Original Article

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Comparison of Parkin Score and New Ballard Score for Gestational Age Assessment in Newborns with Ultrasound Scan as the Standard Reference

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Author`s Contribution

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ABSTRACT

Objective: To compare the assessment of gestational age (GA) in newborns using the Parkin Scoring and the New Ballard Scoring methods with the Ultrasound Scan Method as the Standard Reference, conducted at a peripheral military setup.

Methodology: A descriptive, cross-sectional study was conducted at the Pediatrics department of Combined Military Hospital (CMH), Abbottabad from July 2019 to June 2020. A total of 102 newborns were recruited from the CMH Nursery. GA was assessed using ultrasound scan, Parkin Score (PS), and the New Ballard Score (NBS). Pearson correlation coefficient statistics were calculated to evaluate the strength of associations among the three methods. The significance level (p value) was set at 0.05.

Results: The study included 47 (46.1%) females and 55 (53.9%) males. The highest GA (days) was calculated by ultrasound scan (268.76 ± 0.83), followed by PS GA (266.65 ± 1.00) and NBS (264.38 ± 1.05). There was no significant difference in GA assessment between PS and the ultrasound scan (2.32 ± 1.37 days; p = 0.208). The GA assessment between NBS and the ultrasound scan was found to be significant (4.38 ± 1.37 days; p = 0.004). However, this difference is not clinically significant. The NBS and PS GA assessment had a strong positive correlation (Pearson Coefficient = 0.80).

Conclusions: The PS is a reliable method for assessing GA in newborns and is comparable to the NBS. Further research with a larger sample size should be conducted to validate these findings.

Keywords: Gestational age, Infant Mortality, Parkin Score, New Ballard Score.

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Introduction

Globally, infant mortality remains a pressing concern, with over 4 million infants losing their lives in 2017.[1] Pakistan, unfortunately, shoulders a significant burden, accounting for about 7% of these tragic deaths, totaling around 298,000 infants.[1,2] This staggering statistic underscores the urgent need for focused efforts to address the complex factors contributing to infant mortality in Pakistan.[1,2] The country grapples with the alarming reality of being ranked third in the world for infant mortality rates, primarily attributable to infections, preterm deliveries, and birth-related asphyxia.[1]

In this context, precise assessment of an infant's weight and gestational age (GA) at birth emerges as a critical aspect of neonatal care. Shockingly, a substantial number of newborns in Pakistan are not subjected to weight assessment, and GA often remains undetermined for many of these infants. Accurate GA determination is pivotal for pediatricians as it serves as a fundamental indicator for evaluating infant morbidity and mortality, playing a vital role in devising tailored management and intervention strategies, particularly for those infants facing medical complexities.[3,4]

GA assessment involves in understanding the infant's development, predicting potential health issues, and customizing care plans to meet their specific needs. Accurate determination of gestational age (GA) is a cornerstone of neonatal care, guiding clinical decision-making and appropriate interventions for both preterm and term infants. Conventionally, GA has been estimated using the last menstrual period (LMP) and ultrasonographic measurements. In countries similar to Pakistan, which socio-economic, as well as educational obstacles, depending exclusively on LMP – based calculations can result in inaccuracies, due to recall bias, irregular menstrual cycles, and restricted healthcare access, thereby diminishing the methods reliability.[1,3]

To address these challenges, alternative and more dependable methods for assessing gestational age has been introduced, such as the new Ballard score (NBS), the Parkins score, bracket (PS)[5,6], and ultrasound-based computation The NBS evaluates neuromuscular and physical maturity, offering a comprehensive assessment of GA in newborns. Likewise, the PS focuses on physical parameters and has been recognized as dependable method for GA assessment[7]. Conversely, Ultrasonography provides a direct and precise measurement of GA based on fetal biometrics, establishing itself as the gold standard in GA determination.[8]

Due to the crucial role of precise GA assessment in neonatal care, and the varying reliability of current and alternative methods, thorough comparisons are essential. Directly comparing the new Ballard score, Parkins's score, and ultrasound calculation can assess their efficiency, accuracy, and usefulness in healthcare, and in settings, where access to accurate data on last menstrual period may be restricted. Understanding how these approaches estimate GA is vital for new neonatal care and has implications for the developing healthcare policies and interventions to reduce infant mortality and enhance overall outcomes.

This study endeavors to compare gestational age assessments conducted via ultrasound computation, NBS, and PS. Through this evaluation, we aim to offer valuable insights into the strengths and weaknesses of each method, thereby assisting the healthcare practitioners in selecting the most reliable and appropriate approach for GS assessment in neonates. The findings of this study name have the potential to influence neonatal care practices in resource–constrained settings, contributing to improved healthcare delivery and better neonatal outcomes. Traditionally, GA estimation has relied on Naegele's formula, which calculates GA, based on the LMP or through ultrasonic evaluation. However, particularly in regions characterized by low social economic status, and low literacy rates, this conventional approach encounters significant limitations.

The precision of estimating gestational age using the LMP is profoundly impacted by various factors such as recall bias among pregnant women, variations in menstrual cycles, early pregnancy bleeding, and use of birth control.

To overcome these challenges, different methods for calculating GA, such as ultrasound dating, the New Ballard Score (NBS), the Parkins Score (PS), and the Dubowitz[7] scoring system, have gained recognition. These new methods are thought to be more reliable than the traditional G-LMP approach. For optimal provision of antenatal, natal, and post-natal care it is crucial to identify a dependable GA assessment method which raises the need for further comparative studies to assess the effectiveness of these methods.[8]

Therefore, this study sets out to compare GA assessments through ultrasound computation, NBS, and PS. To contextualize the significance of this comparative study within the broader research field, a comprehensive review of existing literature on GA assessment methods, detailing their strengths and weaknesses, is imperative. This review will elucidate the relevance of the study in addressing a critical gap in neonatal care and contribute to advancing effective GA assessment practices, ultimately improving neonatal health outcomes.

Methodology

A cross-sectional study was conducted at Combined Military Hospital (CMH), Abbottabad, spanning from January to December 2019. A total of 102 newborns using a non-probability, convenience sampling technique. Newborns born in the Gynaecology and Obstetrics Department of CMH Abbottabad were included, provided their parents granted informed consent. Ethical approval was taken from the CMH ethical review committee. A single pediatrician recorded various parameters of the newborns, including gender. Newborns displaying syndromic features, congenital anomalies, gestational age below 28 weeks or above 42 weeks, and those who unfortunately passed away within the first 72 hours were excluded from the study. Gestational age was determined using both the Parkins Scoring System (PS) and the New Ballard Score (NBS). The Parkins Scoring System involves four criteria: skin texture (score 0-4), skin color

(score 0-3), breast size (score 0-3), and ear firmness (score 0-3), with a resulting score ranging from 0 to 13. Each unit score corresponds to a specific gestational age. The New Ballard Score is based on both neuromuscular and physical maturity and can be applied up to four days after birth. It consists of twelve items, six for neuromuscular and six for physical maturity, each scored from -1 to 4 (except popliteal angle, which has a maximum score of 5). The total NBS ranges from -12 to 50, and each five-unit increase corresponds to a different gestational age in weeks. Data analysis was performed using SPSS 25.0. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize gender, mode of delivery, and different gestational age measurements obtained via ultrasound, NBS, and PS. ANOVA one-way test and post-hoc Tukey analysis were applied to assess differences in mean gestational age between the three calculation methods. Additionally, Pearson correlation coefficient statistics were calculated to evaluate the strength of associations among the three methods. The significance level (p value) was set at 0.05.

Results

A total of 102 newborns were recruited for this study. Out of the 102 newborns, there were 47 (46.1%) females and 55 (53.9%) males. Most of the newborns (n = 94; 92.2%) were born by a Lower Segment Cesarean Section, while only eight newborns (7.8%) were delivered through a Spontaneous Vaginal Delivery.

The highest GA was that calculated through the ultrasound scan (268.76 ± 0.83), followed by the Parkins Score GA (266.65 ± 1.00). The GA as assessed by the NBS was the lowest (264.38 ± 1.05), as shown in figure 1.

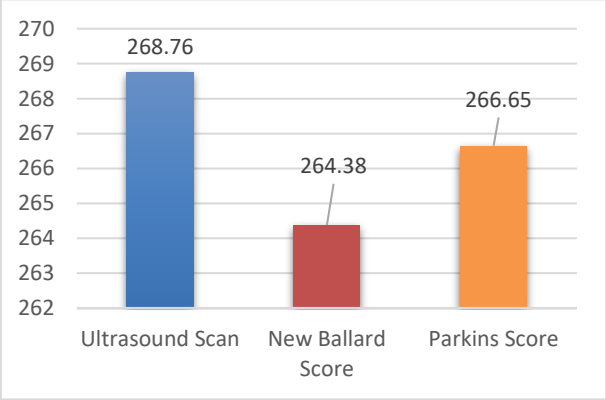

Figure 1. Gestational Age Assessment by Different Methods.

Post hoc Tukey analysis revealed that there was a significant difference in the GA assessment by the ultrasound scan and the NBS method (p = 0.004). The difference in the GA between the Parkins Score and the other two methods was not significant[9]. Also, there was no significant difference in the GA assessment by the ultrasound scan and the Parkins score. (Table I)

Table I: Mean Difference in Gestational Age Assessment between the Three Methods (n = 102)

Assessment Method	Comparison Method	Mean Difference	P Value
Ultrasound Scan	New Ballard Score	4.38 ± 1.37	0.004
	Parkins Score	2.32 ± 1.37	0.208
New Ballard Score	Parkins Score	2.06 ± 1.37	0.288

The analysis was then done for both genders separately. The GA scores for male and female newborns are shown in table II. There was no difference in the GA scores between male and female newborns.

Table II: Mean Gestational Age and Standard Error for Male and Female Newborns as Calculated by the Three Different Assessment Methods.

Assessment Method	Gestational Age		P Value
	Male	Female	
Ultrasound Scan	269.36 ± 1.23	268.06 ± 1.10	0.433
New Ballard Score	263.72 ± 1.80	265.15 ± 0.91	0.505
Parkins Score	265.17 ± 11.07	267.94 ± 1.26	0.161

The post hoc analysis for males revealed a similar pattern as reported for the whole sample. The only difference in the GA was found between the Ultrasound scan values and that calculated by NBS. (Table III)

Table III: Mean Difference and Standard Error in Gestational Age Assessment between the Three Methods for Male Newborns (n = 55)

Assessment Method	Comparison Method	Mean Difference	P Value
Ultrasound Scan	**New Ballard Score**	5.64 ± 2.16	0.026
	Parkins Score	4.19 ± 2.16	0.130
New Ballard Score	**Parkins Score**	1.45 ± 2.16	0.781

The post hoc analysis for female newborns revealed no significant differences in GA between any of the three assessment methods (Table IV).

Pearson's Correlation Coefficients were calculated for comparing each pair of the assessment methods. (Table V) Both the NBS (Pearson co and the PS were moderately correlated with the ultrasound scan method.

Table IV: Mean Difference and Standard Error in Gestational Age Assessment between the Three Methods for Female Newborns (n = 47)

Assessment Method	Comparison Method	Mean Difference	P Value
Ultrasound Scan	**New Ballard Score**	2.91 ± 1.56	0.151
	Parkins Score	0.13 ± 1.56	0.996
New Ballard Score	**Parkins Score**	2.78 ± 1.56	0.177

Table V: Pearson's Correlation Coefficient Values for the Three Different Assessment Methods

Assessment Method	Comparison Method	Correlation Coefficient	P Value
Ultrasound Scan	New Ballard Score	0.53	< 0.001
	Parkins Score	0.51	< 0.001
New Ballard Score	Parkins Score	0.80	< 0.001

Discussion

This study set out to compare the GA as calculated by ultrasound scan method; NBS and PS. The results reported a significant difference in the GA assessment by the ultrasound computational method (268.76 + 0.83) as compared to the NBS (264.38 + 1.05; p = 0.004). The difference between PS and the other two assessment methods was not significant. When the gender wise analysis was done, a similar trend was observed for male patients. For female newborns, none of the differences in the GA were significant. Moreover, the correlational analysis revealed that all the comparisons were moderately strong[9,10,11].

Regarding the difference between the ultrasound scan method and NBS, the difference in the GA was only 4.38 + 1.37. This difference may be significant in statistical terms, but from the clinician's point of view, a difference of 4 days would not be considered of much significance.[12,13] Thus, looking at the results in general, it may be suggested that all the three methods may be used with reliable confidence in the Pakistani neonatal settings.

LMP is better predictor than gestatonal age proved in a study by weinstein et al taking 1st trimester ultrasound as gold standard. Similar results were also seen in studies by Ravi et al., Bela et al. Where parkin score gestational age corelated well with LMP-GA but was less precise than NBS[14, 15.]

Ambey et al compared the GA assessment of normal and sick neonates (total sample = 500) using the PS and the NBS. GA was found to be better assessed by using PS, as compared to the NBS. Also, PS resulted in lesser discomfort for neonatesk.[16]

On the other hand, the NBS only had a mean difference of 4 days. This difference was not significant. Moreover, the two scores (PS and NBS) had a strong correlation coefficient (0.89).[17] This study used LMP as a yard stick, as compared to the ultrasound scan used in our study. Ultrasound is the most reliable method of dating and thus, a better gold standard. [18]

Sreekumar et al. compared the GA of 284 newborns through PS and NBS systems. The difference between the obstetric GA and NBS was 0.04 weeks (< 1 week) while that between the obstetric GA and PS was 12 days. Even though the difference in GA assessment between NBS and PS was 12 days, they were still found to be in agreement (95% Confidence Intervals -1.83 – 4.89).[11]

Lee et al. conducted a systematic review and meta-analysis of 78 studies analyzing 18 difference assessment methods for A. The Dubowitz method was found to be the most accurate system dating pregnancies within 2.6 weeks of the ultrasound scans. This was followed by the NBS which dated pregnancies within 3.8 weeks of the ultrasound scan dates. There were not enough data for a meta-analysis to be conducted for PS.[8]

The NBS is based on two sets of criteria: the neuromuscular and physical. Assessment of GA through the NBS involves six items for the neuromuscular and six items for the physical criteria. It can be difficult to assess these criteria in sick newborns.[5,13] On comparison, the Parkin's Score is only a four-criteria assessment of the GA. Moreover, the PS only includes physical criteria which are relatively easier to assess and results in lesser discomfort for the infants.[6] As suggested by Ambey et al, using the PS resulted in much lesser crying episodes in children, as compared to the NBS.[16]

Our study suggests that the assessment of GA using the PS is as reliable as the NBS. From a statistical standpoint, the PS even gave a better assessment of the GA than the NBS. Our study did have a few limitations. Firstly, only a sample of 102 newborns was included in this study. Larger sample studies should be conducted. Also, only the GA was assessed. The assessment methods should also be analyzed for other criteria such as the ease of use; time taken and discomfort to the newborn.

Conclusion

The Parkins Scoring system is a four-criteria method that takes lesser time and thus, is more conveniently conducted as compared to other systems including a larger number of criteria, such as the New Ballard System. There is a scarcity of literature regarding the reliability of the PS for assessing GA. Our study suggests that the reliability of the PS is as good as the NBS. Future large sample studies on the assessment of PS, in comparison to other assessment methods should be conducted.

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