

Foot Length and its Correlation with Different Anthropometric Variables in Neonates Born in Vinayaka Missions Medical College & Hospital, Karaikal: A Cross Sectional Study

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Abstract:

Background: Gestational age (GA) is a valuable metric for estimating mortality and morbidity as well as evaluating the newborn's level of maturity. Therefore, knowledge of the gestational age (GA) at birth is crucial to guide the appropriate management of a newborn. The aim was to study correlation of foot length (FL) with gestational age at birth and other anthropometric measures among preterm, term and post-term neonates and to study foot length is applicable as a proxy measurement to predict birth weight and gestational age in newborns. **Material and methods:** This is a hospital based cross sectional study of 150 newborn babies, done in the Department of Paediatrics, Vinayaka Mission's Medical College, Karaikal. All live newborn infants were included in the study, while babies with Skeletal deformities were excluded from the study. FL at birth was measured from the centre of the back of the heel to the tip of the big toe. Gestational assessment was done using modified Ballard's scoring on day one. Linear regression analysis was done to investigate the relation of FL to gestational age, birth weight (BW), head circumference (HC) and crown heel length (CHL). **Result:** There were 75 males and 75 females. Of the 150 newborns, preterm babies were 24 (16%), term babies were 126 (84%) and post-term babies were 0 (0%). The mean foot length was 7.68 cm with a range of 6-8.7 cm. Foot length correlated significantly ($p < 0.001$) with gestational age in Preterm AGA, Term SGA and Term AGA groups. The correlation coefficient of foot length with gestational age was maximum in Term SGA ($r = 0.646$) and followed by preterm AGA ($r = 0.48$) and Term AGA ($r = 0.463$). The correlation of foot length with birth weight was significant in Term SGA & Term AGA neonates. Foot length correlated significantly with head circumference and chest circumference as well in Term SGA & Term AGA neonates while significant correlation with crown heel length was observed only in Term AGA infants. **Conclusion:** Foot length correlated significantly with gestational age & other anthropometric variables in preterm & term infants.

Keywords: Small for Appropriate age (SGA), Appropriate for gestational age (AGA) and Large for Gestational age (LGA), Preterm, Term.

Introduction:

Gestational age (GA) is a useful parameter for assessing the maturity of the new born and for prediction of mortality and morbidity. Conventionally, gestational age of neonates is computed based on Naegele's formula or by ultrasonic evaluation during pregnancy or using modified new Ballard scoring (NBS) after birth¹. Anthropometric measures such as: birth weight, crown heel length and head circumference are the commonly used measures of growth in neonates, and they do correlate fairly with maturity. Weight measurements are significantly affected by changes in water, carbohydrate, fat, protein, and mineral levels². Although head circumference reflects brain growth, the effect of head sparing during malnutrition may result in an underestimation of growth^{3,4}. FL is quiet simple to measure where the only requirement is a well calibrated ruler or tape and does not require much expertise. A ruler is small, does not take up space, can be taken to deliveries outside a hospital premises i.e. in remote areas, and can be adequately cleaned and sanitized. It is also easy to acquire a well calibrated ruler. FL measurements can thus be used in remote areas to identify high risk newborn babies. It has been shown that foot length measurement is particularly valuable in premature babies who are so ill that conventional anthropometric measurements cannot be carried out due to the incubator and intensive care apparatus⁵.

Some research studies have investigated newborn foot length (FL) as a screening tool for small babies⁵⁻⁸. This study was done to find the correlation between newborn FL and gestational age and to determine the utility of using newborn FL as screening tool particularly in unwell and pre term infants undergoing intensive care. Both midwives & health care professionals can easily measure it.

Materials & methods:

The present study is a cross sectional hospital-based study of 150 newborn babies, Department of Paediatrics, Vinayaka Mission's Medical College, Karaikal. The duration of study was 1 year. All live newborn infants were included in the study. Newborn babies with Skeletal deformities were excluded from the study. GA of each newborn was calculated using the New Ballard Score. FL of each baby was measured from the heel to the tip of great toe using a stiff plastic transparent ruler. HC by flexible, non-stretchable measuring tape, CHL by infantometer and Birth weight by electronic weighing scale.

Data is analysed in terms of frequency and percentages as appropriate mean, standard deviation. A p value less than 0.05 was considered statistically significant. All statistically calculations were done using computer program Google sheets.

Results:

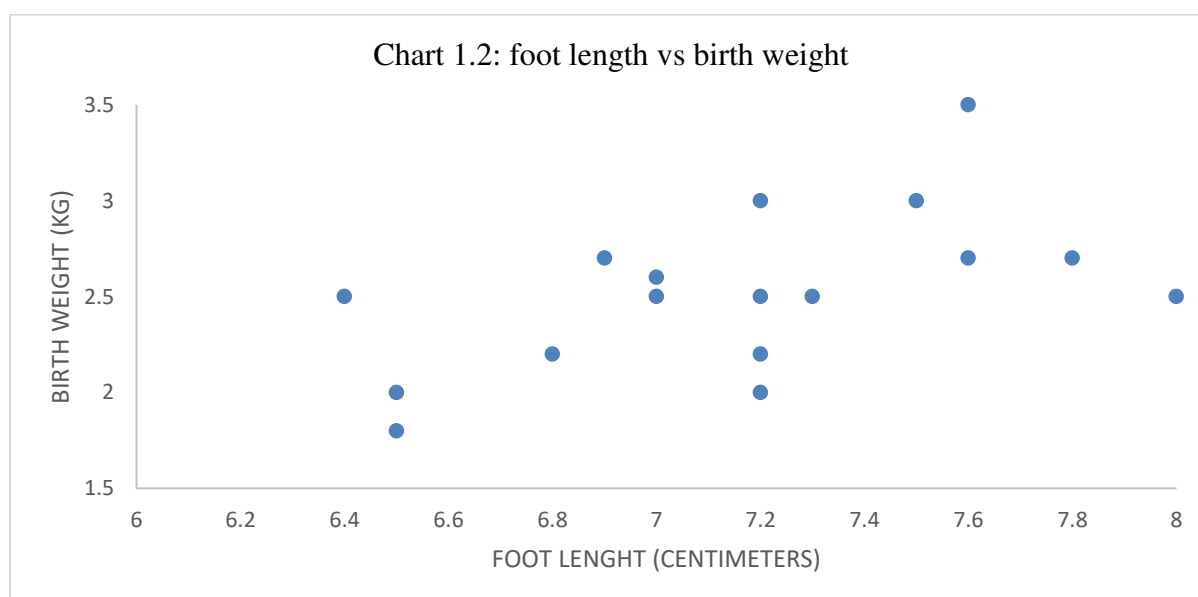
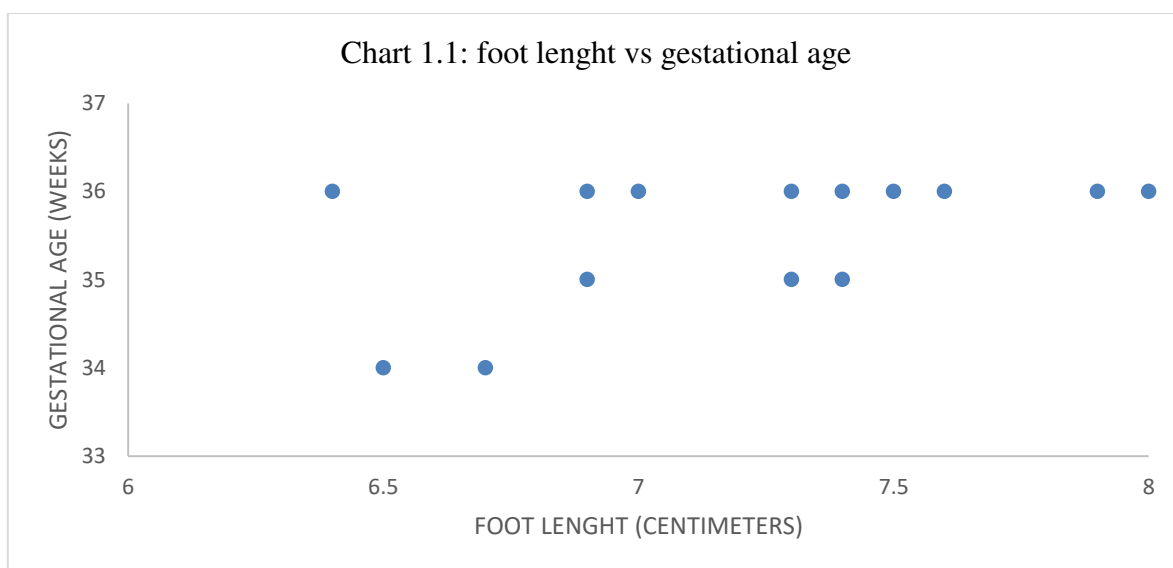
Out of 150 neonates, 50% (n=75) were male babies and 50% (n=75) female babies. Of the total 150 newborns, 97(64.6%) babies were Term AGA, 26(17.3%) babies were Term SGA & 3 (2%) babies were Term LGA. Also 19(12.6%) babies were Preterm AGA, 4 (2.7%) babies were Preterm SGA and 1 (0.67%) were Preterm LGA. The maximum number of newborns were in the Term AGA (64.6%)group. There were no newborns in any postterm groups.

As number of subjects in Preterm SGA(4), Preterm LGA(1) & Term LGA(3) were low, correlation of foot length was done with other anthropometric variables in different neonatal age groups.

Table 1: Correlation of Foot length with other anthropometric variables in different neonates

Variables	PretermAGA (r & p value)	TermSGA (r & p value)	Term AGA (r & p value)
Gestational age	0.480&0.038	0.646&0.000	0.463&0.000
Birth weight	0.306&0.203	0.634&0.001	0.434&0.000
Head circumference	0.212&0.384	0.343&0.087	0.373&0.000
Crown heel length	0.273&0.259	0.126&0.539	0.295&0.003
Chest circumference	0.021&0.932	0.551&0.004	0.398&0.000

Chart 1: Correlation of Foot length with other anthropometric variables in Preterm AGA neonates



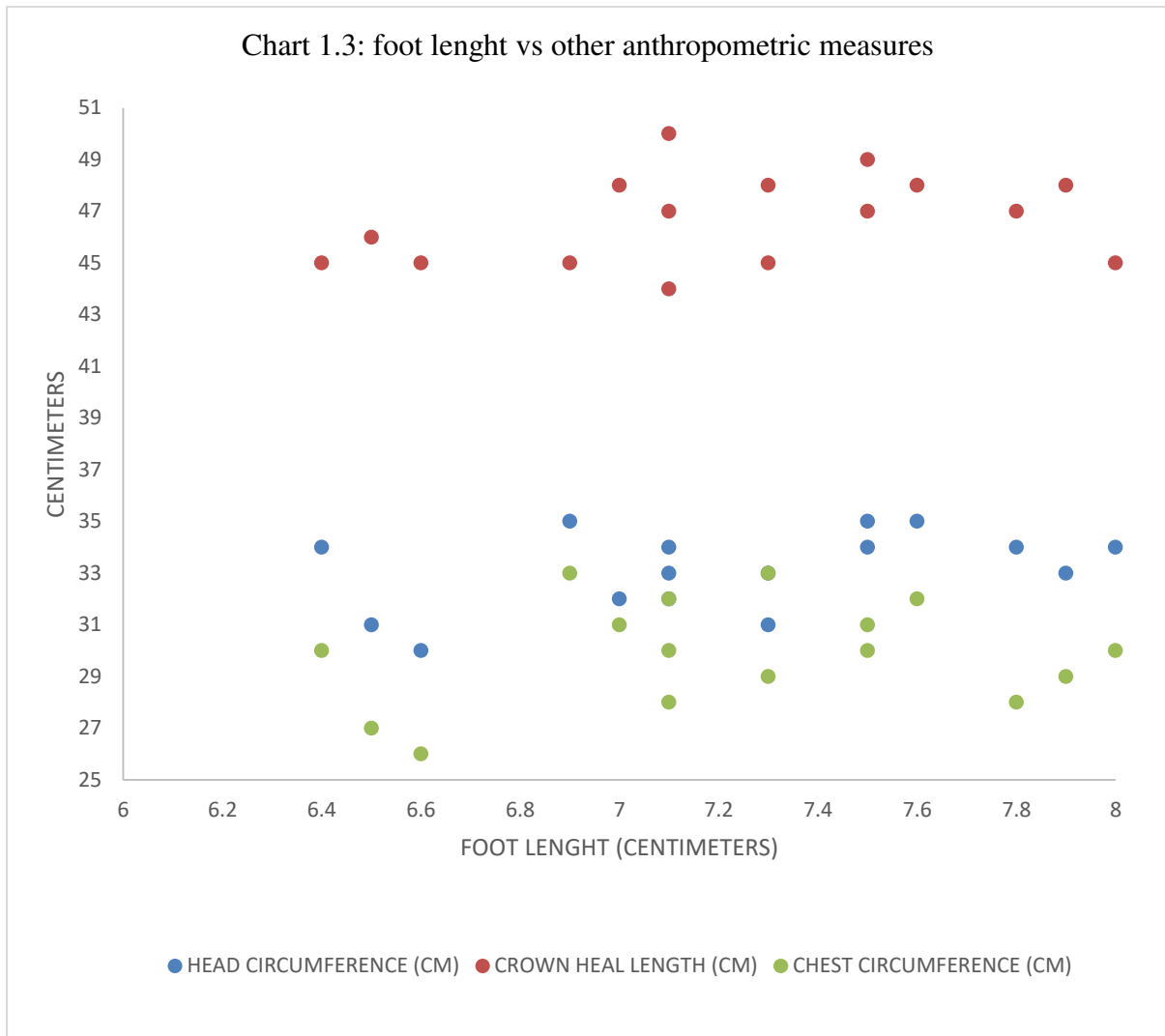
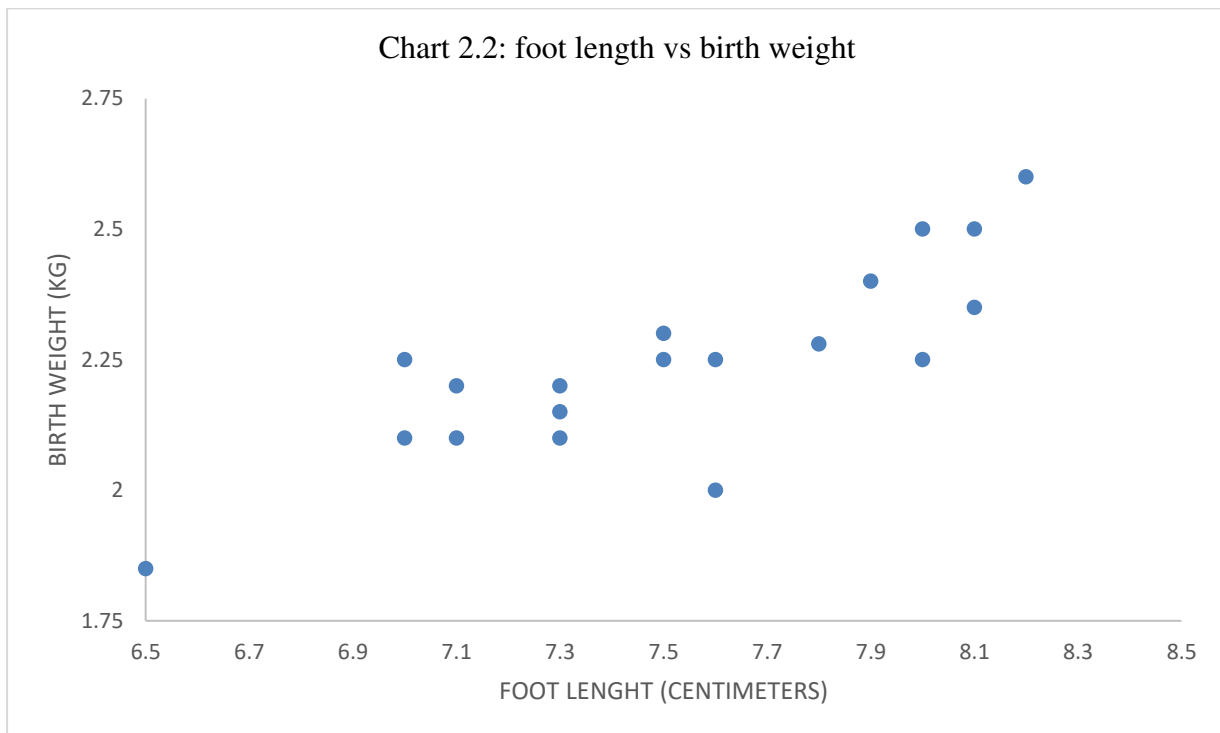
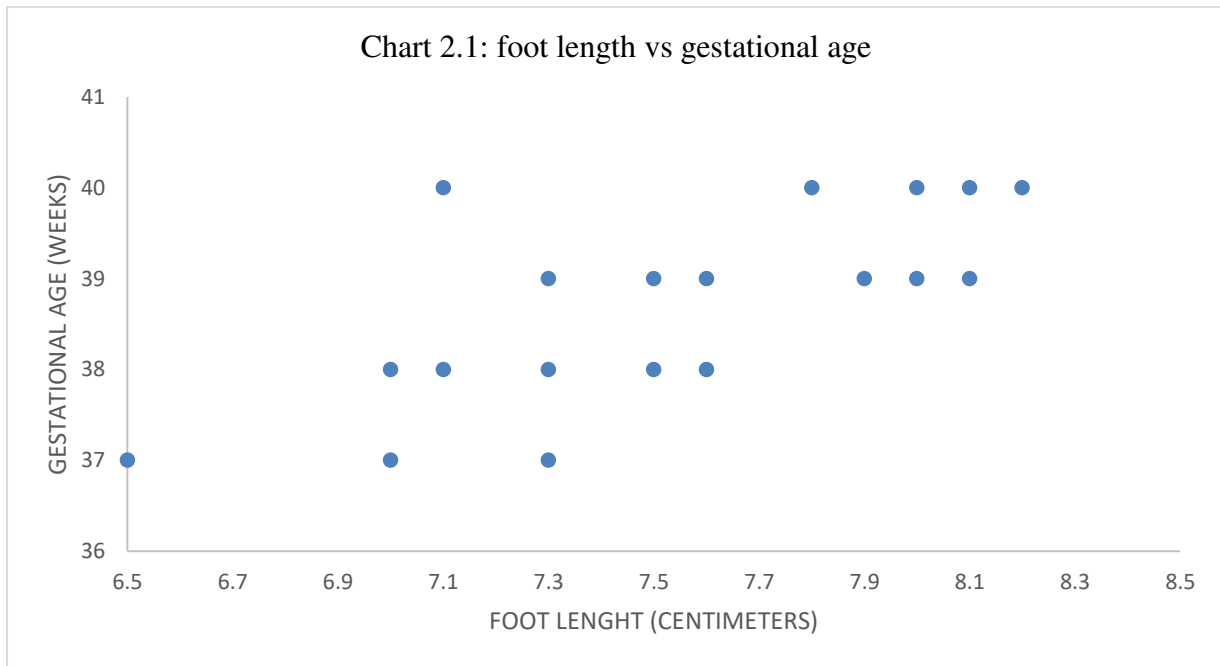


Chart 2: Correlation of Foot length with other anthropometric variables in Term SGA neonates



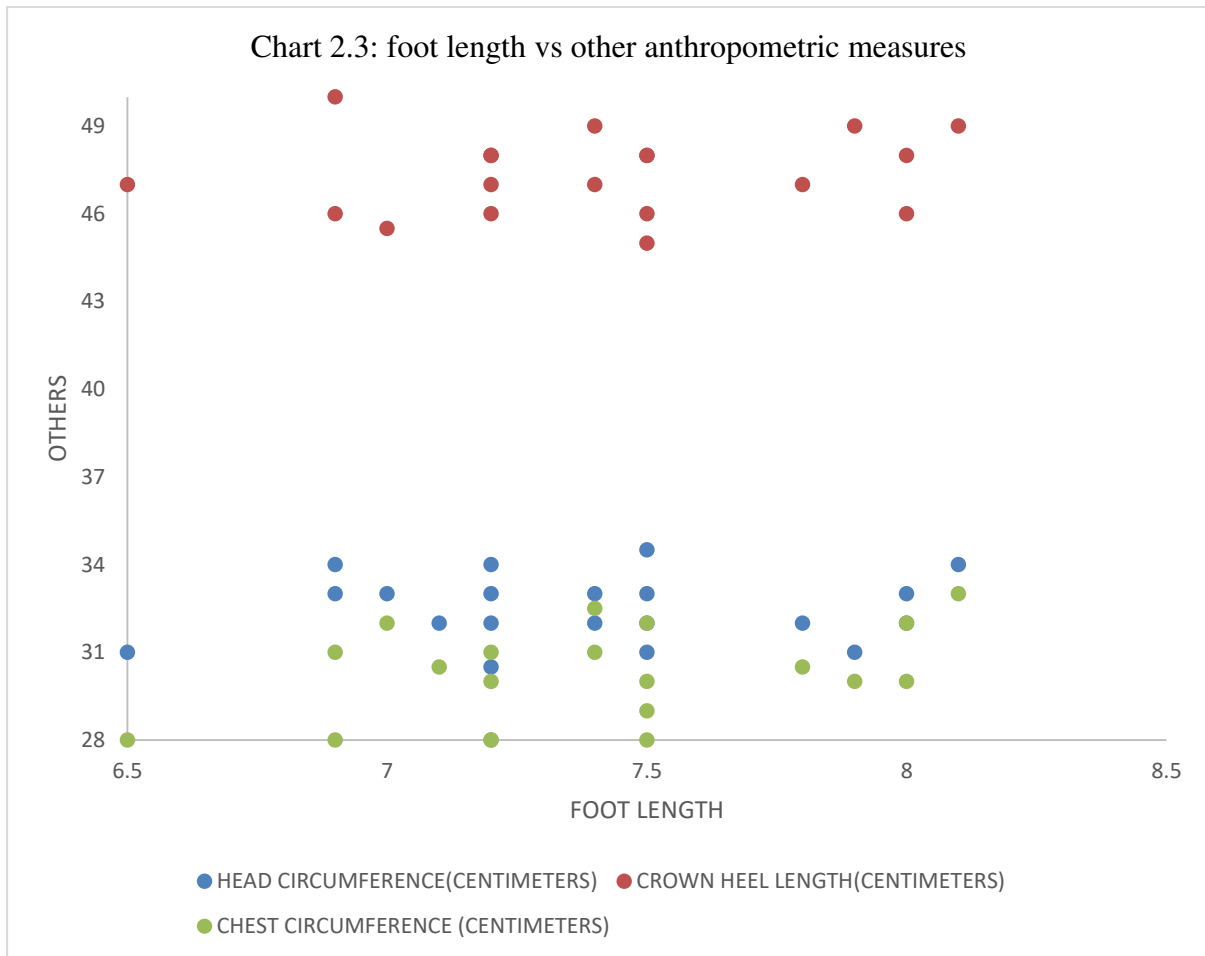
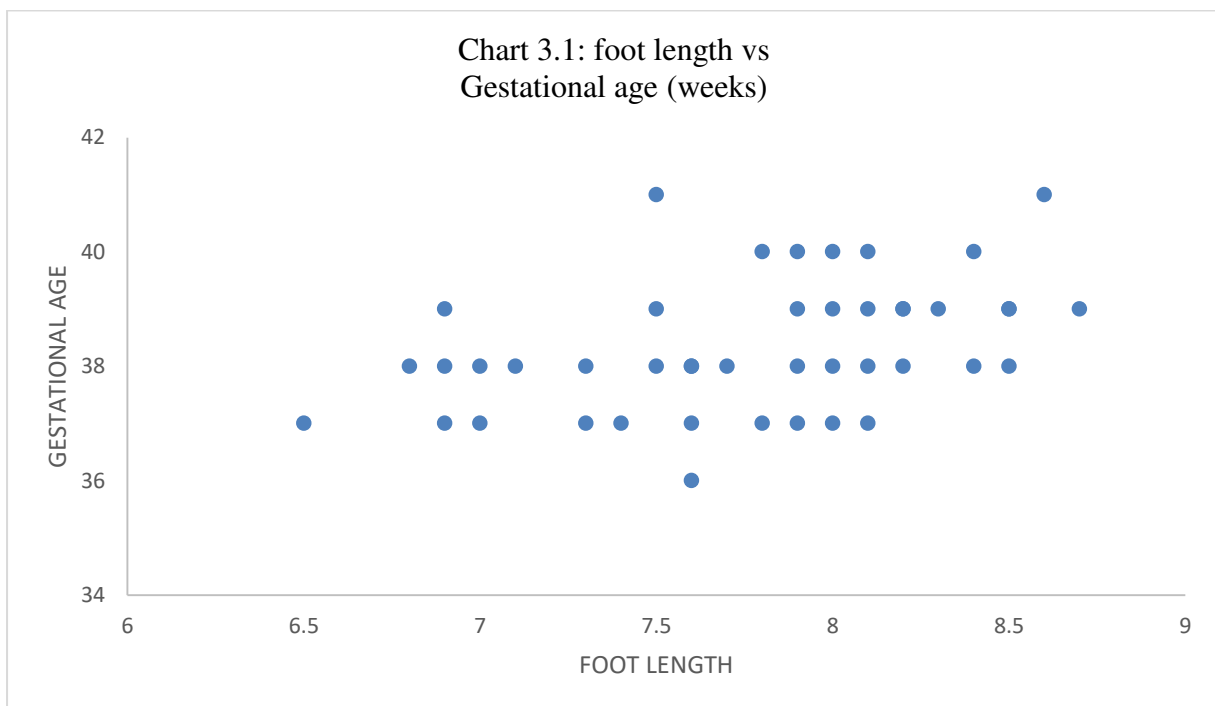
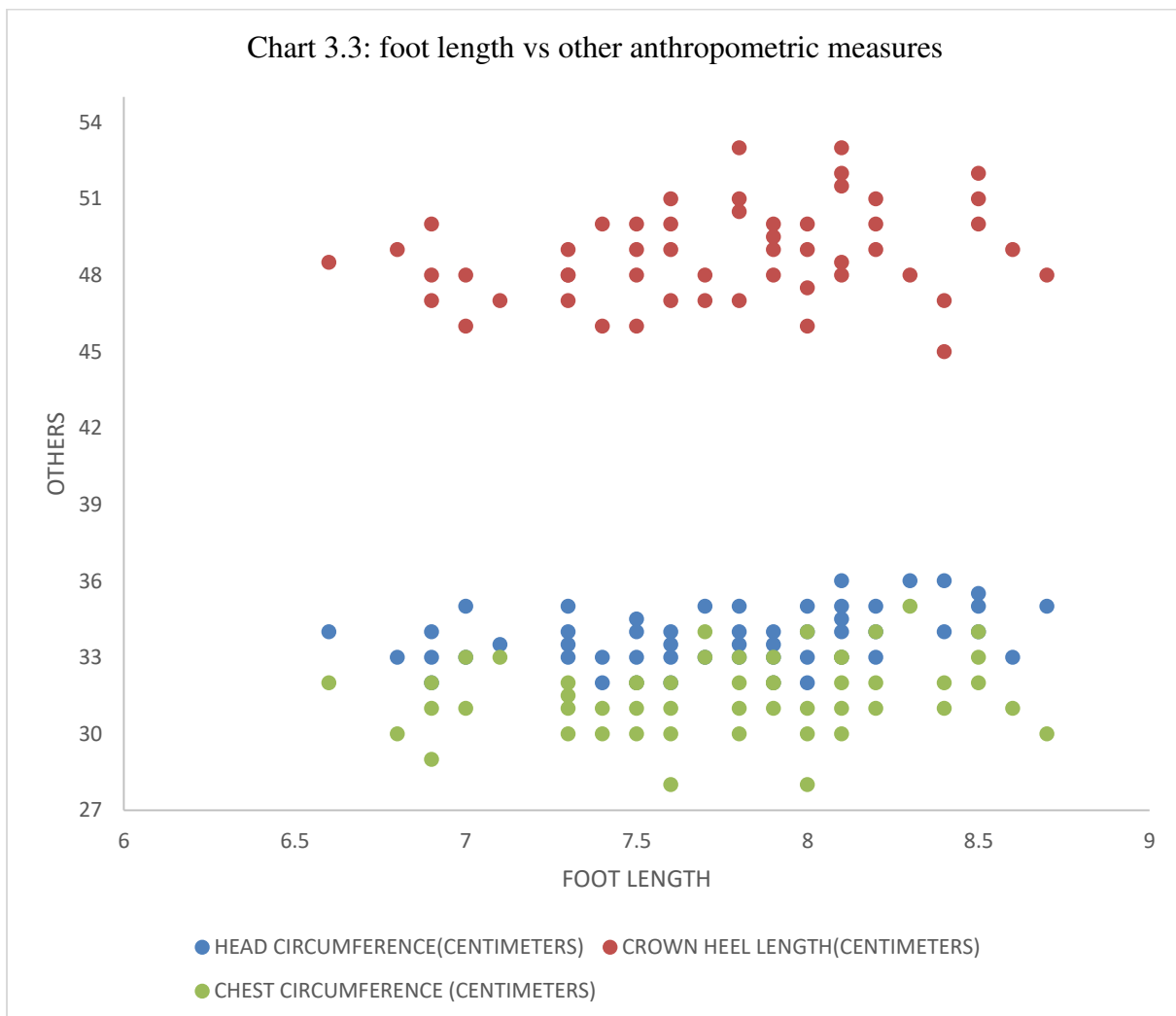
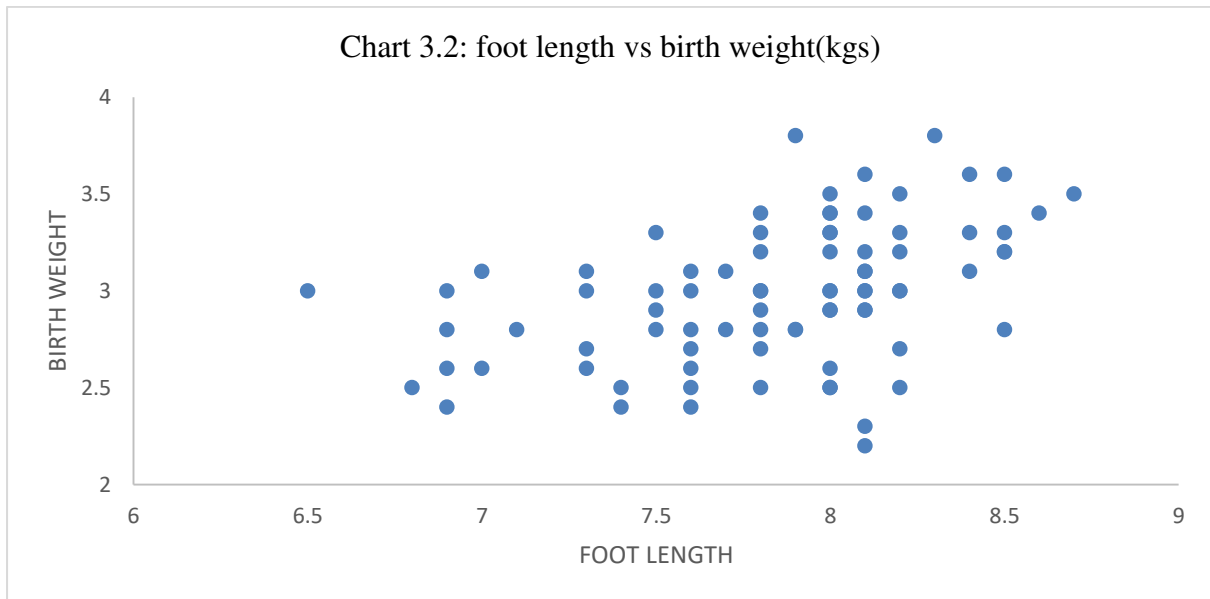


Chart 3: Correlation of Foot length with other anthropometric variables in Term AGA neonates





In above Table 1 & scatter diagram shows the correlation between foot length & other variables among Preterm AGA, Term SGA & Term AGA babies. In Preterm AGA group, foot length (FL) correlated significantly ($p < 0.05$) with only Gestational age (GA). In Term SGA group, Foot length correlated significantly ($p < 0.05$) with Gestational age, Birth weight & Chest circumference. In Term AGA group, Foot length correlated significantly ($p < 0.05$) with Gestational age, Birth weight, Head circumference, Crown heel length & Chest circumference.

Discussion:

Any endeavour to reduce mortality must begin with the early identification of low birth weight babies. It is also important to determine the maturity of the newborn, especially preterm for their better management & follow up. LM, Ballard's scoring, antenatal ultrasonography are currently employed methods to determine the GA of newborns.

In the present study foot length correlated significantly with gestational age in Term SGA, Term AGA, and Preterm AGA. The correlation of foot length with birth weight was significant in Term SGA and Term AGA neonates. Foot length correlated significantly with head circumference and chest circumference as well in Term SGA and Term AGA neonates while a significant correlation with crown heel length was observed only in Term AGA infants.

Gestational age had the highest correlation with foot length in Term SGA ($r = 0.646$) followed by Preterm AGA (0.480) & Term AGA (0.463). The correlation of foot length with birth weight was the highest in Term SGA (0.634) followed by Term AGA (0.434).

Mercer et al showed that ultrasonography measurement of fetal FL was useful in the assessment of gestational age⁹. Markowski et al also showed that FL was positively related to gestational age¹⁰.

Among other parameters, the correlation of foot length with head circumference was highest in Term AGA (0.373) followed by Term SGA (0.343) while with chest circumference was the highest in Term SGA (0.551) followed by Term AGA (0.398). The correlation of foot length with crown heel length found to be significant only in Term AGA infants 0.295.

Conclusion:

We observed that there was a significant correlation between FL and various other anthropometric variable. FL had a higher sensitivity and specificity in identifying LBW and Preterm babies. Therefore, foot length can be implemented as surrogate markers for gestational age in the community at large scale where facility for assessing gestational age by experts is not available.

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