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Original Research Article

ASSESSMENT OF NEONATAL MALNUTRITION IN AGA, SGA and IUGR BABIES, COMPARING CAN (CLINICAL ASSESSMENT OF NUTRITION) SCORE WITH OTHER TRADITIONAL METHODS

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Abstract

Background: Fetal malnutrition" refers to a clinical condition that can occur at any birth weight. Newborn classified having foetal malnutrition may or may not be classified as IUGR and/or SGA since SGA is weight for gestational age adjusted for population with some specified weight cut off, whereas IUGR refers to a variety of unfavorable effects that hamper foetal intrauterine development potential. Since neonatal morbidity and death are more directly connected to a new-born nutritional status at delivery than to birth weight for gestational age, the clinical assessment of nutrition status (CAN) score may be employed to assess the incidence of foetal malnutrition among term newborns and to compare it with anthropometric parameters used to determine foetal growth. **Materials and Methods:** This is a prospective study with sample of 250 singleton term babies employing CAN score as the gold standard to evaluate the utility of birth weight, weight for gestation, length, head circumference (HC), mid arm circumference (MAC), MAC/HC ratio and Ponderal index to measure foetal nutrition. **Result:** CAN score detected 84% malnourished newborns with a cut off value of CAN Score 25. Malnutrition occurred in 4% of suitable for gestational age infants and 42.9% of small for gestational age neonates. Weight for gestation and BMI exhibited the best sensitivity to identify malnourished infants when the CAN score was used as a benchmark (71.83% and 84.48%, respectively). **Conclusion:** CAN Score is expected to be a particularly powerful tool for regular screening of neonates likely afflicted by malnourishment, thus enabling clinicians to timely recognize and prevent sequels of foetal malnutrition.

INTRODUCTION

The concept of fetal malnutrition was initially developed by Clifford and was defined by Scott and Usher as an intrauterine loss or failure to acquire a normal amount of subcutaneous fat and muscles.[1] Risk factors includes maternal factors such as advanced maternal age, parity, race, low educational status, poor wealth status, violence, anemia, malaria, and chronic disease (like pregnancy-induced hypertension and diabetes mellitus).[1-3]

Fetal malnourishment can be assessed physically using the clinical assessment of nutritional status (CAN) score.[4,5] The fetal malnutrition can be clinically recognized by the observation of several morphological changes in the subcutaneous fat, muscle tissue, skin, and hair.[4,6] Even though different experts identified fetal malnutrition at birth by using various assessment methods, clinical assessment of nutritional status (CAN) score is a good indicator than other anthropometric approaches.[5,6]

Fetal malnutrition, small for gestational age, and intrauterine growth restriction are not synonymous; one may occur without the others.[2–4] Fetal length, head circumference, and weight are significantly reduced if the malnutrition occurred in the second trimester, whereas if femur length and head circumference are in the normal range and weight is significantly less than the gestational age, an insufficient nutritional supply occurred during the late third trimester.[4]

The first convincing evidence that fetal undernutrition could have a long-term influence on human health came from the follow-up of adults who were in utero during the Dutch Famine (‘Hunger Winter’) of 1944-45. Young men whose mothers lived in famine-affected areas of the

Netherlands during early pregnancy had an increased risk of obesity compared to men whose mothers lived in non-famine areas (2.7% versus 1.5%). The science of 'developmental origins of health and disease' (DOHaD) started to attract intense interest some 20 years later, when Barker and Osmond linked birthweight (collected by health visitors in the UK from 1911-1930) with death certificate data and discovered that men and women who had a lower birthweight were at increased risk of death from cardiovascular and chronic lung disease(refs).

Globally, around 20 million babies are born per year with birth weights less than 2500 g, and around 1/ 3 to 2/5 of these infants are born at term gestation (gestational age between 37 and 42 weeks) and therefore are SGA. Thus, at least one-half of these (about 3 million) babies are fetally malnourished.[4] An infant who is classified with intrauterine growth restriction (IUGR) and/or small for gestational age may, or may not, have fetal malnutrition.[2,3]

This study is aimed at assessing the prevalence of fetal malnutrition at birth and its associated factors by using physical indices (nine superficial readily detectable signs of malnutrition). Detection of fetal malnutrition at birth is thus important for identifying those newborns who are at higher risk, and it is useful for the government to design strategies, therefore decreasing intrauterine fetal malnutrition.

MATERIALS AND METHODS

It is a cross-sectional study conducted from May 1, 2022 to February 28, 2023 at a tertiary health care centre in North India. All women with the gestational age of 37-42 weeks and who have given singleton live birth were included. Exclusion criteria were women who could not answer the intended questions because of illness and mental problems, who died because of labour complications, referred to other higher health institutions, newborn with incomplete placenta, or with a congenital abnormality or infant of diabetic mother were excluded.

Out of women delivered (428) during the study period, 250 met the inclusion criteria.

Outcome (dependent) variable is fetal malnutrition whereas independent variables are socio-demographic characteristics of the mothers, newborn characteristics, and maternal obstetric factors.

Aims and objectives

1. To identify the incidence and prevalence of fetal malnutrition by clinical assessment of nutritional status using CAN score.
2. To compare the assessment of nutritional status using CAN score to other traditional anthropometric indices.

The following parameters were recorded in all babies (weight was recorded at birth, length, mid arm circumference and head circumference we recorded between 24 – 48 hrs of life): Crown to Heel Length, Occipito-frontal circumference, Mid Arm Circumference, Birth weight.

These measurements (birth weight and length) were then plotted on intrauterine growth charts for Indian babies to classify the newborns into AGA, SGA and large for gestational age (LGA),[7] and the following proportionality ratios were calculated and compared with clinical assessment using CAN score to assess their effectiveness in identifying malnutrition.

Ponderal index of less than 2.2 gm/cm3,[7] Mid arm circumference/head circumference Ratio (MAC/HC) of 0.27 and Body mass index (BMI) of 11.20 kg/m2 was considered as an index of malnutrition.[4,6]

The same newborns were also assessed clinically between 24-48 hours on the basis of the superficial readily detectable signs of malnutrition in the newborn using the clinical assessment of nutrition (CAN) rating as described by Metcoff.[4]

The CAN score ranges between 9 as the lowest score and 36 as the highest score. Any score less than 25 is suggestive of malnutrition In our study, CAN score was the tool accepted as the gold standard for identification of neonatal malnutrition.[8-15]

For studying the relationship of anthropometrical attributes with CAN score, the observations were statistically analyzed using EPI INFO version 6 statistical package.

RESULTS

A total of n=250 newborns were assessed with the incidence of fetal malnutrition being 28% (n=70) as identified by CAN score. There was equal specific sex predisposition in the incidence of fetal malnutrition. On classifying the newborns as per weight for age, 72.42% (181) were found to be AGA and 27.58 (69) were SGA.

When these SGA neonates were assessed by CAN score, 26% (n=18) were found to be well nourished and 11.2% (20) of the AGA newborns were having clinical signs of malnutrition which was statistically significant taking weight as sole criterion to evaluate malnutrition, a sensitivity [Figure 2] of 71.88% and specificity [Figure 1] of 89.9% was observed.

These newborns were also classified based on Ponderal index and 24% (60) of the newborns were malnourished. Upon CAN score assessment, 39.7% (31) were found clinically well-nourished and of the remaining well-nourished neonates with normal PI, 11.2% (25) had significant malnutrition. PI showed a sensitivity (Image-2) and specificity (Image-1) of 53.76% and 84.14% respectively in detecting malnutrition in comparison to CAN score, with a positive predictive value of 60.2% and a negative predictive value of 88.7%.

On classifying the newborns based on BMI, 38.3% (96) newborns were malnourished. But when assessed by their CAN score, 50.5% (49) [Table 1] of these newborns (BMI >11.2) were well

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nourished. On the other hand among newborns with normal BMI (61.7%, n=154), 5.45% (n=9) had signs of malnutrition by CAN score. These were found to be statistically significant. The sensitivity [Figure 2] of BMI in comparison to CAN score was 84.44% and specificity [Figure 1] 75.5%.

With regards to MAC/HC, 28.4% (71) newborns were found malnourished. Among these 71 newborns, a majority ie 65% (46) [Table 1] were identified as well-nourished by CAN score and 21.2% (38) of well-nourished newborns were clinically malnourished. MAC/HC had sensitivity [Figure 2] of 39.68 and specificity [Figure 1] of 75.6%.

When the indices were combined (PI and BMI) and compared to CAN score, the net sensitivity, specificity, positive and negative predictive values remained the same. Analysis was carried out with BMI which had exhibited a very high sensitivity as standard index against CAN score.

Table 1: Illustrating Comparison between Body Indices and CAN score

S.No.	INDEX	CAN Score		FREQUENCY	P VALUE
		MALNOURISHED	NORMAL		
1)	SGA	51	18	69	0.0001
	AGA	20	161	181	
2)	PI < 2.2	29	31	60	0.0001
	> 2.2	25	165	190	
3)	BMI < 11.2	49	47	96	0.0001
	> 11.2	9	145	154	
4)	MAC/HC < 2.7	25	46	71	0.0001
	> 2.7	38	141	179	

PI: Ponderal index; BMI: Body Mass Index; SGA: Small for Gestational Age; AGA: Appropriate for Gestational Age

DISCUSSION

Identification of fetal malnutrition which is a major problem has been so far hidden and unrecognized by the present anthropometric methods and is essential to adapt interventional methods to prevent the sequelae. Our study emphasise on training of health personnels at different levels to evaluate CAN score so as to enable accurate identifying fetal malnutrition which is of importance in developing countries where maximum newborns are delivered in outreach centres where qualified personnel are few.

In our study the incidence of FM was 26%, more than values by Metcoff,[4] (10.9%) and similar to Kumari,[9] (27.4%) and Rao (28%).[10] When weight is used as a lone criterion, we found that many newborns with fetal malnutrition were mislabelled as well nourished and vice versa which is in concordance with studies done by Taylor.[11]

Ponderal index relies on the principle that the length is spared at the expense of weight during acute malnutrition, however it does not take into account chronic malnutrition where as both weight and length are affected with their ratio being normal, hence such newborns who are malnourished will be misdiagnosed as normal. In our study PI exhibited a better specificity but poor sensitivity in identifying malnutrition. This is in concordance with other studies done by Adebami,[15] but not with the study done by Georgieff who found MAC/HC as a more accurate index.[12]

On analysis of of MAC/HC with CAN score, a very poor sensitivity was obtained with a fair specificity, the positive predictive value was also very low, hence making MAC/HC a very poor indicator in detecting fetal malnutrition. These observations are similar to those made by Meadow but lower values of statistics were reported by Mehta.[13,14] In our study we found BMI had a high sensitivity but lower specificity compared to CAN score, suggesting that BMI is a sensitive indicator of fetal malnutrition.

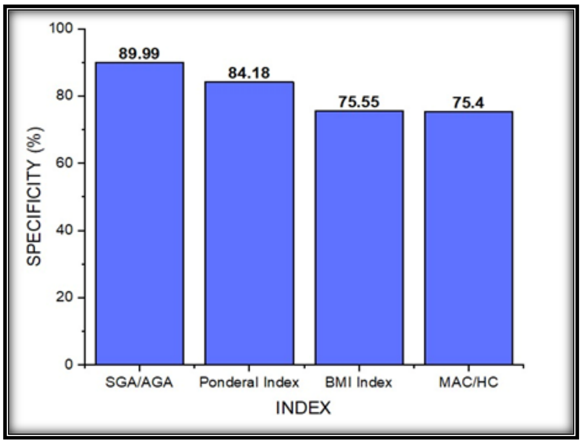

Figure 1: Graphical representation comparing specificity of the various anthropometric indices (in comparison to CAN score)

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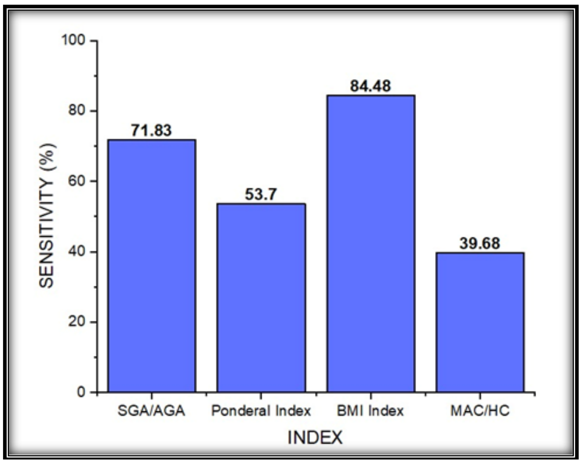

Figure 2: Graphical representation comparing sensitivity of the various anthropometric indices (in comparison to CAN score)

Among the 154 well-nourished newborns with BMI >11.2, 9 were clinically malnourished (CAN score) and the remaining 145 were normal. Further analysis of the PI in these newborns showed that all the 145 with normal BMI, had also normal PI and 7 out of the 9 newborns with low BMI also had low PI implying that only 2 out of the total 250 newborns were misdiagnosed as malnourished when a combination of BMI and PI was applied (1< percent under diagnosis).

Limitations: This study has a small sample size and hence larger multicentric studies are required to identify actual prevalence of fetal malnutrition.

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 equipment's in resource restricted setups. Fetal malnutrition may be present at birth irrespective of the normal anthropometric parameters, and can be accurately identified by CAN score. As there is no single parameter to accurately differentiate between normal and malnourished newborns, hence a combination of BMI and PI along with CAN score can be used as a screening tool for detecting fetal malnutrition.

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