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Canscore In Newborn Babies and Its Correlation with Gestation Age

Dr Vanga Prashanth Yadav[1], Dr. Sabu Richard Abraham[2]

[1]Dept of Pediatrics, Krishna Institute of Medical Sciences, Krishna Vishwa Vidyapeeth (Deemed to be University), Karad

Email ID: prashanthyadavvanga@gmail.com

[2*]MD, FIN, Krishna Institute of Medical Sciences, Krishna Vishwa Vidyapeeth (Deemed to be University), Karad

Email ID: dr.sabuabraham@gmail.com

Corresponding Author:

Dr. Sabu Richard Abraham,

[2*]MD, FIN, Krishna Institute of Medical Sciences, Krishna Vishwa Vidyapeeth (Deemed to be University), Karad

Email ID: dr.sabuabraham@gmail.com

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ABSTRACT

Background: The first 1,000 days of life are critical for growth and neurodevelopment. In India, low birth weight (LBW) remains high (≈30%), with most LBW infants being term intrauterine growth–restricted (IUGR). Birth weight and gestational age alone may not reflect acute nutritional status. The Clinical Assessment of Nutritional (CAN) Score evaluates nine clinical signs of fetal malnutrition (FM), with a score <25 indicating FM.

Objectives: To (1) assess newborn nutritional status by CAN Score within 48 hours of birth and correlate it with gestational age, (2) evaluate associations between CAN Score and neonatal anthropometric indices (weight for gestational age, BMI, Ponderal Index), and (3) determine relationships between CAN Score and maternal factors (prepregnancy BMI, medical conditions).

Methods: In this hospital-based cross-sectional study, 84 singleton newborns ≥34 weeks gestation were enrolled over 18 months. CAN Score, anthropometric measurements (birth weight, length, head circumference, BMI, Ponderal Index), and maternal data (age, parity, BMI, anemia, comorbidities) were collected. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of weight-for-gestational-age, BMI, and Ponderal Index were calculated using CAN Score as gold standard. Associations were tested via chi-square or Fisher's exact tests ($p < 0.05$ significant).

Results: CAN Score identified FM in 54/84 (64.3%) newborns, whereas only 33/84 (39.3%) were small for gestational age (SGA). Among appropriate-for-gestational-age (AGA) infants, 27/51 (52.9%) had FM. Sensitivities of BMI and Ponderal Index for FM were both 72.2% (specificity 60.0%); weight-for-gestational-age sensitivity was 50.0% (specificity 60.0%). No significant associations were found between FM and gestational age, maternal age, parity, BMI, anemia, or other medical conditions.

Conclusion: CAN Score detects FM in a greater proportion of newborns than weight-for-gestational-age or anthropometric indices alone. Its routine implementation alongside standard measures may enhance early identification and intervention for at-risk neonates, particularly in settings with high IUGR prevalence

1. INTRODUCTION

The first 1,000 days of life represent a critical period that lays the foundation for optimal growth and neurodevelopment throughout an individual's lifespan. This period spans from 270 days intrauterine to 730 days postnatal [1]. Gestational age and birth weight are reliable predictors of survival, neonatal growth, and overall development [2]. However, these factors do not adequately reflect the acute nutritional status at birth, which is crucial for determining the future outcomes of newborns [3].

In developing countries like India, the incidence of low birth weight (LBW) remains notably high at around 30%, whereas it ranges from 5% to 7% in developed nations [4]. Only a small proportion approximately 10%—of LBW cases are due to preterm birth, while the majority are attributed to term infants with intrauterine growth restriction (IUGR) [5]. The incidence of neonatal morbidity and mortality is significantly elevated among infants affected by IUGR, underscoring the importance of early diagnosis and intervention [6].

Various methods are employed to detect IUGR neonates, such as weight for gestational age, mid-upper arm circumference to head circumference ratio, and the Ponderal Index (PI), each with distinct advantages and limitations [3,7]. Infants are typically categorized based on their birth weight relative to gestational age into: Appropriate for gestational age (AGA), Small for gestational age (SGA), and Large for gestational age (LGA) [2].

However, these classifications do not comprehensively reflect neonatal nutritional status. For instance, fetal malnutrition (FM) can also occur in AGA infants, while not all SGA babies are necessarily malnourished [8]. The concept of FM was first introduced by Clifford and Scott in 1954 [6], and Usher later defined it as a clinical condition characterized by visible loss or failure to acquire normal subcutaneous fat and muscle [9].

Research suggests that malnourished fetuses whether AGA or SGA—face increased risks of morbidity and mortality, whereas well-nourished SGA infants generally do not [5]. Therefore, FM, term SGA, and IUGR are not synonymous, and one may occur without the others. It is essential to assess fetal malnutrition independently of gestational age classifications.

One commonly used method to distinguish symmetric from asymmetric IUGR is Rohrer's Ponderal Index (PI), calculated as 100 times the birth weight (in grams) divided by the cube of birth length (in cm) [7]. Neonatal outcomes are more closely tied to nutritional status at birth than to size for gestational age alone.

To address this, the Clinical Assessment of Nutritional (CAN) Score, developed by Reba Michels Hill, evaluates nine superficial clinical signs of malnutrition originally described by Metcoff [5]. A total score below 25 indicates fetal malnutrition. The CAN score is simple to use, allowing for early diagnosis and timely care.

Maternal factors play a pivotal role in fetal nutrition and pregnancy outcomes. Despite India's economic growth, the 2015 Global Hunger Index ranked India 20th among countries facing serious hunger and third among South Asian countries, with a score of 29.0, highlighting persistent food insecurity and undernutrition [4].

Pre-pregnancy maternal anthropometry is crucial for predicting pregnancy weight gain and associated risks. Additional contributing factors include adolescent pregnancies, short interpregnancy intervals, low educational levels, and maternal illnesses such as anemia, heart disease, pregnancy-induced hypertension (PIH), gestational diabetes mellitus (GDM), and infections [6].

OBJECTIVES

1. To assess newborn nutritional status using the CAN Score within 48 hours of birth and correlate it with gestational age.
2. To evaluate the association between CAN Score and key neonatal anthropometric indices: weight for gestational age, BMI, and Ponderal Index.
3. To determine the relationship between CAN Score and select maternal factors, including pre-pregnancy BMI and medical conditions.

2. MATERIALS AND METHODS

This hospital-based cross-sectional study was conducted over an 18-month period at Krishna Vishwavidyapeeth, Karad, and included 84 singleton newborns. A purposive sampling technique was employed to enroll all consecutive cases meeting the inclusion criteria. The sample size calculation was based on the formula $n = 4pq / d^2$ where p (prevalence) = 30%, q = 70% (100 − 30), and d (precision) = 10%. Substituting these values yields $n = 4 \times 30 \times 70 / 10^2 = 84$, confirming that 84 newborns were required.

Inclusion and Exclusion Criteria

All live singleton newborns with a gestational age above 34 weeks—determined by last menstrual period (LMP) and confirmed by the New Ballard Score—were included, provided their hospital stay exceeded 24 hours. Mothers had to have documented antenatal checkups and a recorded first-trimester weight. Newborns were excluded if parents declined consent, if maternal antenatal records or pre-pregnancy weight were unavailable, if major congenital malformations or chromosomal defects were present, or if the infant could not be examined due to medical complications in the NICU.

Equipment

Birth weights were measured on a Phoenix electronic weighing machine. Crown–heel length and head circumference were recorded using a Galaxy infantometer and a Butterfly non-stretchable, flexible measuring tape, respectively.

Procedure

Prior to data collection, approval was obtained from the Institutional Research and Ethics Committee. Informed consent was secured from each mother soon after delivery. A standardized data-collection form within the newborn unit captured essential newborn details immediately after birth, including date and time of birth, APGAR score, and any need for resuscitation. Maternal information age, obstetric history, consanguinity status, birth order, LMP, first-trimester weight and height (to calculate BMI), medical comorbidities, and socioeconomic status was abstracted from the mother's case sheet.

Within the first 30 minutes to 24 hours of life, the New Ballard Score was performed to estimate each newborn's gestational age, which was compared against the LMP-based estimate. Between 24 and 48 hours postnatally, a Clinical Assessment of Nutritional (CAN) Score was documented according to the standardized nine-sign protocol. Infants scoring below 25 were classified as having fetal malnutrition; those with scores of 25 and above were considered well-nourished.

Anthropometric Measurements

Birth weight was recorded with the naked infant on the Phoenix scale and plotted on the WHO growth chart to determine AGA, SGA, or LGA status. Crown–heel length was measured on the Galaxy infantometer with the infant lying supine, knees extended, feet against the footboard, and head pressed against the fixed headpiece; this value was also plotted on the WHO growth chart. Head circumference was taken by encircling the occipital prominence and supra-orbital ridge with the non-stretch tape and recording the measurement to the nearest millimeter.

The Ponderal Index (PI) was calculated as follows: $PI = weight\ (g) / [length\ (cm)]^3 \times 100$. Infants with PI below 2.5 were considered malnourished. Body mass index (BMI) was computed by dividing weight in kilograms by the square of length in meters; a BMI under 11.2 kg/m² indicated malnutrition.

Statistical Analysis

All data were entered into Microsoft Excel 2013 and imported into SPSS version 20.0 for analysis. Continuous variables were summarized as means ± standard deviations, while categorical variables were reported as frequencies and percentages. Comparisons among groups used chi-square or Fisher's exact tests as appropriate; a *p*-value less than 0.05 was considered statistically significant. Results were presented in tabular form and illustrated using bar diagrams and pie charts

3. RESULTS

Table 1. Distribution of Newborn Nutritional Status and Maternal Demographics

Parameter	Category	Frequency	Percentage
Nutritional Status by CANSCORE	Malnourished (CANSCORE < 25)	54	64.3%
	Well-nourished (CANSCORE ≥ 25)	30	35.7%
Nutritional Status by BMI	Malnourished (BMI < 11.2)	51	60.7%
	Well-nourished (BMI ≥ 11.2)	33	39.3%
Nutritional Status by Ponderal Index	Malnourished (PI < 2.5)	51	60.7%
	Well-nourished (PI ≥ 2.5)	33	39.3%
Maternal Age	Young primi & multi	15	17.9%
	Elderly primi & multi	69	82.1%
Maternal Parity	Primi Gravida	55	65.5%
	Multi Gravida	29	34.5%
Maternal BMI	< 18.4	15	17.9%
	18.5 – 24.9	48	57.1%
	25 – 29.9	18	21.4%
	30 – 34.9	1	1.2%

Parameter	Category	Frequency	Percentage
	> 35	2	2.4%
Maternal Anemia Status	Anemic	72	85.7%
	Non-anemic	12	14.3%

Table 2. Sex-wise Distribution of Newborns by Weight-for-Gestational-Age Category

SEX	AGA No. (%)	SGA No. (%)	Total No. (%)
FEMALE	24(47.1%)	15 (45.5%)	39 (46.4%)
MALE	27 (52.9%)	18 (54.5%)	45 (53.6%)
Total	51(100%)	32 (38.1%)	84 (100%)

Table 3. Prevalence of Non-anemia Maternal Medical Conditions

Other Medical Conditions Excluding Anemia	Frequency	Percentage
No Other Medical Condition	67	79.8
Hypothyroidism	5	6.0
Pregnancy Induced Hypertension	2	2.4
Gestational Diabetes Mellitus	2	2.4
Bronchial Asthma	6	7.1
Heart Disease	5	6.0

CANSCORE	Sensitivity	Specificity	PPV	NPV
WfGA	50.0%	60%	20.0%	18.2%
BMI	72.2%	60%	76.5%	54.5%
PI	72.2%	60%	76.5%	54.5%

SLE	1	1.2
Total	84	100.0

Table 4. Descriptive Statistics of Maternal and Neonatal Variables

Table 5. Comparison of Anthropometric Indices for Detecting Fetal Malnutrition Using CAN Score as Gold Standard

Variables	Minimum	Maximum	Mean± SD
Age	18	31	22.54±3.21
Maternal BMI	17.7	36.4	23.34±3.72
Gestational Age	36	40	38.31±1.14
Birth Weight (KG)	1.50	3.20	2.37±0.45
Length(cms)	41.5	52.0	47.59±2.56
Head Circumference	29	35	31.53±1.31
BMI	7.6	15.1	10.38±1.4
Pondral Index	1.5	2.50	2.12±0.25
CAN Score	16	33	23.74±3.95

Table 6. Association of Gestational Age, Anthropometric Indices, and Maternal Factors with Fetal Malnutrition (CAN Score)

Variable	Category	Malnourished(CANSCORE < 25) n (%)	Well-nourished(CANSCORE ≥ 25) n (%)	Total n (%)
Gestational Age	Preterm	5 (9.3%)	3 (10.0%)	8 (9.5%)

Variable	Category	Malnourished(CANSCORE < 25) n (%)	Well-nourished(CANSCORE ≥ 25) n (%)	Total n (%)
	Term	49 (90.7%)	27 (90.0%)	76 (90.5%)
Weight for Gestational Age	AGA	27 (50.0%)	24 (80.0%)	51 (60.7%)
	SGA	27 (50.0%)	6 (20.0%)	33 (39.3%)
Neonatal BMI	Low BMI (< 11.2)	39 (72.2%)	12 (40.0%)	51 (60.7%)
	Normal BMI (≥ 11.2)	15 (27.8%)	18 (60.0%)	33 (39.3%)
Ponderal Index	PI < 2.2	39 (72.2%)	12 (40.0%)	51 (60.7%)
	PI ≥ 2.2	15 (27.8%)	18 (60.0%)	33 (39.3%)
Maternal Age	Young primi & multi	12 (22.2%)	3 (10.0%)	15 (17.9%)
	Elderly primi & multi	42 (77.8%)	27 (90.0%)	69 (82.1%)
Maternal Parity	Primi Gravida	40 (74.1%)	15 (50.0%)	55 (65.5%)
	Multi Gravida	14 (25.9%)	15 (50.0%)	29 (34.5%)
Maternal BMI	< 18.4	12 (22.2%)	3 (10.0%)	15 (17.9%)
	18.5 – 24.9	25 (46.3%)	23 (76.7%)	48 (57.1%)
	25 – 29.9	14 (25.9%)	4 (13.3%)	18 (21.4%)
	30 – 34.9	1 (1.9%)	0 (0%)	1 (1.2%)
	≥ 35	2 (3.7%)	0 (0%)	2 (2.4%)
Maternal Hemoglobin Status	Anemic	49 (90.7%)	23 (76.7%)	72 (85.7%)
	Non-anemic	5 (9.3%)	7 (23.3%)	12 (14.3%)
Other Maternal Medical Conditions	No Other Medical Condition	44 (81.5%)	23 (76.7%)	67 (79.8%)

Variable	Category	Malnourished(CANSCORE < 25) n (%)	Well-nourished(CANSCORE ≥ 25) n (%)	Total n (%)
	Hypothyroidism	3 (5.6%)	2 (6.7%)	5 (6.0%)
	Pregnancy-Induced Hypertension (PIH)	2 (3.7%)	0 (0%)	2 (2.4%)
	Gestational Diabetes Mellitus (GDM)	1 (1.9%)	1 (3.3%)	2 (2.4%)
	Bronchial Asthma	3 (5.6%)	3 (10.0%)	6 (7.1%)
	Heart Disease	1 (1.9%)	0 (0%)	1 (1.2%)
	Systemic Lupus Erythematosus (SLE)	0 (0%)	1 (3.3%)	1 (1.2%)

4. DISCUSSION

Assessing fetal nutritional status at birth is critical due to its influence on neonatal survival, organ development, and long-term health. The clinical presentation of fetal malnutrition largely depends on when in gestation the nutritional insult occurs. Early fetal malnutrition tends to produce symmetrical intrauterine growth restriction (IUGR), affecting weight, length, and head circumference equally, while late gestational insults usually result in asymmetrical growth restriction, primarily affecting body weight. Several methods, including anthropometric indices and the Clinical Assessment of Nutritional (CAN) score, are used to evaluate neonatal nutritional status.

In our study of 84 newborns, the mean birth weight was 2370 ± 450 grams, with a mean length of 47.59 ± 2.56 cm and head circumference of 31.52 ± 1.76 cm. Compared to other studies, these values were notably lower. For instance, Sahin Hamilcikan et al. reported a mean birth weight of 3645 ± 396.9 grams and length of 49.38 ± 2.2 cm [10]. This discrepancy may reflect population-specific variations or a higher prevalence of fetal malnutrition in our cohort.

The incidence of fetal malnutrition assessed using the CAN score in our study was 64.3%, which is higher than most previously reported values, which ranged from 10.9% to 54.6% [11]. One reason for this elevated prevalence may be the demographic and socio-economic status of our patient population or a higher number of undiagnosed intrauterine growth restriction cases.

Interestingly, 39.2% of infants in our study were categorized as small for gestational age (SGA), with the remainder classified as appropriate for gestational age (AGA). However, 52.9% of AGA infants were also identified as malnourished according to the CAN score. This observation aligns with prior findings that fetal malnutrition can be present even in AGA neonates and supports the limitations of weight-based classification systems [12].

When comparing the CAN score with the Ponderal Index (PI), CAN score demonstrated slightly higher sensitivity in detecting malnutrition (64.2% vs. 60.7%). This trend has been observed in other studies as well, although some have reported higher PI detection rates [13]. Our analysis also revealed that the sensitivity and specificity of PI were 72.2% and 60%, respectively, suggesting moderate diagnostic utility. In contrast, earlier studies have reported a wider range in PI sensitivity, such as 28.5% to 70.7%, with higher specificity [14].

BMI-based assessments similarly showed suboptimal performance, with our study yielding sensitivity and specificity of 72.2% and 60%, respectively. This further supports the view that standalone anthropometric indices are inadequate as sole diagnostic tools and must be complemented by clinical assessments like the CAN score [15].

Regarding maternal factors, no statistically significant associations were found between fetal malnutrition and maternal age, parity, BMI, or anemia. Although more malnourished babies were born to mothers with anemia and low BMI, the associations did not reach statistical significance. Similar results have been reported in prior studies, underscoring the multifactorial etiology of fetal malnutrition and the complexity of isolating single predictive variables [16].

In conclusion, our findings reinforce the utility of the CAN score as a sensitive screening tool for fetal malnutrition, particularly when combined with other indices such as PI. The relatively high rate of fetal malnutrition observed in our study underscores the need for enhanced prenatal monitoring and postnatal nutritional assessment strategies. Given the limitations of traditional anthropometric markers, integrating clinical scoring systems may improve early detection and intervention outcomes in neonates at risk.

5. CONCLUSION

The present study of 84 singleton newborns demonstrated a high prevalence of fetal malnutrition (64.3%) when assessed by CAN Score, despite only 39.3% being classified as SGA using weight-for-gestational-age. Notably, over half (52.9%) of AGA infants were malnourished by CAN Score, highlighting the limitations of relying solely on birth weight categories. Anthropometric indices—BMI and Ponderal Index—showed moderate sensitivity (72.2%) and specificity (60.0%) compared to CAN Score, whereas weight-for-gestational-age sensitivity was only 50.0%. These findings underscore that anthropometry in isolation may underestimate malnutrition. No statistically significant associations emerged between fetal malnutrition and gestational age, maternal age, parity, BMI, hemoglobin status, or other medical conditions, suggesting that malnutrition arises from complex, multifactorial influences not captured by single parameters. Given CAN Score's simplicity and superior diagnostic utility, routine implementation alongside standard anthropometry is recommended to identify at-risk neonates promptly. Early detection via CAN Score can guide timely nutritional support and follow-up, potentially reducing immediate and long-term adverse outcomes. Integrating CAN Score into neonatal care protocols—especially in resource-limited settings—may enhance the accuracy of malnutrition screening and improve newborn health trajectories

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