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Original Article

Detection and comparison of foetal malnutrition by CANSCORE and other methods with birth weight as a gold standard

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Abstract:

Objective: Clinical assessment of nutritional status of neonate using CANSCORE and comparison with other methods of determining fetal malnutrition.

Design: Cross sectional study.

Setting: Tertiary care hospital.

Study Subjects: 384 live born singleton neonates with known gestational age and no major congenital malformation.

Methods: Birth weight, length, mid-arm circumference and head circumference recorded in newborns. Ponderal index and mid arm to head circumference ratio was calculated. Clinical assessment of nutritional status was done on the basis of CANSCORE and compared with other methods.

Results: CANSCORE < 25 separated 67.71% of the babies as well nourished and 32.29% as malnourished. Weight for age and MAC/HC classified nearly 70% of babies as well nourished and 30% as malnourished. Also Ponderal Index classified 75.52% the babies as well nourished and 24.48% as malnourished.

Conclusion: CANSCORE may be a simple clinical index for identifying fetal Malnutrition and for prediction of neonatal morbidity associated with it, without the aid of any sophisticated equipments.

Key words: CANSCORE, Fetal malnutrition.

Introduction:

The incidence of low birth weight (LBW) babies (< 2500 g) continues to be high in India at about 30% in contrast to 5-7% in developed countries[1]. Preterm babies account for only 10% LBW babies, the rest being term fetal malnourishment[2]. It is important to recognize foetal malnourished babies because of the high incidence of neonatal morbidity and long term sequelae. The reference criteria used for defining foetal malnourishment has been very variable. Weight at birth has been the most common criterion adopted by investigators. Here too, the cut off levels used have been birth weight less than 2500 gms. These methods do not identify foetal malnutrition which indicates a clinical state that may be present at almost any birth weight (3). The concept of foetal malnourishment as defined by low birth weight for gestational age needs reappraisal since a proportion of malnourished infants will in fact have a birth weight > 2500 grams [4]. The Ponderal index (PI) and mid arm/head circumference (MAC/ HC) ratio are two other measurements of body proportionality used to identify fetal malnourishment in newborns. But each has its own drawbacks [5,6].

Since neonatal morbidity and mortality is more closely related to nutritional status of newborn at birth than to the birth weight for gestational age, a clinical assessment of nutritional status (CANSCORE)(7) was developed to differentiate malnourished from appropriately nourished babies. The present study attempts to compare the utility of CANSCORE with other commonly used measures for defining nutritional status at birth.

Material and Methods

This study was carried out on 384 neonates considering low birth weight prevalence 20% and power of study 80% with 95% CI which were selected by systematic random sampling method

delivered at government Medical College and Hospital, Nagpur.

Selection Criteria: Criteria for infants to be included in the study were as follows:

1. Live born, singleton infants with gestational age > 37 weeks.
3. Known gestational age by last menstrual period.
4. No major obvious congenital malformation.

Neonatal Anthropometry: In all neonates weight was recorded on an electronic weighing scale at birth with 2 gram accuracy. Length, mid arm and head circumferences were also recorded with non-streaching measuring tape with 0.1 cm accuracy. The initial 30 assessments were done by two observers and the interobserver reliability was observed to be excellent. All subsequent measurements were performed by a single observer.

Ponderal index (PI) [8] and mid arm/ head circumference (MAC/HC) ratios were calculated from these measurements. A PI of < 2.2 and MAC/HC ratio < 0.27 were considered as malnutrition. A birth weight of less than 2500grams was used for defining fetal malnutrition.

Clinical Assessment of Nutrition (CAN): Clinical assessment of nutritional status was done on the basis of the superficial readily detectable signs of malnutrition in the newborn as described by Metcoff[7]. A CAN score of < 25 was used to define foetal malnutrition. This score offered the best breakpoint between growth retarded and normal infants as determined by weight for age.

Project	**CANSCORE**			
	4	**3**	**2**	**1 point**
Hair	Thick, dense, smooth, satin-like, easy to comb	Thick, Scarce, there is little hair straight .	Hair thin, straight and put up with more hair	Sparse, straight and erect hair, the hair bundle associated with reduced pigmentation
Cheek	Plump, round face	Slightly reduced fat	Significantly reduced	Fat is almost gone, narrow face
Neck chin	Fat overlap into double or triple chin, neck cover	Slightly reduced fat chin, the neck can be seen	Fat pad thin chin, neck revealed	Chin fat disappears, the neck is clear, loose skin, wrinkle
Arm	Fullness, can not lift the skin	Arm a little thin, check on the pressure of hands, the accordion-like folds can be formed	Small arms, to form accordion-like folds	Very little fat, loose skin, accordion-like folds significantly
Back	Inter-scapular area of skin can not be picked	Little to lift the skin	Easy to lift and skin	Loose skin, easy to lift, wrinkles can form
Buttock	Fat pad thickness	Slightly reduced fat	Significantly reduced fat, hips tip, wrinkle	Fat disappears, fight wrinkles, loose skin and a very, kind of hip, such as pipe
Leg	Described with the same arm	Described with the same arm	Described with the same arm	Described with the same arm
Chest	Full, see the intercostal space	Intercostal space slightly visible	Intercostal space revealed	Intercostal space very clear, obvious loss of subcutaneous tissue
Abdomen	Fullness, thickness of subcutaneous fat	Slightly reduced fat	Abdominal wall thinning, can form the accordion-like folds	Abdominal bulging or boat-shaped abdomen, loose skin, can form the accordion-like folds

Statistical Analysis

The observations were statistically analyzed on EPI INFO version 7 with test of significance calculated by Chi square test. Sensitivity, specificity, positive and negative predictive value were also calculated as validity measures for CANSCORE wherever required.

Results

Table 1 – Summary statistics on Anthropometric parameters of study subjects (n= 384)

Anthropometric Parameters	Mean	SD	Range
Birth Weight (gm)	2657.69	± 392.76	1750 - 4008
Birth Length (cm)	48.8	± 1.83	43 – 54.2
Head Circumference (cm)	34.2	± 0.85	30 – 36.7
Mid arm Circumference(cm)	9.28	± 0.85	7.2 – 10.4
Ponderal Index	2.3	± 0.25	1.66 – 3.3
MAC/HC ratio	0.27	± 0.013	0.23 – 0.31

Table 1 shows the Summary statistics on Anthropometric parameters of study subjects. All the babies in the study (n=384) were full term infants with Mean Gestational age 39 ± 0.95 wks. Mean birth weight of study population was 2657± 392 grams, the mean length was 48.8±1.83 cm, the mean mid arm circumference was 9.28±0.85 cm and the mean head circumference was 34.2 ± 0.85 cm.

Table 2 : Distribution of Well nourished and Malnourished Infants by different Methods

Nutritional Status	Method							
	CAN SCORE	Number (%)	Birth Weight in grams	Number (%)	MAC/HC ratio	Number (%)	Ponderal index	Number (%)
Malnourished	< 25	124 (32.29)	<2500	113 (29.43)	< 0.27	115 (29.95)	< 2.2	94 (24.48)
Well nourished	≥ 25	260 (67.71)	≥2500	271 (70.57)	≥ 0.27	269 (70.05)	≥ 2.2	290 (75.52)

Distribution of study population as well nourished (WN) and malnourished (MN) according to different methods is depicted in *Table 2. The* CANSCORE classified 32.29% as malnourished and 67.71% as well nourished, Birth Weight classified 29.43% as malnourished and 70.57% as well nourished, MAC/HC ratio classified 29.95% as malnourished and 70.05% as well nourished, while Ponderal Index classified 24.48% as malnourished and 70.52% as well nourished.

Table 3: - Comparison of validity measures of different methods considering Birth Weight as gold standard

Value	CAN SCORE	Ponderal Index	MAC/HC ratio
Sensitivity (%)	92.92	66.37	82.30
Specificity (%)	92.99	92.99	91.88
Positive predictive value (%)	84.68	79.79	80.87
Negative predictive value (%)	96.92	86.90	92.57
Kappa Coefficient	0.8354	0.6242	0.7380

Comparison of validity measures of different methods considering Birth Weight as gold standard is seen in table 3, It was found that when different methods were compared with birth weight as gold standard the Sensitivity, specificity, positive predictive value, negative predictive value and Kappa Coefficient was 92.92%, 92.99%, 84.68%, 96,92% and 0.8354 respectively for CANSCORE, 66.37%, 92.99%, 79.79%, 86.90% and 0.6242 respectively for Ponderal Index and 82.30%, 91.88%, 80,87%, 92,57% and 0.7380 respectively for MAC and HC ratio.

When Kappa statistic was applied it showed almost perfect agreement with CANSCORE and Substantial agreement with Ponderal Index and MAC and HC ratio.

Discussion

Low birth weight is a major public health problem in India, In contrast to what is observed in most developed and many developing countries of the world, two third of these low birth weight babies are with foetal malnourishment[5]. It has been shown that foetally malnourished (growth retarded) babies differ in etiology, neonatal morbidity, mortality and later development from term appropriately grown infants[9].

Most of the classification systems for malnourished babies are based on observed birth weight either below or more than or equal to 2500 grams [10-12]. However, none of the above classification system identifies foetal malnutrition, a term coined by Scott and Usher[13], which indicates a clinical state that may be present at almost any birth weight irrespective of classification of infants into normal birth weight or low birth weight. When CANSCORE is compared with Birth Weight it gave a sensitivity of 84.68% and specificity of 96.92%

The clinical manifestation of foetal malnutrition depends in part on the timing it began during gestation. It is characterized by obvious intrauterine loss of, or failure to acquire normal amount of subcutaneous fat and muscle. Weight, length and head circumference may or may not be affected.

Ponderal index has also been used by various authors to classify intrauterine growth retarded infants. Miller and Hassanein(8) proposed that a full term infant is growth retarded if his PI is < 2.2. Ponderal index relies on the principle that length is spared at the expense of weight during period of acute malnutrition; weight and length velocities may be proportionately impaired so infants with chronic insult *in utero* may be misclassified by PI. When CAN score was compared with Ponderal Index it gave a

sensitivity of 61.29% and a specificity of 93.08% in the present study.

Meadow and colleagues[14] concluded that the MAC/HC ratio, independent of birth weight, readily discriminated the late gestation growth retarded baby. Their study showed that this ratio can be used as a reliable test to identify neonates whose growth is retarded, even when their weight is normal. But those babies whose head circumference is reduced because of proportionate growth retardation might not be identified. The low value in this study might indicate the chronic stress these infants face *in utero.* CANSCORE gave a sensitivity of 75.81% and specificity of 91.92% with MAC/HC ratio. The study re-emphasizes the observations of Metcoff about foetal malnutrition and it is a clinical diagnosis, independent of birth weight for gestational age. The advantage of CAN score is that it is a simple, clinical index for identifying fetal malnutrition and may have the potential to predict neonatal morbidity associated with it without the aid of any sophisticated equipments. A larger subject population would be required to establish the utility of CANSCORE as a good clinical index for predicting neurodevelopment outcome in infants with foetal malnutrition.

Limitations- As it is scoring system based on clinical assessment there may be subjective variation but in present study first 30 subjects were examined and scored with other paediatrician and result are compared which shows they were matched with each other.

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