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ESTIMATION OF GESTATIONAL AGE AND IDENTIFICATION OF PREMATURE NEONATES USING NEONATAL ANTHROPOMETRY – OCCIPITOFRONTAL CIRCUMFERENCE AND CROWN HEEL LENGTH

Pediatrics

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ABSTRACT

Background: Prematurity is an important contributor to neonatal mortality in India. Gestational age assessment is done by the conventional method "New Ballard Technique" which is more subjective and requires Pediatricians for assessing, and it is difficult in peripheral centers where the availability of Pediatricians is less. We aimed to determine if anthropometric measurements like occipitofrontal circumference and crown–heel length of the neonate can be used for assessing the Gestational age of neonate, as these measurements are easy to measure by untrained persons in the periphery.This helps in early intervention, if the neonate in preterm and can reduce mortality of preterm neonates. **Objectives:** To estimate Gestational Age (GA) of neonates using Occipitofrontal Circumference(OFC) and Crown Heel Length(CHL). **Study Design:** An Observational study **Participants:** All neonates delivered in BGS GIMS, Bangalore during the study period. **Results:** OFC and CHL have a good correlation with Gestational age with r-value 0.751 and 0.799. The regression equation derived were Predicted GA = 1.7143 (OFC) + (-19.7143) andPredicted GA = 1.2 (CHL) + (-20.4) respectively for OFC and CHL. Multiple regression gave equation Predicted GA = 0.311 (OFC) + 1.108 (CHL) + (-25.841) which is statistically significant. **Conclusion:** OFC and CHL are quick and easy methods which can be used as simple tools for predicting Gestational Age. This can help in identification of preterm neonates by peripheral health care workers and to intervene early and reduce mortality of neonates.

KEYWORDS

Prematurity, Gestational Age, Occipitofrontal Circumference, Crown Heel Length

INTRODUCTION:

An estimated one million babies die globally annually due to prematurity. Of which approximately 375,000 neonatal deaths due to prematurity and low birth weight occur in India alone (1,2). The contribution of newborn deaths to the under-5 mortality has grown from 37% in 1990 to 41% in 2011 Contributors for neonatal mortality are preterm delivery (29%), asphyxia (23%) and severe infections like sepsis and pneumonia (25%) (1,2). As prematurity is a leading cause, early identification and intervention is needed to reduce neonatal mortality rate.

Gestational age is calculated based on the Naegele's formula or by ultrasonic evaluation. Gestational age estimates based on Naegele's formula tend to have a lower accuracy in settings with low literacy in India. Reliability of the New Ballard score as an assessment tool to determine gestational age is uncertain and its accuracy depends on the skill of the examiner and the neonate's condition. Therefore, an inexpensive and practical method is needed to identify at risk preterm newborns soon after the birth. (3). Birth weight, head circumference, and crown heel length of newborn infants are important clinical indicators used for evaluation of prenatal growth and identification of infants that require detailed assessment with close monitoring during the neonatal period.

OBJECTIVES:

- To correlate Occipitofrontal Circumference and Crown Heel length of neonates with Gestational Age
- To estimate gestational age of neonates using Occipitofrontal Circumference and Crown Heel Length

METHODS:

An Observational study

Study Period: 6 months, from December 2021 – May 2022

Sample size of 209, (Term-102, Preterm-107)

Sampling Technique: Convenience sampling technique

Inclusion Criteria:

All neonates delivered in BGS GIMS, Bangalore during study period.

Exclusion Criteria:

i. Neonates with major congenital anomalies/ syndromic features.
ii. Neonates with Birth trauma
iii. Neonates whose parents did not give consent.

After obtaining written informed consent from the parents, neonates satisfying inclusion criteria were included in the study.

Assessment of gestational age:

Gestational age was calculated according to the last menstrual cycle. Each neonate was also assessed postnatally using the New Ballard score and gestational age was estimated

Measurements:

The crown heel length and head circumference of each infant was measured using infantometer and nonelastic tape measure respectively at 24-48 hours of life. Crown heel length was measured from the top of the head to the sole of the foot with the baby lying supine by infantometer; OFC was measured as maximum circumference around the head at the level of the point just above the glabella anteriorly and the top of the occipital bone posteriorly.

Statistical Analysis:

All the data were entered and compiled in Microsoft Excel and analyzed using SPSS 20.0 Descriptive statistics are calculated for Gestational age (GA), OFC, and CHL. Correlation analysis is done between GA with HC and GA with CHL and linear regression analysis is done. Multivariate regression analysis was run to predict GA from OFC and CHL.

RESULTS:

Table 1: Descriptive Statistics

Study Variables	Mean	Std. Deviation
GA for LMP	37.4	2.2
GA for Ballard Score	37.0	2.7
OFC	33.4	1.2
CHL	47.4	1.6

Table 2: Correlation between two variables

Correlation between	N	Pearson Correlation	p-value
GA for Ballard Score Vs OFC	209	0.751	0.000
GA for Ballard Score Vs CHL	209	0.799	0.000

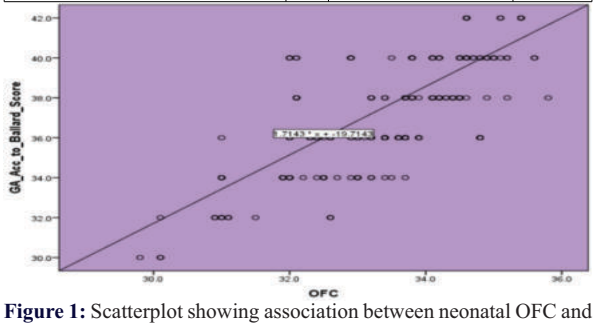

Figure 1: Scatterplot showing association between neonatal OFC and gestational age. The regression line is shown.

Predicted GA = 1.7143 (OFC) + (-19.7143)

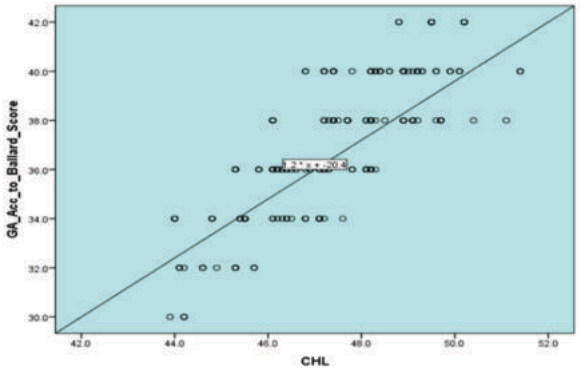

Figure 2: Scatterplot showing association between neonatal crown-heel length and gestational age. The regression line is shown.

Predicted GA = 1.2 (CHL) + (-20.4)

Table 3: Model Summary

Model	R	R2	Adjusted R2	Standard Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	p-value
1	0.802	0.643	0.639	1.6201	0.643	185.158	2	206	0.000 (<0.05)

Table 3, shows that R (*multiple correlation coefficient), is the* measure of the quality of the prediction of the dependent variable) A value of 0.802, indicates a good level of prediction.

The R^2 value (also called the coefficient of determination), is the proportion of variance in the dependent variable that can be explained by the independent variables (technically, it is the proportion of variation accounted for by the regression model above and beyond the mean model). From our value of 0.643 that our independent variables explain 63.9% of the variability of our dependent variable.

Statistical Significance:
The F-ratio in table 4 ANOVA tests whether the overall regression model is a good fit for the data. The table shows that the independent variables statistically significantly predict the dependent variable F (2, 206) = 185.158, p-value <0.005. Therefore, the regression model is a good fit for the data.

Table 4: ANOVA

Model	Sum of Squares	Df	Mean Square	F	P -value
Regression	972.039	2	486.020	185.158	0.000
Residual	540.726	206	2.625		
Total	1512.766	208			

Table 5: Estimated model coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	p-value	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	-25.841	3.273		-7.896	0.000*	-32.293	-19.389
OFC	0.311	0.216	0.143	1.437	0.152	-0.116	0.737
CHL	1.108	0.165	0.669	6.699	0.000*	0.782	1.434

* <0.05
The general form of the equation to predict GA from OFC, CHL is:
Predicted GA = 0.311 (OFC) + 1.108 (CHL) + (-25.841)
Unstandardized coefficients indicate how much the dependent variable varies with an independent variable when all other independent variables are held constant.

The unstandardized coefficient, B1, for OFC is equal to 0.311. This means that for each increase in OFC, there is an increase in GA of 0.311and for each increase in CHL, there is an increase in GA of 1.108.

Statistical significance of the independent variables
The statistical significance of each of the independent variables. This tests whether the unstandardized (or standardized) coefficients are equal to 0 (zero) in the population. If $p < 0.05$, we can conclude that the coefficients are statistically significantly different from 0 (zero). The *t*-value and corresponding *p*-value are mentioned in the table.

Inference:
Multiple regression was run to predict GA from OFC and CHL. These variables statistically significantly predicted GA, F (2, 206) = 185.158, p-value <0.005.

DISCUSSION:

Out of 209 neonates 107 were preterm and 102 were term according to New Ballard Scoring. The anthropometric measurements like Occipitofrontal circumference were measured in all the neonates. OFC increased with increasing gestational age from mean of 31.35 cm at 32 weeks and 34.2 cm at 40 weeks and the r-value for correlation of OFC with GA was 0.751 and regression equation for calculation of GA from OFC was Predicted GA = 1.7143 (OFC) + (-19.7143). CHL also increased with increasing gestational age from mean of 44.9cm at 32 weeks to 49.7cm at 40 weeks of gestation and r-value for correlation was 0.799. Regression equation for calculation of GA was Predicted GA = 1.2 (CHL) + (-20.4). A multiple linear regression equation was derived to predict gestational age from OFC and CHL: Predicted GA = 0.311 (OFC) + 1.108 (CHL) + (-25.841).

Prematurity is a major determinant of neonatal survival, and it is a major contributor to neonatal mortality. Estimation of gestational age by methods like recall of LMP leads to errors and ultrasonic assessment in the developing countries is difficult. (5) The New Ballard Score used for GA assessment has both physical and neuromuscular criteria. It has disadvantages as it requires a person trained in pediatrics and it is a subjective test. Neurological examination requires both skill and training; Anthropometric measurements collected by health workers have been shown to be more reliable than clinical examination (6,7)

A study conducted by Thawani R et al. observed that GA varied from 25 weeks to 42 weeks, 373 neonates, they found a good linear correlation between GA and CHL, they proposed linear regression equation: GA (weeks) = 20.06 + [0.34 x CHL (cm)] (8). A study by Gandhi D et al. has found strong linear correlation between GA and HC (r= 0.977) (9),

CONCLUSION:

OFC and CHL are simple, quick and easy measurements which can be used as alternate tools for predicting Gestational Age. They can be done without any extra skills and can be used by health care workers to determine the GA of the neonates and help in identifying preterm neonates in peripheral health centres. This allows early recognition and timely referral/intervention which reduces neonatal mortality.

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