Original Research Article

Sole print area as a parameter for assessing the gestational age of the neonate – A prospective cross-sectional study

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Abstract

Background: Simple parameters other than birth weight such as sole print area, head circumference, chest circumference, mid-arm circumference will be useful to quantitate fetal and neonatal growth and to identify at risk babies at rural community level. **Aim:** To know whether the Sole print area corresponds to Gestational age in Newborn so as to be used as a parameter for estimating Gestational age. **Objectives:** Neonates will be categorized as Term, Preterm, SGA/ IUGR. The estimated sole print area in the term, Preterm and SGA/ IUGR will be compared and correlated with the Gestational Age estimated by New Ballard Score. **Materials and Methods:** A prospective cross sectional study was done in the department of paediatrics and included 1000 first day neonates born in Labour room, OT and present in Post Natal ward. Data was collected from newborn clinical examination after taking a written consent from the caretaker. The gestational age of infants will be calculated from the first day of LMP and confirmed by clinical assessment using New Ballard Score. Sole print was obtained using a stamp pad and the sole print area was estimated by placing the print on a transparent grid, each square measuring ¼ cm x ¼ cm. Based on each value by correlating with NBS each value is assigned for Term, Preterm, SGA/ IUGR. **Results:** Of the total 1000 deliveries, 360 were from LSCS and 640 were SPVD. Of the 1000 deliveries, 530 were term, 300 were preterm and 170 were IUGR/SGA. The mean New Ballots Score (NBS) of the babies was 36.41 falling within the range of NBS from 26 to 45. Analysis using pearson correlation coefficient indicates a significant linear relationship between sole print area and gestational age, r = 0.347 and correlation is highly significant ($p<0.001$). **Conclusion:** there is a linear relationship between sole print areas with gestational age assessed by NBS and this is useful to quantitate fetal and neonatal growth and to identify at risk babies at rural community level.

Key Words: gestational age, neonatal.

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INTRODUCTION

Prematurity is a significant contributor to neonatal mortality. Conventionally, assessment of gestational age (GA) based on New Ballard Score (NBS) which is a Gold Standard, for which a Pediatrician is needed. Other method is Ultrasound to assess Gestational Age, is a limiting factor where only 51% of the women undergo the recommended 3 antenatal visits, providing an easy method to assess GA may be a viable option. It is universally acknowledged that size of the baby at birth is an important indicator of fetal and neonatal health in the context of both individual and population. WHO has estimated 5 million neonatal deaths globally occur every year. In India 55 – 60% of infant death occurs in neonatal

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period. Over 80% of all neonatal deaths in both the developed and developing countries occur among the Low birth weight babies.[1] About 25 -35% of babies in India are Low birth weight babies as opposed to about 5-7% of newborns in west. These LBW babies include preterm, term and small for gestational age and IUGR. High incidence of Low birth weight babies in our country is accounted by a higher number of SGA (Small for Gestational Age)/IUGR babies rather than the preterm babies.[1] These babies with abnormal fetal growth need to be identified and observed closely as they have higher neonatal mortality and morbidity, as compared with grown babies of identical gestation. These babies with abnormal fetal growth are more prone for metabolic derangements like hypoglycemia and polycythemia during neonatal period. Therefore, it is very essential to recognize neonates with abnormal fetal growth at birth; so that it forewarns pediatrician for subsequent management of complications on priority basis. The clinical assessment of gestation at birth by physical and neurological examinations of the baby is more reliable as compared to the methods recommended for assessment of baby in-utero. As gestation proceeds, the baby grows and matures physically and neurologically.[2] Cross sectional data on birth weight and gestational age at birth are commonly used to construct a longitudinal curve of growth. Generally, these curves are assumed to be representative of fetal growth and then a source of information about fetal development.[3] Birth weight (B. wt) has been universally used as a measure of intrauterine growth, because of its correlation with gestation and relative ease of recording in hospital setting.[4] Weight is the most widely used single clinical indicator of growth. However, birth weight by itself is not infallible. Infants of identical race, sex, gestational age and length have been known to differ in their body weights by up to 40%. Also birth weight is the sum of fat and lean body tissue. Weight gain represents the sum of increment of different body components including muscle, skeleton, adipose tissue and water. So it is rather nonspecific measure of growth.[4] Further, in our country most of birth occur at home and are conducted by traditional birth attendants, where there is a paucity of weighing scales. Recording of birth presents a major logistic at rural community level. The scoring system devised by Dubowitz *et al*. proved an accurate method of assessing gestational maturity in the newborn, and proved practical in the day-to-day care of neonates on the obstetric unit, where there was no difficulty in applying the system as a routine procedure. The system could be used by medical and nursing staff, in either hospital or domiciliary practice, to give gestational assessments of within one week's accuracy in the vast majority of normal babies examined.[5] So measuring fetal growth by a simple, reliable and acceptable method applicable by paramedical workers has become a need for third world countries and led to quest to alternative anthropometric parameters, which could be utilized to quantitate fetal growth. Studies from other workers also established the strong correlation of mid-arm circumference as well as thigh circumference with gestational age and early neonatal mortality.[6,7,8,9,10] WHO also recommended that in areas where the early weighing of neonate is not feasible, community health workers should be trained to measure the head and chest circumference to find out at risk neonate[11] Thus alternate anthropometric parameters could be useful for assessing fetal growth. Present study was performed with objective to find out whether "Sole Print Area" corresponds to Gestational age in Newborn as a parameter for estimating Gestational age. Sole print is taken for identification of newborn babies in most of the countries. This observation can be gainfully employed for further studies to know whether simple parameter other than birth weight will be useful to quantitate fetal growth and to identify at risk babies at rural community level.

MATERIAL AND METHODS

The prospective cross-sectional study was carried out in Labour room, OT, Post natal ward of Bhaskar General Hospital, Yenkapally. The study period was from January 2015 to July 2017. The study was approved by the Institutional Ethical Committee. The study includes 1000 neonates on the first day of life, born in Labour room, OT, Post Natal ward of Bhaskar General Hospital selected by convenience sampling. Data was collected from newborn clinical examination. All the nneonates attendees were given a choice to participate in the study. They were explained about the importance of the Study, the procedure of the study and written consent was taken. Babies with congenital anomalies/ syndromic babies, all twins and multiple gestations were excluded. The gestational age of infants was calculated from the first day of LMP and confirmed by clinical assessment using New Ballard Score. In cases where history was not available or reliable, clinical criteria (NBS) were used. After initial steps of resuscitation, neonates were routinely examined and sole print which is routinely taken as identification mark of neonate was taken on the case Sheet. Imprint was taken using a stamp pad. The Sole print area assessment was performed for each subject at birth with a transparent GRID of ¼ cm by placing a sole print underneath. Either the left or the right sole print was taken into consideration. Gestational age was calculated by enquiring into 1st day of mothers last menstrual period and was subsequently confirmed by New Ballard Score. Fetal Birth weight was also

measured. Neonate's sole print, which is routinely taken for identification purpose is placed on a transparent grid, each square measuring ¼ cm x ¼ cm. The no of squares where the sole print is occupying more than half are counted and the entire sole print area is assessed by no of squares occupied, divided by 16 which give the sole print area in cm2

NO. OF SQUARE BOXES X 1/16 GIVES THE SOLE PRINT AREA OF THE NEONATE.

Based on each value by correlating with NBS each value is assigned for Term, Preterm, SGA/ IUGR. As the sole print shows the creases, which is criteria for NBS helps in identifying SGA/IUGR from preterm. This data was tabulated and analyzed in Microsoft excel and SPSS version 21. Descriptive Statistics, Percentages, Proportions and Students t-test were applied in the study wherever required. P<0.05 was considered statistically significant.

RESULTS

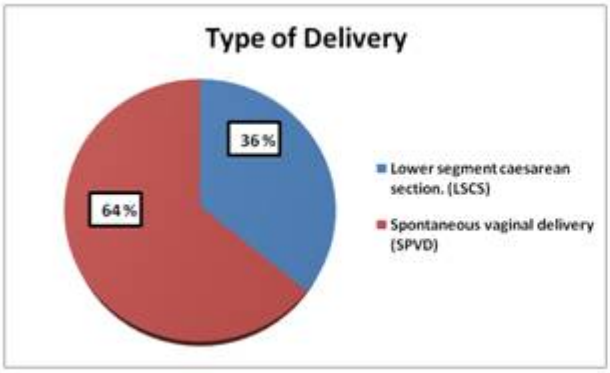

Figure 1:

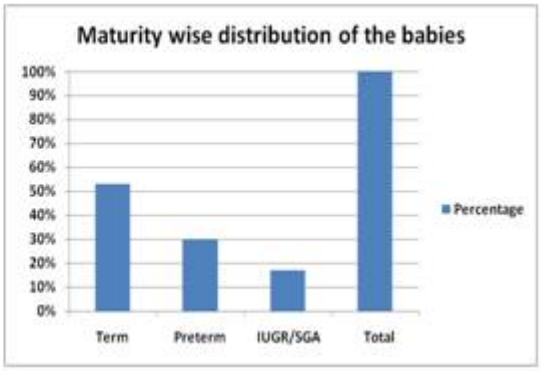

Figure 2:

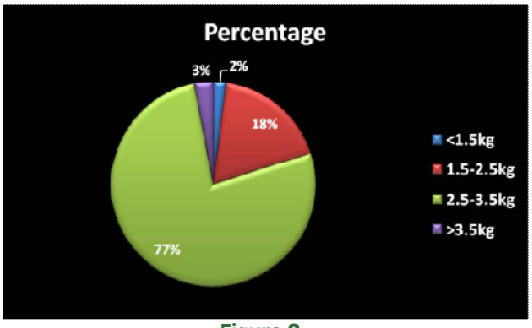

Figure 3:

Figure 1: Distribution according to type of delivery: of the total 1000 deliveries, 360 were LSCS and 640 were SPVD
Figure 2: Maturity wise distribution of the babies: of the 1000 deliveries, 530 were term, 300 were preterm and 170 were IUGR/SGA.
Figure 3: Distribution according to the birth weight of the babies:

Table 1: Mean New Ballots Score (NBS) of the babies

NBS score	Mean	Standard deviation(SD)	Range
	36.41	4.117	26-45

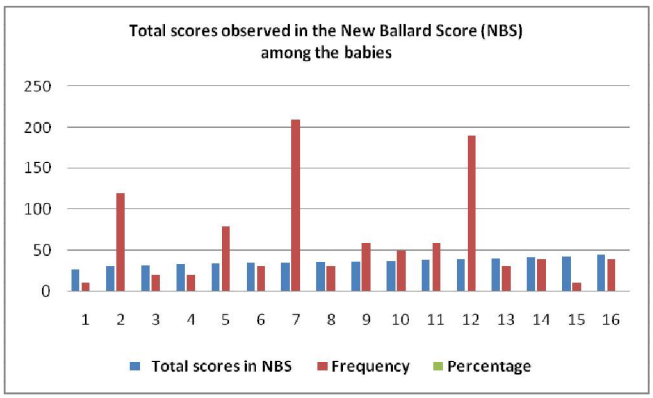

Figure 4:

Table 2: Descriptive statistics of the various parameters of the babies

Parameters	Mean± SD	Range
Birth weight (BW)	2.79 ± 0.467	1.25 – 3.75
Head circumference (HC)	33.43± 1.34	30.10 – 36
Sole Print Area(SP)	14.17±1.956	8.93 – 18

Table 3: Correlation between Gestational Age (GA) and the Anthropometric measurements (Birth weight, Head Circumference and Sole print area)

	GA (Wks)	No of babies	Birth weight (BW) * Mean ± SD	Head circumference (HC) ** Mean ± SD	Sole Print Area (SPA) *** Mean ± SD
	32	10	1.24 ± 0.07	30.50 ± 0.3	13.60 ± 2.42
	35	50	2.35 ± 0.49	31.68 ± 1.6	14.02 ± 2.01
	36	140	2.62 ± 0.37	32.95 ± 1.57	14.06 ± 1.99
	37	160	2.80 ± 0.48	33.58 ± 1.08	14.06 ± 1.99
	38	230	2.72 ± 0.32	33.41 ± 1.09	14.12 ± 1.95
	39	190	2.76 ± 0.36	33.32 ± 1.31	14.12 ± 1.97
	40	150	3.13 ± 0.47	34.05 ± 1.38	14.05 ± 2.05
	41	40	3.22 ± 0.32	34.52 ± 0.56	13.96 ± 1.82
	42	30	3.10 ± 0.26	34.23 ± 0.05	14.13 ± 1.86
Correlation			**0.479**	**0.322**	**0.347**
p value			**<0.001**	**<0.001**	**<0.001**

***Analysis using Pearson correlation coefficient indicates a significant linear relationship between Birth Weight (BW) and gestational age (GA), r=0.479 and correlation is highly significant (p<0.001) ****Analysis using Pearson correlation coefficient indicates a significant linear relationship between head circumference (HC) and gestational age (GA), r=0.322 and correlation is highly significant p<0.001) *****Analysis using Pearson correlation coefficient indicates a significant linear relationship between sole print area (SPA) and gestational age (GA), r=0.347 and correlation is highly significant (p<0.001)

Table 4: Association between sole print area and Preterm, SGA/ IUGR babies

Sole print area (SP)	Preterm babies (300)	SGA/ IUGR babies (170)	p value
Mean	14.12	13.7	
Standard deviation	2.0	2.0	0.03

Table 5: Association between sole print areas and Term, Preterm and SGA/ IUGR babies

Sole print area	Term babies(530)	Preterm and SGA/ IUGR babies (470)	P value
Mean	14.17	13.9	
Standard deviation	1.95	1.97	0.02

DISCUSSION

It is a universal practice of taking neonates foot print for identification purpose. Many studies have reported that various anthropometric measurements correlated with the gestational age. The present study was done to see whether sole print area can be used as a parameter for calculating the gestational age. In the present study, 1000 neonates were studied. 55% were male neonates, 45% were female neonates. Based on GA by NBS, 53% neonates were Term, 30% Preterm, 17% SGA/IUGR. The mean NBS was 36.41 with SD 4.117 score ranging 26- 45 for term, preterm and SGA/ IUGR. The mean Sole Print was 14.17 cm^2 with SD 1.95 in term, mean SP was 14.12 cm^2 with SD 2.0 in preterm and mean SP was 13.7 cm^2 with SD 2.0 in SGA/ IUGR. As the mean and SD values of preterm and SGA/ IUGR are indistinguishable. The sole print shows the creases which helps in identifying preterm from SGA/IUGR. Sole creases are one of the criteria for assessing GA by NBS. The mean Birth weight was 2.79 Kg head circumference was 33.43 cm and sole print area was 14.17 cm^2. Gruenwald et at (1966) developed a birth weight reference from singleton births, based on a combination of data on 1232 surviving infants obtained in early study and on 12500 consecutive births. He was one of the first investigators to note the apparently bio modality of the birth weight distribution in preterm infants and to attribute this to errors in gestational age assessment based on LMP.[12] In our study also, the birth weight correlated in estimation of gestational age. SS Verma et at (1999) carried out study titles "prediction of birth weight from simple anthropometric measurements in Indian male and female newborn babies". It was observed that birth weight correlated ($p<0.001$) with all the three anthropometric measurements. The magnitude of the correlation of birth weight with head circumference, chest circumference and length was in descending order.[13] In our study also, the birth weight correlated with the head circumference and sole print area in estimation of gestational age. Thus among the various studies done to determine the correlation of various anthropometric measurements with birth weight and GA, they correlated well in identifying at risk babies. The present study also showed significance in anthropometry of the neonate for assessing the gestational age. The present study uses 'sole print' which is routinely used for identification of the neonate; the sole print area was assessed and calculated. It correlated well with GA of the neonate when compared with NBS and other anthropometric measurements. This data can be used to identify "at risk" babies in community level by considering easy to measure parameter. Early identification can aid timely referral intervention in case of high risk babies. Advantage of using sole print area is that it will not be affected by acute illnesses insulting in significant weight loss. In resources poor settings, where weighing machine is not available. Community health worker may not be trained to use this parameter for identification of high risk babies. Such studies done on larger population may provide data base for the indigenous population. Another suggestion where community health workers are likely to be absent at time of birth, it is important that the mothers are given a GRID paper, to measure and instructed its use. This can be a part of delivery kit containing for example, soap, a razor blade, a bandage and a dressing set each of which would promote a healthy delivery. This data can be gainfully to know whether simple anthropometric measurements other than the birth weight will be useful to quantitate newborn growth.

CONCLUSION

In this study there is a linear relationship between sole print areas with gestational age assessed by NBS. There is increase in the sole print area with increase in birth weight. Sole print area correlated in identifying SGA/IUGR at risk babies. Correlation among other anthropometric measurements (birth weight and head circumference) correlates with gestational age. This study recommends a community based survey and research.

SUMMARY

The present study which was a prospective cross sectional study was conducted in1000 neonates for assessing their gestational age by calculating the sole print area and correlating with NBS and other anthropometric measurements like birth weight and head circumference. The data tabulated and analyzed. The results of the study have lead to the conclusions that a significant linear relationship ($r=0.347$) was found between the sole print area and gestational age which was found to be statistically significant ($p=0.000$). Statistically significant association was found between sole print area and preterm/IUGR babies which can be useful in categorizing the baby in either preterm or IUGR. Similar large scale studies need to be done in the future. Hence this study emphasizes the importance of measuring sole of foot to assess gestational age. In few conditions it may not possible to take birth weight or any other variable to assess gestational age, even in such situations, sole print area measurement can be easily taken and thereby rapidly assess the gestational age and appropriate timely care can be given to the newborn.

REFERENCES

1. Singh M, M.D. Care of Newborn. 6th edn. New Delhi: Sagar publications; 2004, 1- 3, and 215-238.

2. Meharban Singh, "Care of the newborn", 8th Edition.
3. Allen J. Wilcox, UI. D. Birth weight, gestation, and the fetal growth curve. AM. J.Obstet. Gynecol. 1981; 139: 863.
4. Shiv Prasad S. R, Mohan M, Kumar A, Kapani V. Intrauterine growth curves for mid arm and thigh circumferences. Indian pediatrics 1989; 26: 343-347.
5. Dubowitz, L. M. S., Dubowitz, V., and Goldberg, C. (1970). Clinical assessment of gestational age in the newborn infant. Journal of Pediatrics, 77, 1.
6. Bhargava SK, Ramji S, Man mohan, Marwah J, SAchdev HPS. Mid arm and chest circumference at birth predictors of low birth weight and neonatal mortality in the community. Br Med J 1985; 29: 1617-1619.
7. Bhatia B.D, Tyagi N.K. Birth weight: relationship with other fetal anthropometric parameters. Indian pediatrics 1984; 21: 833- 838.
8. Sanasaw SR, Georgiff MK, Pereira GR. Mid arm circumference and mid arm circumference- head circumference ratios: Standard curves for anthropometric assessment of neonatal nutrition status. J pediatr 1986; 109:311-315.
9. Sharma J.N, Sharma B.S, gupta M.L, Saxena S, Sharma V. Mid arm circumference at birth as predictors of low birth weight babies and early neonatal mortality. Indian paeditrics 1986; 23:915-919
10. Excler JL, Sann L, Lasne Y, Picardo J. anthropometric assessment of nutritional status in newborn infants. Discriminative value of mid arm circumference and of skin fold thickness. Early Hum Dev, 1985; 11:169-178.
11. WHO physical status. The use and interpretation of anthropometrics: Report of WHO expert committee. Tech. Report. Series. 854. Geneva. WHO. 1995.
12. Gruenwald P et at. Growth of the human fetus. I. Normal growth and its variation. American Journal of Obstetrics and Gynecology. 1966; 94:1112-1119.
13. SS Verma, 'L Sharma. Prediction of birth weight from simple anthropometric measurements in Indian male and female newborn babies. Indian Pediatrics. 1999 vol. 53-68.

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