

Relationship between Gestational Age & Anthropometric Parameters of Neonates - A Preliminary Study

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Abstract

Introduction: In cases of infanticide, surreptitious disposals, still births and spontaneous or induced abortions, the accurate age of the infant needs to be calculated. Furthermore, in cases of sexual abuse, the court may need to know the period of gestation of the infant, to date the crime. However, for assessment of gestational age Sri Lankan anthropometric data is not available. Therefore this study helps to fill this void.

Objective: Establish the relationship between the gestational age and Weight, Occipito-Frontal Circumference (OFC), Hand length (HL), and Foot Length (FL) of neonates.

Methodology: Following ethical clearance, data was collected at Teaching Hospital Peradeniya, from neonates of gestational ages ranging from 33 – 40 weeks, within 48 hours of birth by two pre-intern doctors. We excluded those suffering from anomalies which cause distortion of the anthropometric parameters. The weight recorded at birth was taken while a non-stretchable, standard tape was used to measure the OFC. HL and FL were measured with an electronic Vernier caliper.

Results: The total sample size of 108 babies consisted of 76 term babies and 32 pre term babies. The values ranged from 1300g to 3850g for weight, 25cm to 36.4cm for OFC, 34.4mm to 72.16mm for HL and 55mm to 87.7mm for FL. The detailed age specific data will be discussed, graphed and compared with available British and USA data.

Conclusion and Suggestions: The findings of this preliminary study indicate that the gestational age can be estimated using anthropometric measurements. We suggest the need to expand this study to other areas of Sri Lanka in order to prepare graphs of anthropometric measurements applicable to Sri Lanka.

Keywords: neonates, anthropometric parameters, Occipito-Frontal Circumference (OFC), Hand length (HL), and Foot Length (FL)

Introduction

Experts in the field of Forensic Medicine are often confronted with cases of infanticide, surreptitious disposals, still births and spontaneous or induced abortions, where they have to meet the challenge of determining the accurate age of the foetus/infant with the highest possible accuracy.

It is of utmost importance as medical doctors, being expert witnesses to the courts of law, need to give an opinion regarding the viability of the infant. Such evidence is used to determine whether or not to file a case against the suspect, and if a case should be filed, under which section of the Penal Code the accused should be charged. Furthermore, in case of sexual abuse, the court may need to know the period of gestation (POG) of the infant/ fetus, in

order to calculate the time of conception, which in turn, would be useful in determining the probable period during which sexual intercourse took place.

Determination of age is also important in a paediatric practice, in instances where the mother is unaware of the period of amenorrhoea and ultrasonic determination of gestational age has not been carried out. Further, determination of length and surface area with the use of foot length in sick pre term neonates, is more convenient as it can be done without disturbing them.[1]

Sri Lankan forensic pathologists who have to investigate and report to courts on cases of suspected abortion, still birth, infanticide, sudden infant death syndrome, abandoned babies etc, have no Sri Lankan guidelines to go by, but have to rely on USA or UK data. We hope that this study will help to rectify this situation.

Objectives

Establish the relationship between the gestational age and the following anthropometric measurements of neonates.

- Weight
- Occipito-Frontal Circumference (OFC)
- Foot length
- Hand length

Methodology

Ethical clearance was granted by the ethical review committee, Faculty of Medicine, University of Peradeniya. Permission to conduct the research was obtained from the Director, Paediatricians and Obstetricians of the Teaching Hospital, Peradeniya. Data was collected in the post natal ward and special care baby unit of

Teaching Hospital, Peradeniya after obtaining informed written consent from the mother.

The weight, OFC, foot length, and hand length were measured in neonates between gestational ages 33-40 weeks. Those with anomalies which cause distortion of the anthropometric parameters were excluded. E.g. hydrocephalus, Down syndrome, craniosynostosis. Neonates who were suffering from sepsis were also excluded.

All measurements were taken adhering strictly to the recommended aseptic techniques with minimum handling, within 48 hours of birth by two pre-intern doctors, trained in the correct method of taking measurements.

The weight recorded at birth was taken. OFC was measured just above the eye brows anteriorly and external occipital protuberance posteriorly with a standard tape. The measurement from the tip of the heel to the tip of the great / second toe (whichever was longer) was taken as foot length. Hand length was measured from the distal skin crease at the wrist to the tip of the middle finger. Foot length and hand length of babies in the post natal ward was taken with an electronic Vernier caliper. Neonates in the special care baby unit were measured using the non-stretchable, standard tape which was used by the unit because of the practical difficulties and risk of infection.

Results

The total sample of 108 babies consisted of 76 term babies and 32 pre term babies. The values ranged from 1300g to 3850g for weight, 25.0cm to 36.4cm for OFC, 34.4mm to 72.2mm for hand length and 55mm to 87.7mm for foot length. (68% of measured values lie between the error bars)

Number of babies	POG (Weeks+days)	Weight (g)	OFC (cm)	Foot length (mm)	Hand length (mm)
4	(33)-(33+6)	1532.0	27.81	64.52	50.23
9	(34)-(34+6)	1807.7	30.03	70.28	54.41
8	(35)-(35+6)	2238.7	31.51	68.96	58.84
11	(36)-(36+6)	2126.0	31.49	73.29	56.85

Table 01: The average values of pre term babies

Number of babies	POG (Weeks+days)	Weight (g)	OFC (cm)	Foot length (mm)	Hand length (mm)
22	(37)-(37+6)	2510.6	31.79	71.10	59.48
25	(38)-(38+6)	2952.4	34.15	76.78	63.06
5	(39)-(39+6)	3052.0	33.53	77.50	67.26
24	(40)-(40+6)	3081.3	34.02	76.50	61.65

Table 02: The average values of term babies

Fig- 01: Mean and error bars of one standard deviation - weight by gestational age

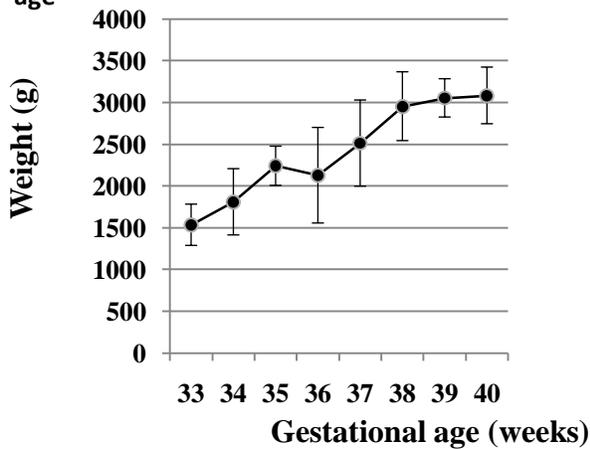


Fig- 02: Mean and error bars of one standard deviation - OFC by gestational age

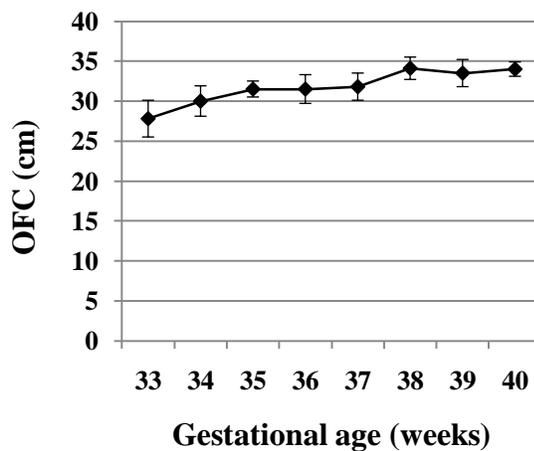


Fig- 03: Mean and error bars of one standard deviation - Foot length by gestational age

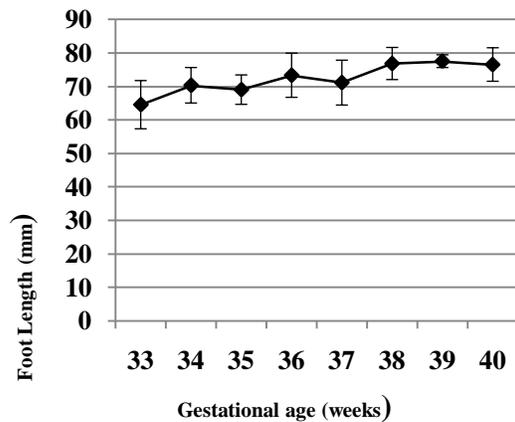
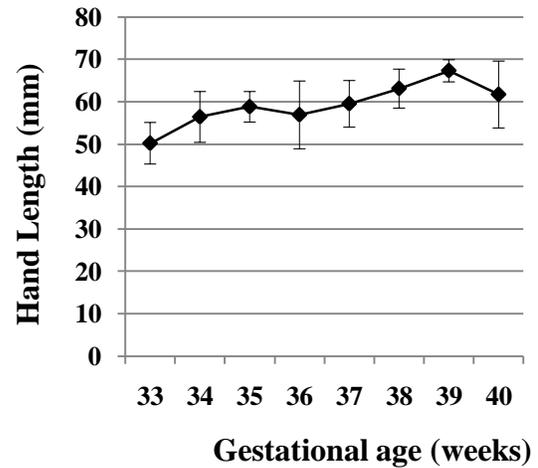


Fig- 04: Mean and error bars of one standard deviation - Hand length by gestational age



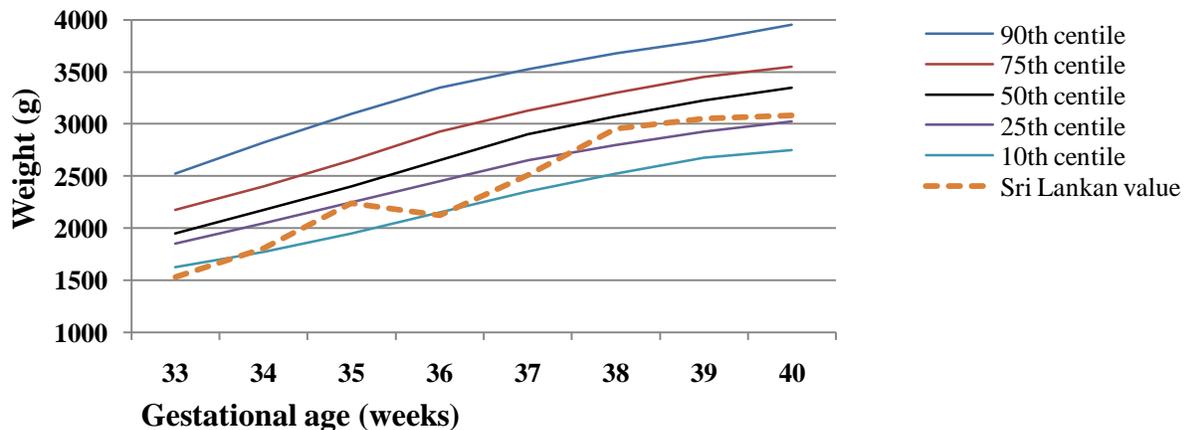
Discussion

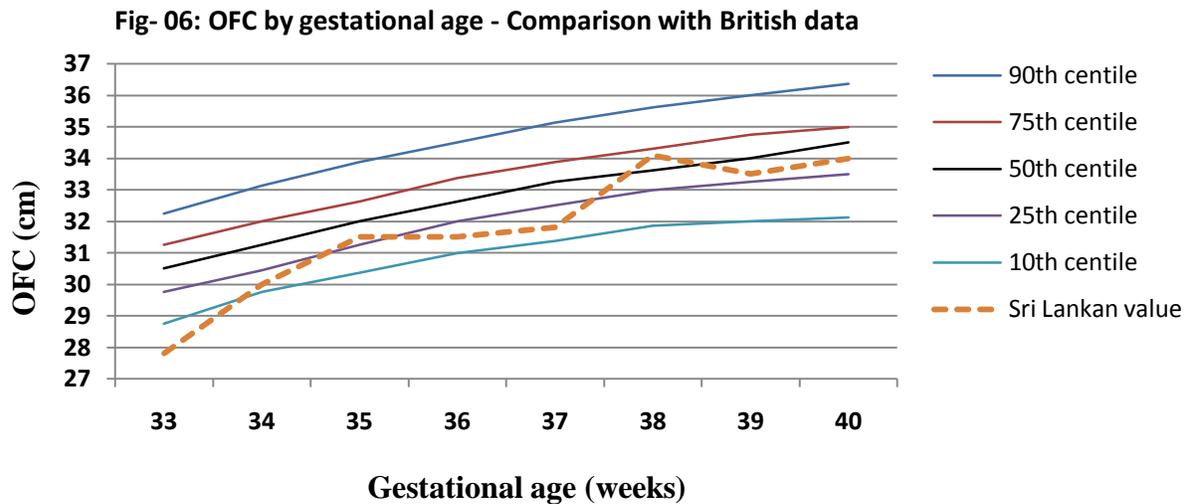
The preliminary results indicate that the gestational age appears to be directly proportional to the anthropometric parameters and therefore that gestational age can be estimated using anthropometric measurements.

In Sri Lanka, we use US and UK data as we have no established Sri Lankan values to go by. Therefore, international data is compared with values from our study, assuming it would represent Sri Lankan population, to see whether currently available charts would tally with Sri Lankan values. (See Fig 05, 06 and 07)

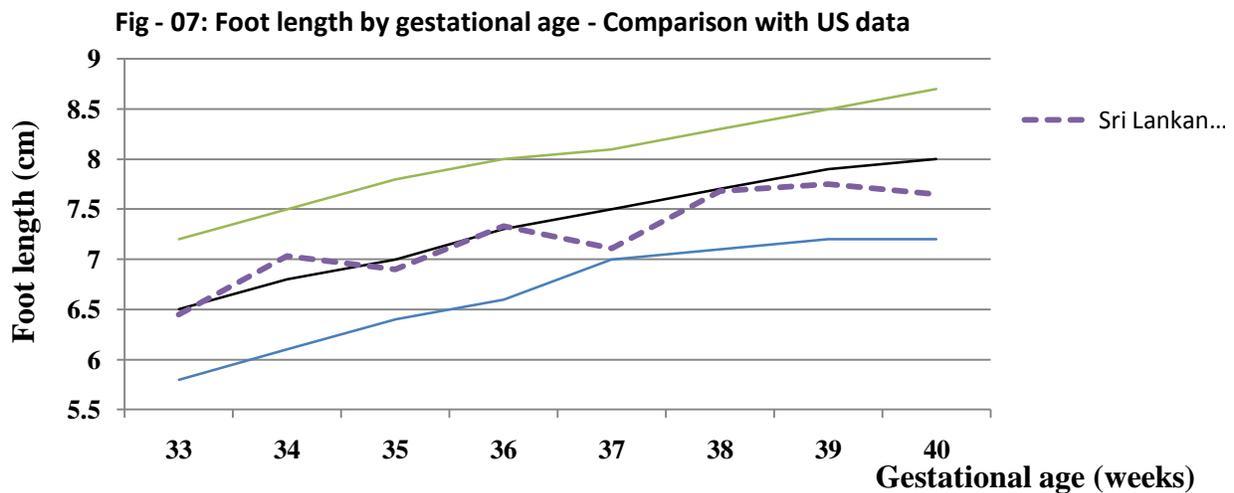
Relationship between Weight and OFC with gestational age has been studied in 1978 by Naeye and Dixon[2].

Fig- 05: Weight by gestational age - Comparison with British data





As illustrated by Fig 05 and 06 the average weight and OFC of Sri Lankan neonates lie between the 10th and 50th centiles of British values. This highlights the importance of preparation of our own anthropometric charts for the above parameters. Relationship between foot length and gestational age has been studied in 1984 [3].



Comparing our results with their study, average foot length of our babies lies nearly around the 50th centile of their chart. Kumar and Kumar established an equation for POG (weeks) according to foot length data in India. $POG \text{ (weeks)} = 8.9 + 3.5 \text{ (Foot length in cm)}$ with standard error of 0.75 [4].

Though this formula does not correlate with our values, with the use of Sri Lankan values we could prepare formulae of our own not only for foot length, but also for weight, OFC, and hand length.

Conclusion

The findings of this preliminary study indicates that the gestational age can be estimated using anthropometric measurements, but as US and UK data does not tally with Sri Lankan values it is essential to prepare our own anthropometric graphs which are applicable to our babies.

Recommendations

We suggest the need to expand this study to other areas of Sri Lanka in order to prepare graphs of anthropometric measurements applicable to whole of Sri Lanka.

References

1. Jayendra RG, Major S, Vani SN, et al. Foot length measurement in the neonate. *Indian J Pediatr.* 1991; 58: 675-677.
2. Naeye RL, Dixon JB. Distortion in fetal growth standards. *Pediatric Research.* 1978; 12: 987-91.
3. Debich-Spicer DE, Gilbert-Barness E, Opitz JM. *Handbook of Paediatric Autopsy Pathology.* New Jersey, Humana Press, 2005: 50.
4. Kumar GP, Kumar UK. Estimation of Gestational age from hand and foot length *Medicine Science and Law.* 1994; 34: 48-50.

Contribution of authors

Design to the study – DMGF

Supervision to the study-DMGF

Analysis of the data- PURK,IRW,USNR,SMK

Interpretation of the results- DMGF,PUNK

Writing the manuscript –DMGF, IRW,USNR,SMK

Revising the manuscript- DMGF