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Original Research Article

Comparison of clinical assessment of nutritional status (CAN) score with other methods in the assessment of fetal malnutrition

M. Amarendra*, M. Yoganand

Department of Pediatrics, Konaseema Institute of Medical Science and RF, Amalapuram, Andhra Pradesh, India

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***Correspondence:**
Dr. M. Amarendra,
E-mail: marina.amarendra@gmail.com

ABSTRACT

Background: Assessment of nutritional status of new born has been a major concern to many clinicians because of the potentially serious sequelae of malnutrition on multiple organ system and future health. Various methods have been used to identify malnourished babies as early as possible. The objective of the study was to assess the nutritional status of new born at birth using CAN score and to compare the utility of CAN score with other commonly used measures for defining nutritional status of new borns like weight for gestational age, Ponderal index and Kanawati index.
Methods: The present study is a hospital based cross sectional study consisting of 250 singleton full term with no major congenital malformations. Clinical assessment of nutritional status was done on the basis of CAN score and compared with other methods like weight for gestational age, Ponderal index and Kanawati index.
Results: Out of 250 babies, CAN score detected 171 (68.4%) babies as malnourished, weight for gestational age at birth detected 150 (60%) babies as AGA and 100 (40%) babies as SGA. Based on Ponderal index and Kanawati index, 154 (61.6%) babies and 140 (56%) babies were malnourished respectively. Using CAN score as the gold standard for identifying fetal malnutrition, the sensitivity and specificity of weight for gestational age at birth were 51% and 21.5%, the sensitivity and specificity of Ponderal index were 69.5% and 55.6% and the sensitivity and specificity of MAC/HC (Kanawati index) were 77.7% and 91.1%.
Conclusions: CAN score is a simple, systemic method of identifying fetal malnutrition. This method does not require any sophisticated equipments or laborious calculations and is a good indicator in comparison with other methods of determining fetal malnutrition.

Keywords: AGA, CAN score, Fetal malnutrition, Kanawati index, Ponderal index, SGA

INTRODUCTION

The goal of neonatal nutrition is to ensure a smooth transition of the growth process from the prenatal to postnatal period. Birth weight and gestational age are understood to be important factors of survival, future growth and overall development of the child. However, these factors do not indicate the actual nutritional status of the newborn, which is thought to be the key factor in the future outcome of a newborn baby. The incidence of low birth weight (LBW) babies continues to be high in India (30%) and other developing countries when compared to developed countries (5 to 7%).[1] Preterm babies account for only 10% of LBW babies, the rest being term intrauterine growth retarded infants.

The high incidence of LBW babies in India is due to the neglect of health and education of females, teenage marriages, frequent pregnancies, maternal malnutrition, anemia and infections are important contributory causes. It is important to recognize IUGR babies because of high incidence of neonatal morbidity and mortality. There are various methods to identify these IUGR babies like

weight for gestational age, ponderal index, mid arm circumference/head circumference (Kanawati index) etc. But each method has its own disadvantages.

At present, commonly used methods of classifying infants are based on weight at birth for gestational age. Accordingly, infants are classified into appropriate for gestational age (AGA), small for gestational age (SGA), and large for gestational age (LGA). This does not indicate the overall nutritional status of the baby. Fetal malnutrition can occur even in infants with appropriate for gestational age and fetal malnutrition may not be present in infants who are small for gestational age.[2] Fetal malnutrition is a clinical state characterized by obvious intrauterine loss or failure to acquire normal amount of subcutaneous fat and muscle.[6] Fetal malnutrition can be present at any birth weight.

Studies have found that perinatal problems and CNS sequelae occurred primarily in those with malnutrition, whether AGA or SGA, but not in those who were simply SGA and well nourished. Thus it is necessary to classify babies as with or without malnutrition in addition to small for gestational age (SGA) or appropriate for gestational age (AGA). Fetal malnutrition (FM), and the term small for gestational age (SGA), and intrauterine growth retardation (IUGR) are not synonymous and one may occur without the other.[3-5]

SGA is weight for gestational age based on population norms and some predetermined weight cut-off (-2SD, 10%).[2,3,6,7] IUGR refers to a multiplicity of adverse effects limiting the fetal growth potential. An infant who is classified IUGR may or may not be classified SGA2. Likewise an infant who is IUGR and/or SGA may or may not have FM.[2,4,5,8] Roherer's Ponderal index is a method used to identify at risk intrauterine growth retarded babies and which also distinguishes symmetric and asymmetric babies. Ponderal index is equal to one hundred times the birth weight in grams divided by cube of the birth length in cms.

Later, CAN score scoring system was developed as a systematized extension of the observation of McLeal, Usher and Scott. CAN score scoring system is based on nine superficial detectable signs of malnutrition in the newborn as described by Metcoff J in which a score of ≤25 is used to define malnutrition.[5] CAN score scoring system helps to classify babies based on nutritional status, as malnourished or well-nourished babies, so that malnourished babies can be given special care.

The objective of the study was to assess the nutritional status of newborn at birth using CAN score. To compare the utility of clinical assessment of nutritional status score with other commonly used measures for defining nutritional status of newborn like weight for gestational age at birth, ponderal index and kanawati index.

METHODS

Source of data

The present study is a hospital based cross sectional study consisting of singleton full term neonates with no congenital malformations. They were evaluated at Department of Paediatrics, Konaseema Institute of Medical sciences and Research foundation, Amalapuram during the period between December 2014 and November 2015.

Collection of data

Size of the sample was 250 term neonates. Sampling method used was simple random sample method.

Inclusion criteria

Live born, singleton, term normal and stable new borns with gestational age between 37 to 40 wks whose hospital stay were between 24 to 48 hours of age

Exclusion criteria

New borns with any congenital malformations, new born diagnosed with any disease during hospital stay, hospital stay is <24 hours or >48 hours of age, new born with gestational age <37 weeks or >40 weeks.

Statistical analysis

The data was collected and analyzed. Frequency, percentages, sensitivity, specificity, positive and negative predictive value were calculated, wherever required. Pearson's coefficient with value p <0.05 considered as significant.

Neonatal anthropometry

In all neonates weight was recorded on an electronic weighing scale at birth. Length, mid arm and head circumferences was recorded between 24-48 hours of birth. Ponderal index, and Kanawati index (MAC/HC) were calculated from these measurements. A Ponderal index value <2.25 and Kanawati index value <0.27 were considered as malnutrition. Clinical assessment of nutritional status (CAN) score Clinical assessment of nutritional status was done within 48 hours on the basis of the superficial readily detectable signs of malnutrition in the newborn as described by Metcoff J (Table 1).[5] A CAN score of <25 was used to define malnutrition.

RESULTS

Using CAN score as the gold standard for identifying fetal malnutrition the sensitivity and specificity of commonly used methods to identify fetal malnutrition like Ponderal index, weight for gestational age at birth and MAC/HC (Kanawati index) were calculated.

Table 1: The CAN score system.

CAN score	1	2	3	4
1. Hair	Straight "staring" hair with depigmented stripe (flag sign)	Still thinner, more straight, "staring" hair which does not respond to brushing	Thinner, some straight, "staring" hair	Large amount, smooth, silky, easily groomed
2. Cheek	significantly reduced bucal fat with narrow, flat face	Flat, poor or small pad of fat	Flat with good pad of fat	Full buccal pads and round face
3. Neck and Chin	No fat fold, neck with loose, wrinkled skin, very evident	some mandibular fat, minimal neck fat	Full mandibular fat, moderate neck fat, no rolls	Double or triple chin fat fold, neck not evident
4. Arms	sub cutaneous tissue minimal,skin very loose, easily grasped and pulled away from elbow	some sub cutaneous tissue present on upper and lower arm, pleats easily, can pick from elbow but not on back of hand and forearm	moderate sub cutaneous tissue present on upper and lower arm , slight pleating of skin, can not pick from elbow or back of hand and forearm	Full, round, cannot elicit "accordion" folds or lift folds of skin from elbow or tricep area
5. Legs	sub cutaneous tissue minimal, skin very loose, easily grasped and pulled away	some sub cutaneous tissue present, pleats easily	moderate sub cutaneous tissue present, slight pleating of skin	Full, round, cannot elicit folds or lift folds
6. Back	skin loose, easily lifted in a thin fold from the interscapular area	Flat (not full) but definite fat present	Round, less full, less firm	Difficult to grasp and lift skin in the interscapular area
7. Buttock	virtually no evident gluteal fat and skin of the buttocks and upper posterior high loose and deeply wrinkled	Skin upper medial thigh loose, skin easily picked up over anterior thigh but not over tibia and knee	Some subcutaneous tissue, can pick up easily but good turgor	Full round gluteal fat pads
8. Chest	progressively prominence of the ribs with obvious loss of intercostal tissues	Prominent ribs, some intercostals tissue	Intercostals space prominent, ribs obvious	Full, round, ribs not seen
9. Abdomen	distended or scaphoid, but with very loose skin, easily lifted,wrinkled	Scaphoid but not very loose skin, easily lifted and with some wrinkles	Round with loose skin, not easily lifted with no wrinkle	Full round with no loose skin

Assessment of nutritional status based on CAN score system

Table 2: Assessment of nutritional status based on CAN score.

Well nourished (CANS >25)	Malnourished (CANS <25)	Total
79	171	250
31.6%	68.4%	100%

In the present study, out of 250 babies, based on CAN score, scoring system 171 (68.4%) babies were malnourished babies and 79 (31.6%) babies were well nourished (Table 2).

Distribution of newborn babies according to weight for gestational age at birth

Table 3: Distribution of newborn babies according to weight for gestational age at birth.

AGA	SGA	Total
150	100	250
60%	40%	100%

In the present study, out of 250 babies, 150 (60%) babies were appropriate for gestational age and 100 (40%) babies were small for gestational age (Table 3).

Comparison between weight for gestational age at birth with CAN score in detecting fetal malnutrition

Of 250 babies studied, 100 babies were SGA, of which 83 (83%) babies had fetal malnutrition and out of 150 AGA babies, 88 babies (58.6%) had fetal malnutrition based on CAN score. p-value being 0.000 (<0.05), there was a statistical significant relation between birth weight and fetal malnutrition. Fetal malnutrition was more with SGA babies, when compared to AGA babies (Table 4).

Table 4: Comparison between weight for gestational age at birth with CAN score in detecting fetal malnutrition.

Weight for gestational age at birth	CAN score<25		CAN score>25		Total	
	No.	%	No.	%	No.	%
AGA	88	58.6	62	41.3	150	60
SGA	83	83	17	17	100	40
Total	171	100	79	100	250	100

Assessment of nutritional status based on Ponderal index

In the present study, out of 250 babies, based on Ponderal index, 154 (61.6%) babies were classified as malnourished babies and 96 (38.4%) babies were classified as well nourished.

Table 5: Assessment of nutritional status based on Ponderal index.

Well nourished (PI >2.25)	Malnourished (PI <2.25)	Total
96	154	250
38.4%	61.6%	100%

Comparison between Ponderal index and CAN score in detecting fetal malnutrition

Table 6: Comparison between Ponderal index and CAN score in detecting fetal malnutrition.

Ponderal index	CAN score<25		CAN score>25		Total	
	No.	%	No.	%	No.	%
<2.25	119	69.6	35	44.3	154	61.6
>2.25	52	30.4	44	55.7	96	38.4
Total	171	100	79	100	250	100

Of the 250 babies, CAN score system identified 171 (68.4%) babies as malnourished, whereas Ponderal index identified 154 (61.6%) babies as malnourished. p-value 0.000 (<0.05) indicates that CAN score appears to be statistically significant in detecting fetal malnutrition (Table 6).

Assessment of nutritional status based on Kanawati index (MAC/HC)

Table 7: Assessment of nutritional status based on Kanawati index (MAC/HC).

Well nourished (>0.27)	Malnourished (<0.27)	Total
110	140	250
44%	56%	100%

Comparison between Kanawati index (MAC/HC) and CAN score in detecting fetal malnutrition

Of the 250 babies, CAN score system identified 171 babies as malnourished, whereas Kanawati index identified 140 babies as malnourished. p- value (<0.05) (p=0.000), indicates that CAN score appears to be statistically significant in detecting fetal malnutrition (Table 8).

Table 8: Comparison between Kanawati index (MAC/HC) and CAN score in detecting fetal malnutrition.

Kanawati Index	CAN score<25		CAN score>25		Total	
	No.	%	No.	%	No.	%
<0.27	133	77.8	7	8.9	140	68.4
>0.27	38	22.2	72	91.1	110	31.6
Total	171	100	79	100	250	100

Comparison of above three methods for detection of fetal malnutrition with CAN score

Using CAN score as the gold standard for identifying fetal malnutrition, the sensitivity and specificity of Ponderal index were 69.5% and 55.6%.

The sensitivity and specificity of weight for gestational age at birth were 51% and 21.5%. The sensitivity and specificity of MAC/HC (Kanawati index) were 77.7% and 91.1% (Table 9).

Table 9: Comparison of above three methods for detection of fetal malnutrition with CAN score.

	Weight for gestation age at birth	Ponderal index	MAC/HC
Sensitivity	51%	69.5%	77.7%
Specificity	21.5%	55.6%	91.1%
PPV (%)	58.6%	77.2%	95%
NPV (%)	17%	45.8%	65%

DISCUSSION

Assessment of nutritional status of fetus has been a major concern to many clinicians because of the potentially

serious sequelae of malnutrition on multiple organ system. Various methods have been used to identify malnourished babies as early as possible. The clinical manifestation of fetal malnutrition depends 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.[5]

Fetal malnutrition is a clinical diagnosis and is independent of birth weight for gestational age neither SGA nor IUGR are synonymous with fetal malnutrition. In fetal malnutrition, the subcutaneous tissue and underlying muscle are diminished and the skin of arms, legs, elbows, knee and intercapsular region are very loose. Differentiation of malnourished neonates from adequately nourished neonates, whether AGA or SGA, provided the basis for utility of CAN score.[5] In the present study, by using CAN score as the gold standard for assessing nutritional status at birth, the sensitivity and specificity of other commonly used methods like weight for gestational age at birth, Ponderal index and MAC/HC (Kanawati index) for assessment of nutritional status at birth were calculated. In the present study, out of 250 babies, based on CAN score, scoring system 171 (68.4%) babies were malnourished (CAN score <25) and 79 (31.6%) babies were well nourished (CAN score>25). In a study by Mehta et al based on CAN score 40.03% babies were malnourished and 59.97% babies were well nourished.9 In another study by Adebami et al only 18.8% of babies were malnourished and 81.2% babies were well nourished.10 The number of fetal malnourished babies is higher in our study compared to other studies. This is because our hospital being a tertiary care centres and serves majority of people who belong to rural areas and low socio-economic status. Majority of cases referred to our hospital have antenatal risk factors such as anaemia, eclampsia, etc. which are proven risk factors for fetal malnutrition.

In the present study, the total number of newborns included was 250 with mean birth weight of 2216±417.5gms. Percentage of babies appropriate for gestational age (AGA) was 60% and small for gestational age (SGA) was 40% compared well with Rao et al where AGA was 58.3% and SGA was 41.7%.11 In another study by Liladhar Kashyap et al AGA was 62.6% and SGA was 37.4%.[12]

Of 250 babies studied, 100 babies were SGA, of which 83 (83%) babies had fetal malnutrition and out of 150 AGA babies, 88 babies (58.6%) had fetal malnutrition based on CAN score with p-value being 0.000 (<0.05), there was a statistical significant relation between birth weight and fetal malnutrition. In a study by Metcoff et al 68% AGA babies were malnourished and 83% SGA babies were malnourished.[5] Fetal malnutrition was more with SGA babies, when compared to AGA babies. Since the diagnosis of SGA is usually made based on the use of pre-determined intrauterine growth chart, some babies with fetal malnutrition who are not SGA will be missed using this traditional classification system.

In the present study, out of 250 babies, based on Ponderal index, 154 (61.6%) babies were classified as malnourished. It is more as compared to a study by Mehta et al where only 186(29.19%) babies were malnourished out of 637 babies based on ponderal index.[9]

In this study, 140 (56%) babies were classified as malnourished based on kanawati index well compared to the study by Mehta et al where 317(49.76%) babies were found malnourished out of 637 babies based on kanawati index.[9]

In our study CAN score system identified 68.4% babies as malnourished, whereas Ponderal index identified 61.6% babies and kanawati index identified 56% babies as malnourished with p-value <0.05 indicates that CAN score appears to be statistically significant in detecting fetal malnutrition.

Using CAN score as the gold standard for identifying fetal malnutrition, the sensitivity and specificity of weight for gestational age at birth were 51% and 21.5%, the sensitivity and specificity of Ponderal index were 69.5% and 55.6% and the sensitivity and specificity of MAC/HC (Kanawati index) were 77.7% and 91.1%.

CONCLUSION

Low birth weight is a major public health problem in developing countries. The present study of classifying babies on the basis of weight has helped in their overall management to some extent. This has not brought down the infant mortality rate to expected levels. The present study has shown that significant percentage of even the full term AGA babies is also malnourished. So, an approach to improve the intrauterine nutrition of these babies might help in achieving this target. The factors responsible for fetal malnutrition have to be studied in detail and appropriate intervention should be applied.

CAN score scoring system is a simple, systemic method of identifying fetal malnutrition. Using this method, assessment of fetal malnutrition can be done in all babies irrespective of birth weight for their gestational age. This method does not require any sophisticated equipment or laborious calculation. CAN score is a preferred method for screening the malnourished babies. It should be used as a routine method of assessing nutritional status in

labour ward and neonatal centre, so that we can readily pickup all malnourished babies.

If we consider weight as the only criteria for assessing nutritional status, there is more probability of missing malnourished babies in AGA category and well-nourished babies in SGA category. A larger subject 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. CAN score, which is a simple clinical index for identifying fetal malnutrition, is a good indicator for the same in comparison with other methods of determining fetal malnutrition.

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