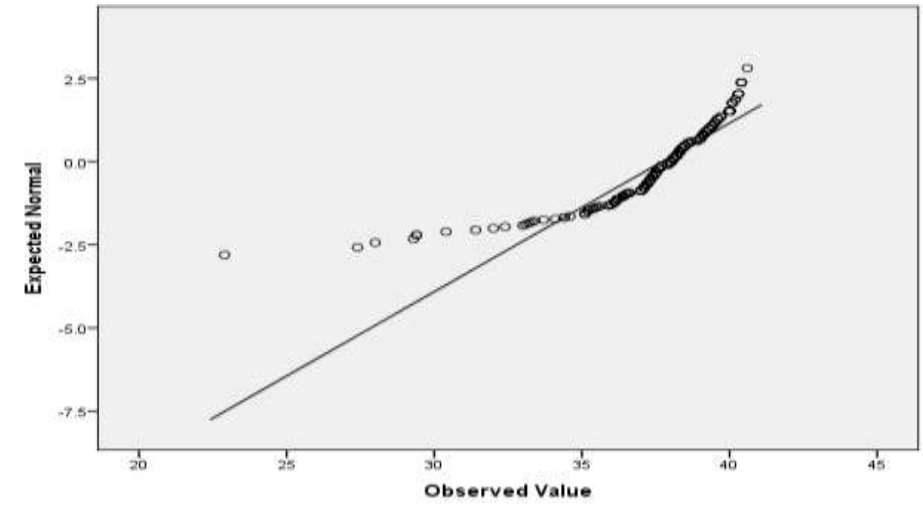

Figure 3: Normal Q- Q Plot of Gestational age in weeks

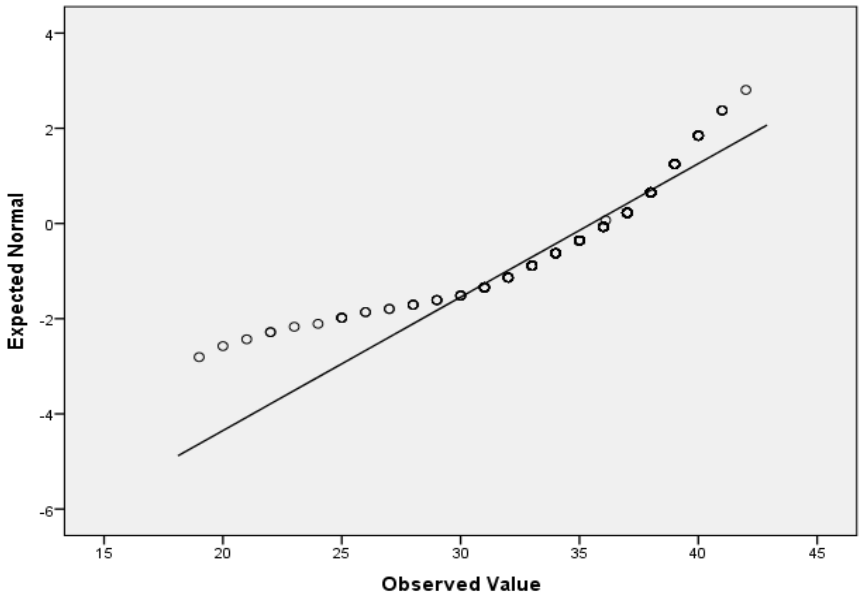

Figure 4: Normal Q- Q Plot of New Ballard Score

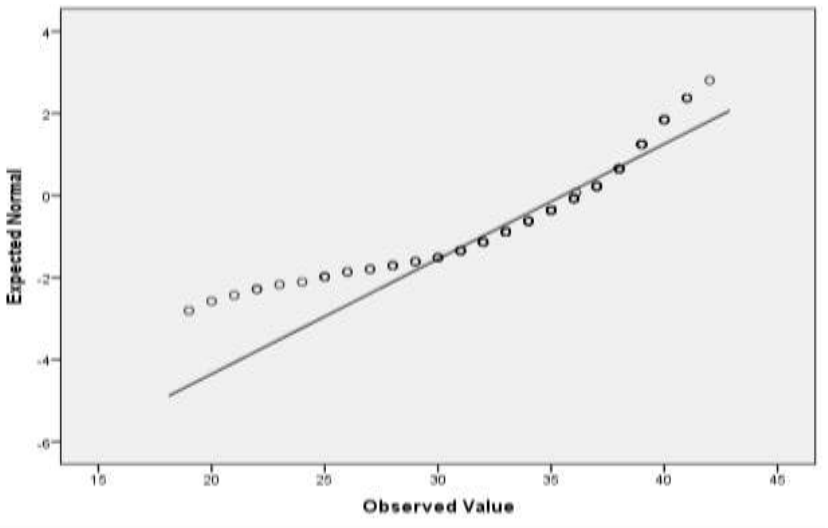

Figure 5: Normal Q- Q Plot of Simple Gestational Age Score

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VII July 2025

Correlation between different scoring systems:

Table 1 shows the positive correlations between the quantitative variables mentioned above. Spearman correlations were used to assess correlations because the normality prerequisites were not met to manipulate Pearson correlations. As seen in Table 1, the positive correlation between gestational age, NBS, and SGA is significant (p-value <0.00). A strong correlation of gestational age for days and weeks is observed, as both were calculated using the same method (LMP). Similarly, moderate levels of positive correlations between NBS and gestational age were observed at several weeks (r = 0.612) and weeks of gestational age (r = 0.586). The positive correlation between NBS and SGA is strong with a correlation coefficient of 0.752 (p < 0.00), and the correlation between SGA and gestational age is moderate (r = 0.485).

Physical maturation and neuromuscular maturity are assessed with new ballad score estimates. Physical maturation includes assessment of skin structure, lanugo, plantar folding, chest, eyes, ears, and genitals.

Spearman's Correlation		GA (in days)	GA (in weeks)	NBE Score	SGA Score
Gestational Age (in days)	Correlation Coefficient	**1.000**			
	Sig. (2-tailed)	.			
	N	400			
Gestational Age (in weeks)	Correlation Coefficient	.983**	**1.000**		
	Sig. (2-tailed)	.000	.		
	N	400	401		
New Ballard Score	Correlation Coefficient	.612**	.586**	**1.000**	
	Sig. (2-tailed)	.000	.000	.	
	N	399	399	399	
Simple Gestational Age Score	Correlation Coefficient	.485**	.468**	.752**	**1.000**
	Sig. (2-tailed)	.000	.000	.000	.
	N	399	399	399	399

**. Correlation is significant at the 0.01 level (2-tailed).

Table 1: Correlation between Gestational age, New Ballard score and Simple gestational age score

Neuromuscular maturity is assessed by posture, square windows, arm recoil, popliteal force, shaped filamentous signs, and ear healing. A simple pregnancy age is H. It is evaluated based on only four factors: skin, texture, breast, and genital ratings.

The gold standard for assessing pregnancy age comes from LMP. It was used as a standard to assess the effectiveness of NBS and SGAS values. Gestational age and new ballad scores were divided into pregnancies before the period (<37 weeks) and before the period (>=37 weeks). SGA was categorized by a cutoff of 13 of these 71 women, with 69 and 68 being grouped by NBS or SGAS (True Positive, TP). Thus, two and three pregnant women were incorrect as the concept of NBS or SGA (false negative, FN). Similarly, 328 by the LMP method was classified as the concept of pregnancy. Of these, 186 and 197 were classified as NBS or SGA (True Negative, TN) conditions. Here, 142 and 131 by NBS or SGA were misrepresented previously. (FALSE positive, FP (Table 2).

GA assessment	**LMP**	
New Ballard Score	<37 weeks	>=37

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		weeks
<37 weeks	69	142
>=37 weeks	2	186
SGA Score		
<13	68	131
>=13	3	197

Table 2: Comparison of prediction of Gestational age using standard LMP method, New Ballard Score and Simplified Gestational Age score

Predictive measures:

The sensitivity of NBS and SGA is 97.2% or 95.8%. This means that the likelihood of identifying a true positi ve through NBS is 97.2% and 95.8% of SGA. For specificity, i.e. H. NBS and SGA, the test's ability to correctl y identify actual negativity was only 56.7% or 60.1%. The PPVs in NBS and SGA are only 32.7% or 34.2%. The ability of these tests to identify people who did not have a condition was 98.9% or 98.5% of NBS or SGA. The accuracy of NBS was calculated for two components. Physical maturation and neuromuscular maturity are separated. The diagnostic accuracy of physical and neuromuscular maturation was 77% and 89%. Similarly, this is 77.5% on SGAS (Table 3).

GA assessed by:	**Sensitivity (%)**	**Specificity (%)**	**PPV (%)**	**NPV (%)**	**Accuracy**	**AUC**
New Ballard Score	97.2	56.7	32.7	98.9	77* 89#	86.3* 95.3#
SGA score	95.8	60.1	34.2	98.5	77.5	88.4

* NBS: Physical maturity # NBS: Neuromuscular maturity

Table 3: Validation of New Ballard Score and Simplified Gestational Age Score assessed against that assessed by LMP

DISCUSSION

This study included "Diagnostic accuracy of simplified assessment values for pregnancy age of newborns" with a total of 399 newborns. The average age was 47.5. And 37.7 weeks (+2.00) in a few weeks. Moderate positive correlations were observed for several weeks ($r = 0.612$) and gestational age ($r = 0.586$) between NBS and gestational age. The positive correlation between NBS and SGA is strong with a correlation coefficient of 0.752 ($p < 0.00$), and the correlation between SGA and gestational age is moderate ($r = 0.485$). The gold standard for assessing pregnancy age comes from LMP. A total of 71 pregnant women using the standard LMP method have been observed to be classified as a gestational age of <37 weeks. Of these 71 women, 69 and 68 were pre-correctly grouped by NBS or SGA (True Positive, TP). Thus, two and three pregnant women were incorrect as the concept of NBS or SGA (false negative, FN). Similarly, 328 by the LMP method was classified as the concept of pregnancy. Of these, 186 and 197 were classified as NBS or SGA (True Negative, TN) conditions. Here, 142 and 131 by NBS or SGA were misrepresented previously. (FALSE positive, FP). Derived summary of accuracy is significant, including positive correlations between pregnancy age, NBS, and SGA (p-value <0.00). A strong correlation of gestational age for days and weeks is observed, as both were calculated using the same method (LMP).

In a similar study by Archahane B. Patel et al. Four SGA objects (skin, breast, genitals, and attitudes) were selected from a total of 171 LBW neonates included in the development study. Very early births (32 weeks) had a prevalence comparable to the overall prevalence. The SGA had a greater agreement between two ratings (0.825

Cohens Kappa) than the NBS (0.709 Cohens Kappa). Compared to NBS, SGA showed greater positive predictors for 32-week and 32-35-week time intervals [1]. In this study, positive correlations between gestational age, NBS, and SGA were found to be significant (p-value <0.00). A strong correlation of gestational age for days and weeks is observed, as both were calculated using the same method (LMP). Similarly, a moderate level of positive correlation between NBS and gestational age (r = 0.612) and a gestational age (r = 0.586) was observed. The positive correlation between NBS and SGA is strong with a correlation coefficient of 0.752 (p < 0.00), and the correlation between SGA and gestational age is moderate (r = 0.485).

In a study by Stephan Karl, the mean distortion was between reference ultrasound and the clinical procedure (95% confidence interval: 14-42 days). Ultrasound in mid-pregnancy provided the most accurate prediction of preterm birth (F measurement: 0.72). On the other hand, neuromuscular ballad scores provided the most accurate early baby prediction (F measurement: 0.17). The final menstrual cycle and pitch were the most effective clinical indicators of gestational age and preterm birth (F measured 0.35) [21]-[23]. In the proposed study, the sensitivity of NBS and SGA is 97.2% or 95.8%. This means that the likelihood of identifying a true positive through NBS is 97.2% and 95.8% of SGA. For specificity, i.e. H. NBS and SGA, the test's ability to correctly identify actual negativity was only 56.7% or 60.1%. Positive predictors indicate the ability to test correctly identify people with a condition of interest. We can see that the PPVs in NBS and SGA are only 32.7% or 34.2%. The ability of these tests was 98.9% or 98.5% of NBS or SGA, with 129 newborns being tested after more than 2 weeks, and subjects not being tested on day 5 or 7, while K Sasidharan's study, on day 7, NBS GA was falsely evaluated in 26.7% of cases and in 19.8% of cases. All the differences were two weeks. Intraclass correlation (ICC) for Gold Standard GA and NBS-based GA for Day 1 raters were 0.94, 0.94, and 0.92 for Day 5 and Day 7 raters compared to Gold Standard. On days 5 and 7, the ICC was for reliability between the terms 0.97 and 0.96. The overall ICCs for raters on days 5 and 7 were 0.98 and 0.97 compared to RAW-NB on days 1 to 7 to 7 of neurological values. Ratings from day 5 and 7 were 0.92 and 0.88. All the ICCs above had a p-value, 0.001 [24][25].

Carol B. Benson evaluated the accuracy of ultrasound factors for the second and third stage gestational age against a highly reliable gold standard (crown ram length). 460 foetal sonograms were selected. When predicting gestational age in the late stages of pregnancy, the acclimated double-headed diameter and head circumference performed better than the bitrochanteric diameter, thigh length, and abdominal circumference (p.05, f test). The most accurate predictors for the third stage of pregnancy were standard angle diameter and thigh length, which were significantly better predictors than bicone diameter and ventral perimeter (p.05, F test) [26]. In his study, Deborah Constant found that the mid-term gestational age was five days (on the wheels during pregnancy) and nine days (by LMP calculations) than the gestational age defined by ultrasound. According to LMP calculations, 12% of women were eligible for medical abortion, but not after ultrasound. Uncertainty regarding LMP dates was related to false decisions about the age of pregnancy at which women were eligible for medical abortion (p = 0.015). 3% of women whose LMP date was within 56 days of conviction had an ultrasound gestation age of >70 days. With absolute inaccuracy of less than 5 days in the first gestation period and 7 days in the second 7 days, Robin B found that estimation of gestational age based on the length of the crown rump in early pregnancy and the late combined biometric measurements was very accurate [27]-[29].

CONCLUSIONS

Tertiary care should focus on improving dating during pregnancy by ultrasound and improving validity in growth-restricted populations. Where ultrasound is not possible, multiple methods for newborn assessment are used of which Simplified gestational age assessment score plays an important role in assessing gestational age in neonate more than 28 weeks.

ACKNOWLEDGMENT

N/A

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