Assessment of Foot Length for Estimation of Small for Gestational Age in Rural Area

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Abstract

Background:
Neonatal period is the most vulnerable for Small for Gestational Age (SGA) new-borns for survival.About 60% of the new-borns who born term but have low birth weight due to fetal growth restriction termed as Small for Gestational Age (SGA). The burden of SGA newborn is very high in countries of low and middle income and is concentrated high in South Asia. Identifying these low-birth-weight SGA newborns and referring them to higher centers for effective interventions would help in decreasing neonatal mortality and morbidity. Among the anthropometric measurements, birth weight is the single gold standard for identification SGA but assessment of accurate BW in rural areas where weight machine and trained personnel are not available specially in home deliveries, other simple and easier anthropometric measurement of the newborn may be as important. Foot length is a screening tool that may be simple but accurate to identify small new-born in need of extra care in rural settings of developing country like Bangladesh. Neonatal foot length (FL) has been proposed as a stable and reliable alternative, as it is less affected by intrauterine growth restriction (IUGR).

Objective:
To compare mean foot length in term Appropriate for Gestational Age (AGA) and SGA newborns, to assess the correlation between foot length and gestational age in both groups and to determine if foot length can help to differentiate between AGA and SGA infants when GA is uncertain.

Methods:
This cross-sectional, analytical study was conducted in the Department of Anatomy, Rangpur Medical College, Rangpur from July 2020 to June 2021 on 200 newborns of both sexes with gestational age between 37 and 42 weeks. The newborn was selected and measured within 24 hours of birth. 100 term newborns weighted<2.5 kg regarAded as SGA were the case and another 100-term newborns weighted>2.5 kg regarded as AGA served as control. The birth weight, foot length were measured and a comparison was done between AGA and SGA newborns. Data was analyzed by using a statistical package for social sciences (SPSS version 26).

Result:
The mean± SD of birth weight in AGA and SGA groups was 2.99±0.31kg and 2.10±0.24kg respectively, it was observed that the mean±SD of foot length in AGA group was 8.41±0.74cm and was 7.17±0.81cm in SGA group. Both BW and foot length was significantly higher in AGA group than SGA group. Again, foot length was significantly correlated with birth weight in both AGA and SGA groups.

Conclusion:
Foot length of SGA newborns are as effective as birth weight measurement to predict birth weight in SGA newborns

Keywords: Appropriate for gestational age (AGA), Small for gestational age (SGA), Birth weight (BW), Foot length (FL).

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Introduction:

The neonatal period is the most vulnerable period of life.[1] Neonatal deaths account for 45% of all deaths among under-five children.[2] Most of them die at home or at primary health care centers with minimal facilities. About 60% of the low birth weight (LBW) newborns are born at term due to fetal growth restriction termed as Small for Gestational Age (SGA) newborns, whereas the remaining 40% are born preterm.[3] The term 'small for gestational age' (SGA) describes newborns who have lower than expected weight, length, and head circumference when controlled for gestational age and sex. In 1995, the World Health Organization published recommendations defining SGA as less than the 10th percentile of weight for gestational age and Large for gestational age (LGA, >90th percentile) with those appropriate for gestational age (AGA) using localized and anthropometric newborn curve.[4]The burden of SGA births is very high in low and middle income countries mostly in South Asia. Identifying these LBW and SGA newborns and referring them to higher centers for effective interventions would help in decreasing neonatal mortality and morbidity.[5]Anthropometric measurements of the newborn population specially measurement of birth weight are an important scientific research tool to study the determinants and consequences of impaired or excessive fetal growth.[6] It is a non-invasive and cheap universal technique to assess the body size, proportions, and human composition.[7]In Bangladesh, 70% to 90% of births occur in rural areas at home and are conducted by illiterate and often untrained traditional birth attendants.[8] Taking accurate birth weight in such field situations is a problem due to the unavailability of weighing scales, ultrasonography, and trained personnel.[9] The identification and evaluation of low-cost tools to accurately identify small newborns in primary health care and community settings has been ranked as the number one research priority to reduce global mortality from LBW.[10] Neonatal foot length (FL) has emerged as a promising alternative anthropometric marker due to its relative stability throughout gestation and resistance to growth restriction effects compared to weight-based measures.[11] So, this study was done to measure foot length of newborns and to compare and correlate these measurements with BW thus identifying among this anthropometric measurement which would be used as an alternative to birth weight for predicting SGA newborns.

Methods:

This cross-sectional, analytical study was done in the Department of Anatomy, Rangpur Medical College, Rangpur from July 2020 to June 2021 on 200 Bangladeshi newborns of both sexes with gestational age between 37 to 42 weeks through purposive sampling and were divided into two groups. 100 term newborns weighted >2.5 kg who were born in the department of Gynae & Obs was in appropriate for gestational age (AGA) group and the group SGA consisted of 100 term newborns weighed <2.5kg who were admitted to the SCANU of the Department of Pediatrics of Rangpur Medical College Hospital. Subjects of both groups were studied within 24 hours of delivery. Newborns delivered by cesarean section and normal vaginal delivery were included. However, neonates with any congenital abnormality- microcephaly, macrocephaly, any identifiable neurological disorder, any H/O birth injury, and obstructed labor with maternal DM, and HTN disorders were excluded from the study. Ethical clearance was taken from Ethical Committee of Rangpur Medical College and permission was also taken from proper guardians of the subjects Both. The Birth weight (kg) and Foot length were measured. Both the measurements were taken thrice and the mean of these three was taken. Birth weight was measured on an undressed newborn using a digital weighing scale and noted in grams to the nearest 5g.Foot length was measured from the heel to the tip of longest toe on the foot using a measuring tape and noted in cm.[12] All measurements were done in triplicate, the-mean of the measurements were used for analysis. All data was collected on study-specific forms. Data collection forms was checked for logical errors and completeness prior to data entry. Both the measurements were performed according to NHANES, anthropometry procedures manual.[13] The statistical analysis was carried out using the statistical package for social sciences (SPSS version 26.0). Mean and standard deviation were calculated for each group. The statistical significance of the difference in quantitative variables between the Group - AGA Group and SGA Group was evaluated by independent sample t-test. Correlation of birth weight with foot length was done by Pearson's correlation coefficient test. In the statistical analysis, the significance level was set at p-value <0.05 with a 95% confidence interval.

Results:

There was statistically significant differences of mean birth weight and foot length between AGA and SGA groups (Table-I). On the other hand, no significant differences of mean birth weight and foot length were observed between male and female within groups (Table-II)

Table-I: Comparison of birth weight and foot length between AGA and SGA group. AGA (male=42, female 58), SGA (male 40, female-60)

Sex	Mean±SD Range		p-value
	AGA	SGA	
Birth weight (Kg)			
Male	2.98±.25 2.5 -3.6	2.06±.25 2.5 -4.0	<0.001
Female	2.99±.35 1.5-2.4	2.12±.24 1.0 -2.4	<0.001
Total	2.99±.31 2.5-4.0	2.10±0.24 1.5-2.41	<0.00
Foot length (cm)			
Male	8.26±.81 6-9.50	7.19±.73 6-9	<0.001
Female	8.52±.68 7-9.50	7.11±.78 6-9.50	<0.001
Total	8.41±0.74 6-9.5	7.17±0.81 6-8.5	<0.001

Table-II: Comparison of birth weight and foot length of male and female within AGA and SGA group. AGA n=(male=42, female 58), SGA n=(male 40, female-60)

Variables	Mean±SD Range		p-value
	Male	Female	
Birth weight (Kg)			
AGA	2.98±.25 2.5 -3.6	2.99±.35 1.5-2.4	0.78
SGA	2.06±.25 2.5 -4.0	2.12±.24 1.0 -2.4	0.22
Foot length (cm)			
AGA	8.26±.81 6-9.50	8.52±.68 7-9.50	0.11
SGA	7.19±.73 6-9	7.11±.78 6-9.50	0.66

Scattered diagram in Figure-1 showed the significant positive correlation between birth weight with foot length in AGA and SGA group new-born (“r<0.05).

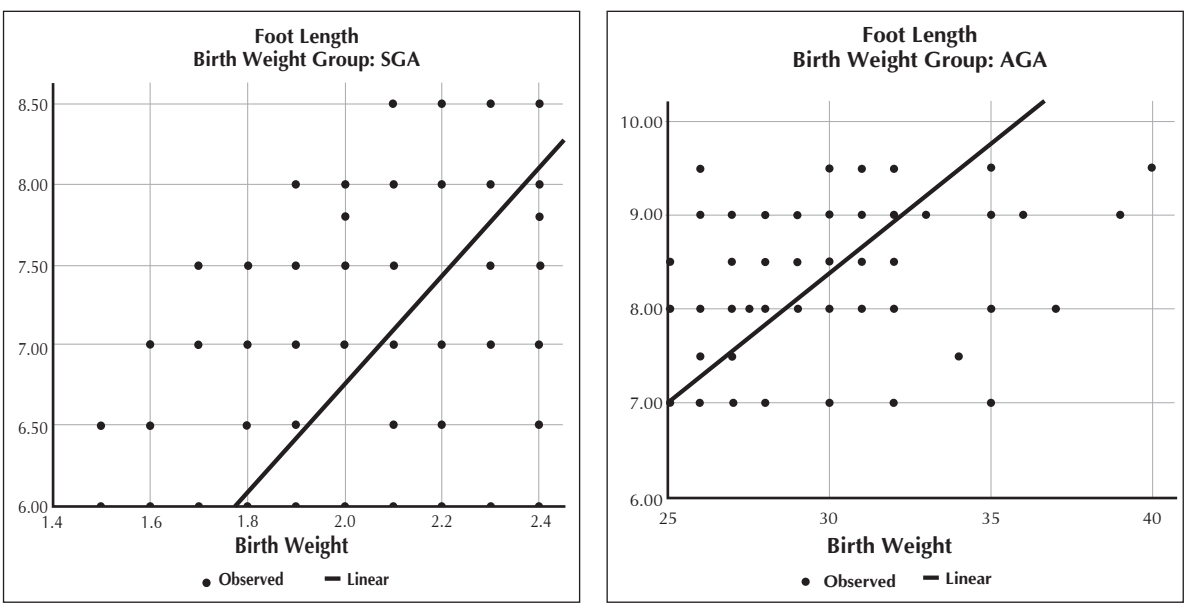

Figure-1 (a,b): Correlation of birth weight with foot length in AGA group (r-0.29, p-0.04) and SGA group (r-0.44, p-0.00)

Discussion:

The Millennium Development Goal-4 to reduce deaths of children of under-5 years by 2/3rds-may be unattainable without halving newborn deaths, which now comprise 38% of all under-5 deaths globally.[14] A major risk factor for neonatal mortality is LBW. Nearly all the newborns who die are LBW, and mostly in rural communities.[15] In the present study, the term new-borns weighted <2.5kg was regarded as SGA 8 >=2.5 was regarded as AGA. Mullany et al[16] stated that <2000 gm was a very low birth weight. In the present study, in the AGA group, the mean± SD of birth weight was 2.99 plus/minus 0.31kg and in the SGA group, the mean±SD was 2.1 plus/minus 0.24kg. Currently, new-born foot length is studied as an alternative anthropometric measurement to detect SGA, as no special skill is needed; pre term new-boms are not at risk of hypothermia because of measurement. New-born foot length measurement is easy, quick and efficient measurement for new-born.[17]

In present study, in AGA group the range of foot length was 6 to 9.5 cm and mean± SD was 8.41±74 cm In SGA group, the range of foot length was 6 to 8.5 cm and mean± SD was 7.17±0.81cm The foot length in AGA group was significantly higher than SGA group (p <,001). Similar result was found James et al (1979),[18] Mullany et al (2007),[16] Alia et al (2011),[9] Elizabeth, Christopher and Patrick (2013)[19] and Rakkapan and Kuppusamy (2016),[20] Srinivasa, Manasa and Madhu (2017)[21] and Doddamani, Jyothi and Pujar (2018).[22] The result of the present study was compared with findings of studies done by different authors in Bangladesh and abroad.[4,6] Among them, in SGA group, the highest mean value was found by Doddamani, Jyothi and Pujar (2018)[22] that was 7.45 cm, lowest mean value was found by Rakappan and Kuppusamy (2016)[20] that was 5.96cm and in AGA group highest mean value was found by Alia et al (2011)[9] that was 8.78cm and lowest mean value was found by Rakappan and Kuppusamy (2016)[20] that was 6.85cm.

In present study, in AGA group there was significant positive correlation between birth weight and foot length (r=29, p=.04).

Conclusions:

The neonatal mortality rate is very high in Bangladesh because of resource-poor settings. This study has shown that the simple and inexpensive measurement of foot length newborns play similar roles in predicting SGA newborns. These measurements are easy to learn and can conveniently be introduced into the existing systems of health care in the community of developing nations like Bangladesh, Asia, and Africa for use by paramedical workers to detect neonates who are at risk. For use in low-resource settings, any anthropometric device must be inexpensive and easy to maintain. Color-coded insertion tapes for measurement of variables can easily be made using locally available materials.However, it was a single-centered study in a tertiary care hospital, which may not focus on the actual status of the country. So, a multicenter study in rural areas of Bangladesh with a larger sample would focus on the actual status of the country.

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