ORIGINAL ARTICLE

Detection of Fetal Malnutrition by Clinical Assessment of Nutritional Status Score (CAN Score) at Birth and its Comparison with other methods of Determining Intrauterine Growth

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ABSTRACT:
Objective: Detection of fetal malnutrition by **C**linical **A**ssessment of **N**utritional status score (**CAN** score) at birth and its comparison with other methods of determining intrauterine growth. **Methods** : A Cross sectional study consisting of 500 singleton full term neonates with no major congenital malformations. They were evaluated at department of Paediatrics, Hamidia hospital Gandhi medical college, Bhopal . Neonatal Anthropometrical measurements were calculated as per standard procedures. Newborns were classified for weight against gestational age on the basis of Alexander and Associates intrauterine growth curves. Ponderal index (PI) was calculated. CAN score was applied and compared with other methods. All data were statistically analyzed. **Results** : CAN score of <25 identified 72.60%(n=363) of babies as well nourished and 27.40%(n=137) as malnourished out of total 500 full term neonates. On comparing with weight for gestational age, CAN score identified malnutrition in 8.3% of AGA babies and 40.1% of SGA babies were found to be well nourished. Ponderal index identified malnutrition (PI<2.2) in 27.8% of neonates out of which CAN score detected only 69.06% as fetally malnourished and 30.96% as well nourished. Also 11.35% newborns classified as well nourished (PI>2.2) by applying Ponderal index were found to be malnourished by CAN score. Taking CAN score as gold standard method for detecting fetal malnutrition, the sensitivity and specificity of weight for gestational age were found to be 81.75% and 78.44% respectively and that of Ponderal index 70.07% and 88.15% respectively **Conclusion** :CAN score may be a simple clinical index for identifying fetal malnutrition. : **Key words** :CAN score, Fetal malnutrition

INTRODUCTION: The incidence of Low birth weight babies continues to be high in India at about 30% in contrast to 5-7% in developed countries (1) . Most of LBW babies are intrauterine growth retarded infants who are at higher risk of neonatal morbidity and long term sequelae. There are various methods to identify these IUGR neonates like weight for gestational age, Ponderal index, Mid arm/Head circumference ratio etc. But each method has its own disadvantages (2,3) and moreover these methods do not identify fetal malnutrition that is not synonymous with the terms like small for gestational age and intrauterine growth retardation. Fetal malnutrition (4), a term coined by Scott and Usher, indicates a clinical state that may be present at almost any birth weight. An infant who is classified as fetal malnutrition, may or may not be classified into IUGR and /or SGA because SGA is weight for gestational age based on population norms and some predetermined weight cut off and IUGR refers to multiplicity of adverse effects limiting the fetal growth potential. Since neonatal morbidity and mortality is more closely related to nutritional status of newborn at birth than to the birth weight for gestational age. Clinical Assessment of Nutritional Status (5) (CAN sore) was developed to differentiate malnourished from appropriately nourished babies. The present study attempt to compare the utility of CAN score with other commonly used measures for defining nutritional status at birth.

MATERIAL & METHOD: This study was carried out at Sultana Zanana, Hamidia Hospital Gandhi Medical College , Bhopal (MP). Subjects were 500 single normal term (38-42weeks of gestation) newborns. Only those infants whose hospital stay exceeded 24 hours of age and having no major congenital malformations were included in the study. Before starting the study, the inter and intra observations of the CAN SCORE were tested and found to be within acceptable limits (p>0.05) Neonatal Anthropometry: All measurements were carried out between 24-48 hours of newborn age. All infants were weighed nude using a standardized lever type weighing machine having a precision of 10 gms. Length was measured by infantometer. Head circumference was measured by using a standard non–stretchable measuring tape .All measurements were taken as per standard guidelines. Infant's age was assessed by using New Ballard score 6 and it was further correlated with Last menstrual Period and Ultrasonic measurements taken antenatally in available cases. Newborns were classified as small for gestational age (SGA) and Appropriate for age (AGA) on the basis of normograms of the Alexander and Associates intrauterine growth curves (7) . Ponderal index (8) was calculated from these measurements. Demographics, gestational age, observed and expected birth weights, and CAN score were recorded on the form for each baby. CAN score is presented in the table 1. It has 9 superficial readily detectable signs which are rated from 1 (worst-severe fetal malnutrition) to 4 (best well nourished). The highest score was 36 and lowest was 9. A CAN score of less than or equal to 24 was taken as fetally malnourished (FM).

TABLE 1 Signs for Clinical Assessment of Nutritional (CAN) Status in the Newborn

- **Hair**

Large amount, smooth, silky, easily groomed (4).
Thinner, some straight, "staring" hair (3).
Still thinner, more straight, "staring" hair which does not respond to brushing (2).
Straight "staring" hair with depigmented strip (flag sign)(1).

- **Cheeks**

Progression from full buccal pads and round face (4), to significantly reduced buccal fat with narrow, flat face (1).

- **Neck and Chin**

Double or triple chin fat fold, neck not evident (4); to thin chin. No fat fold, neck with loose, wrinkled skin, very evident (1).

- **Arms** – Full, round, cannot elicit "accordion" folds or lift folds of skin from elbow or tricep area (4); to a striking "accordion" folding of lower arm, elicited when examiner's thumb and fingers of the left hand grasps the arm just below the elbow of the baby and thumb and fingers of the examiners right hand circling the wrist of the baby are moved towards each other; skin is loose and easily grasped and pulled away from the elbow.

- **Legs :** Like arms.

- **Back**

Difficult to grasp and lift skin in the interscapular are (4); to skin loose, easily lifted in a thin fold from the interscapular area (1).

- **Buttocks**

Full round gluteal fat pads (4); to virtually no evident gluteal fat and skin of the buttocks and upper posterior high loose and deeply wrinkled (1).

- **Chest**

Full, round, ribs not seen (4); to progressively prominence of the ribs with obvious loss of intercostal tissues (1).

- **Abdomen**

Full, round, no loose skin (4); to distended or scaphoid, but with very loose skin, easily lifted, wrinkled and "accordion" folds demonstrable.

Statistical Analysis : Data were statistically analyzed and test of significance calculated by Chi square test. Sensitivity, specificity, positive and negative predictive values were also determined.

RESULTS: Mean birth weight of study population was 2.78 ± 0.44kg, the mean length was 48.12 ± 1.92cm, the mean head circumference was 33.75 ± 1.37cm. Comparison of CAN score with the weight for gestational age and Ponderal index is presented in the table 2 and 3 respectively. Various statistical results are presented in table 4.

TABLE 2 DISTRIBUTION OF SMALL FOR GESTATIONAL AGE AND FETAL MALNUTRITION DIAGNOSES IN 500 NEONATES

WEIGHT FOR GESTATIONAL AGE*	CANS		
	FM	NOURISHED	TOTAL
AGA	25 (8.3%)	288 (92.01%)	313 (62.6%)
SGA	112 (59.89%)	75 (40.1%)	187 (37.4%)
TOTAL	137 (27.4%)	363 (72.6%)	500 (100%)

Chi –square 159.06 p= <0.0001

Note that 25 (8.3%) of AGA and 112 (59.89%) babies or 27.4% of 500 term neonates, were malnourished in utero (FM). However, 75(40.1%) of 187 SGA babies were not malnourished.

* Weight for Gestational age: classified on the basis of Alexander and Associates Intrauterine growth curves

CANS clinical assessment of nutritional status scores, max =36; <25= FM

AGA – appropriate for gestational age, SGA- small for gestational age, FM- fetal malnutrition

TABLE 3 – COMPARISON OF CAN SCORE WITH PONDERAL INDEX

Ponderal Index (PI)	CAN SCORE		
	FM	NOURISHED	TOTAL
<2.2	96 (69.06%)	43 (30.93%)	139 (27.8%)
>2.2	41 (11.35%)	320 (88.69%)	361 (72.2%)
TOTAL	137 (27.4%)	363 (72.6%)	500 (100%)

Note that PI detected 139(27.8%) babies as malnourished but by applying CAN score only 96 (69.06%) babies were found to be fetally malnourished, while 43(30.93%) babies were well nourished. Moreover PI classified 361(72.2%) babies as well nourished but by applying CAN score 41(11.35%) babies were found to be malnourished in utero.

TABLE 4- COMPARISON OF CAN SCORE WITH OTHER METHODS FOR DETECTION OF FETAL MALNUTRITION

Value	Birth weight for Gestational age	Ponderal index
Sensitivity(%)	81.75	70.07
Sensitivity(%)	78.44	88.15
Positive predictive value (%)	59.89	69.06
Negative predictive value (%)	91.6	88.64

Note that if we take CAN score as gold method for detecting fetal malnutrition then Weight for gestational age and Ponderal index method have low sensitivity and specificity. Thus CAN score could be a better index in detecting fetal malnutrition.

DISCUSSION: Early fetal growth is a biophysical process. The most rapid period of normal fetal growth is between 12 –36 weeks of gestation. The rate of fetal growth peaks to 220-225 gm /week at 32 to 36 weeks of gestation and declines thereafter (9) . The clinical manifestations of fetal malnutrition depend, in part, on when it began during gestation. Babies whose length, head circumference, and weight are significantly reduced probably were exposed to malnutrition beginning early in the second trimester. Those whose length and head circumference are less affected but are small and underweight with some loss of subcutaneous tissues and muscle probably became malnourished beginning early in the third trimester. For babies who are significantly underweight for gestational age with obvious loss of subcutaneous tissues, but with length and head circumference within the normal range, an insufficient or unbalanced nutrient supply most likely occurred in the late third trimester (after 36 weeks ‘gestation). For the last two categories, weight, that is, total tissue mass, may be above the tenth percentile for gestational age; however, signs of malnutrition may be obvious. Such an infant’s expected weight might have been at the 50 th to 75 th percentile in utero, whereas observed birth weight is at the 10 th to 15 th percentile at birth. (10,11,12).Fetal malnutrition 4 is clinical diagnosis and is independent of birth weight for gestational age. Neither SGA nor IUGR are synonymous with FM. Differentiation of FM neonates from adequately nourished neonates, whether AGA or SGA, provided the basis for utility of CAN score. The comparison of various modalities, for example, reduced growth, neurologic handicaps, later learning difficulties, poor school performance, low IQ tests of SGA versus AGA, with the latter considered the ‘control group’, and using observed birth weight for gestational age, as in most reported studies, were based on the presumption that SGA is synonymous with FM. Failure to identify FM confounds both the test and control groups by inclusion of undiagnosed FM babies among the AGA controls, and nourished but not FM babies in the SGA test group, thus underestimating the effects of FM on physics and mental development .In our study, 40.1% of SGA infants were not malnourished [based CAN SCORES] and 8.3% of AGA infants were fetally malnourished. If as observed by HILL (13) , 39% of later neurologic and intellectual handicaps occur predominantly in FM babies, they would have been missed if only a birth weight of less than the 10th percentile was used. Thus, about 59.89% of the SGA and at least 8.3% of the AGA malnourished babies are at risk. In the study by Hill (13) et al, Overall, 32 .6% of FM infant would have been misclassified as AGA. Significantly lower IQ (verbal, performance, and full-scale65) scores than well-nourished infants. Thirty-nine percent of FM infants with handicaps, including spastic diplegia, seizures, visual problems, learning disabilities, or mental retardation, had birth weights greater than the 10 th percentile on the Denver fetal growth curves. FM would not have been recognized as a probable cause of later neurologic or mental disabilities. Our data, like Hill’s, indicate that when classification into SGA and AGA groups is based on growth curves alone, and all SGA babies are considered at risk, then comparison of the two groups would be biased, because 40.1%are likely to be SGA/NOURISHED and 8.3% of AGA/FM babies likely would be considered as the AGA ‘control’ [presumably NOURISHED] group.

Ponderal index (8) has also been used by various authors to classify intrauterine growth retarded infants. Miller and Hassanein proposed that a full term infant is growth retarded if his PI is<2.2 .Man Mohan et al (14) defined SGA as those with PI falling short of 10 th percentile for their gestational age so in a term infant PI < 2.25 should be an indicator of intrauterine undernutrition. Ponderal index relies on the principle that length is spared at the expense of weight during period of acute malnutrition; weight and length ve-

-locities 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 70.07% and a specificity of 88.15 % in the present study.

CONCLUSION: CAN score 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 population would be required to establish the utility of CAN score as a good clinical index for predicting neurodevelopment outcome in infants with fetal malnutrition.

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