

A cross-sectional study of the correlation between Maternal Anthropometry and Neonatal Anthropometry

Dr. Deepa Agrawal¹ (Senior Resident), Dr. Mohini Dwivedi² (Senior Resident) & Dr. Nisha Tiwari³ (Assistant Professor)

Department of Paediatrics, Shri Balaji Institute of Medical Science, Raipur¹

Department of Paediatrics, VMMC & Safdarjung Hospital, New Delhi²

Department of Obstetrics & Gynecology, Sukh Sagar Medical College and Hospital, Jabalpur³

Corresponding Author: Dr. Deepa Agrawal

Abstract

Background & Methods: The aim of the study is to study the correlation between Maternal Anthropometry and Neonatal Anthropometry. New-born anthropometric (birth weight, length at birth and circumference of chest and head) measurements were recorded within 24 hours of birth and gestational age was calculated from history of maternal last menstrual period (LMP) and antenatal Ultrasound. All new-born anthropometry were measured by standard techniques.

Results: Correlation between maternal height and neonatal parameters. We observed a statistically significant positive correlation of maternal height with birth weight ($r=0.239$; $p=0.017$), head circumference ($r=0.316$, $p=0.001$) and chest circumference ($r=0.218$; $p=0.030$). However, no significant correlation could be observed between maternal height and neonatal height ($p>0.05$)

Conclusion: No significant correlation was found between maternal age and neonatal anthropometry. Based upon the findings of our study, it could be concluded that maternal nutritional status as observed by maternal weight and height, as well as parity has significant impact on neonatal health and may help in predicting neonatal outcome. Birth weight of neonate showed a significant positive correlation with maternal height and parity. Head circumference and chest circumference of neonate also showed a significant positive correlation with maternal weight and maternal height. We found no correlation between neonatal length and maternal parameters.

Keywords: maternal, anthropometry, neonatal & anthropometry.

Study Design: Cross-sectional study.

Introduction

Anthropometry is derived from a Greek word i.e. “Anthropos meaning man” and “meter meaning measurements”.[1] According to WHO, anthropometry is single most portable, inexpensive, easily applied, acceptable and non-invasive method for estimating the composition of body. It helps in assessment of health and nutrition of the individual. It refers to the measurement of the human individual for the purposes of understanding human

physical variations.[2]

Nutritional status of neonates has received considerable attention particularly in developing countries as it is associated with socioeconomic development of the country. Anthropometry of neonate is probably the most important factor that affects the future, survival and quality of life. In both developed and developing countries, birth weight is an important determinant of neonatal mortality and morbidity. For these reasons birth weight has long been a subject of clinical and epidemiological investigations and an area of public health interest.[3] Other anthropometric measurements used in neonates include neonatal length at birth, head circumference, chest circumference, upper segment and lower segment ratio, mid upper arm circumference etc. Birth weight is the most commonly used anthropometric index.

Low birth weight neonates are susceptible to infection as they start their life with a disadvantage.[4] Several researchers have attempted to identify suitable anthropometric surrogates which are simple and reliable to identify low birth weight babies. Obese children are at a risk of hypertension and/ or diabetes at later stages. Inadequate nutrition in adolescence can potentially retard growth and sexual maturation, although these are likely consequences of chronic malnutrition in infancy and childhood.[5] Because infant mortality rates in developing countries are high, there has been a large amount of work on low birth weight and studies of risk factors for low birth weight and intrauterine growth retardation were a natural step forward. Low birth weight is linked adversely with morbidity and mortality.[5]

Poor nutritional status of pregnant women is one of the most important contributory factor to infant's poor nutritional status. Maternal nutritional status influences infant's birth weight. The risk of foetal death is high in undernourished mother and those who survive may have impaired immune function and may have increased risk of disease. The neonate of undernourished mother may remain undernourished and may have low cognitive abilities, reduced muscle strength and increased risk of infectious as well as non infectious disease in later life.[6]

Assessment of maternal nutritional status relies on measures of stature and pre-pregnancy weight (PPW). Maternal weight and height have been shown to be significant predictors of birth weight. Maternal nutrition status during pregnancy has been considered an important prognostic indicator of birth outcome.[7]

Material and Methods

Our study was conducted as a cross sectional study on a total of 100 neonates and their respective mothers delivered at Shri Dada Dev Matri Avum Shishu Chikitsalaya, Dabri, New Delhi during the study period of one year.

Inclusion criteria

1. Pregnant women with first visit in less than 13 weeks
2. Term pregnancy i.e. between 37 weeks to 40 weeks
3. Singleton pregnancy
4. Women of 21-40 years of age.
5. Normal physiological pregnancy

Exclusion criteria

1. Mothers having first visit after 13 weeks of gestation
2. Not having clear data of gestational week at registration
3. Preterm or post term pregnancy

4. Twin pregnancy

5. High risk or complicated pregnancy i.e. any medical disease including but not limited to diabetes, hypertension, asthma, tuberculosis.

Following delivery, neonatal examination was done. New-born anthropometric (birth weight, length at birth and circumference of chest and head) measurements were recorded within 24 hours of birth and gestational age was calculated from history of maternal last menstrual period (LMP) and antenatal Ultrasound. All new-born anthropometry were measured by standard techniques.

Following neonatal parameters were recorded:

- Birth weight (in grams) -Birth weight was taken in a digital weighing machine without clothing under radiant warmer. Weight was recorded to the nearest 10 gm placed on a hard, flat surface.
- Length at birth (in centimetres)- New-born length was measured by infantometer with accuracy to 0.1 cm placed on a hard and flat surface.
- Head and chest Circumference (in centimetres)- Head and chest circumference were measured by a non-stretchable fibre tape with markings in millimetre division with accuracy of 0.1 cm.

Result

Table 1: Distribution of mothers according to age

Age Groups	Frequency	Percentage
21 - 25 yrs	60	60.0%
26 - 30 yrs	37	37.0%
>30 yrs	3	3.0%
Total	100	100%
Mean ± SD	25.34 ± 2.56	
Range	21 - 32	

The mean age of females in our study was 25.34 ± 2.56 years. Out of 100 mothers enrolled in this study, majority belonged to age group of 21-25 years (60%), 37 % were in age group 26-30 years and 3 % were above 30 years.

Table 2: Distribution of mothers according to parity

Parity	Frequency	Percentage
1	36	36.0%
2	52	52.0%
3	12	12.0%
Total	100	100%

In our study, majority of mothers were second gravida (52%), whereas 36 % were primipara and 12 % were third gravida.

Table 3: Association between maternal weight and new-born anthropometric parameters

Neonatal parameters	Maternal weight				p value
	45 - 50 Kg	50 - 55 Kg	55 - 60 Kg	60 - 65 Kg	
	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	
Weight	2.46 \pm 0.12	2.91 \pm 0.46	2.77 \pm 0.38	2.66 \pm 0.49	0.013
Length	48.22 \pm 0.63	49.74 \pm 1.73	49.61 \pm 1.16	49.28 \pm 1.37	0.006
HC	33.19 \pm 0.48	33.91 \pm 1.38	34.06 \pm 0.92	34.1 \pm 1.00	0.057
CC	30.47 \pm 0.76	31.5 \pm 1.14	31.65 \pm 1.03	31.68 \pm 1.29	0.007

Above table reveals that maternal weight was significantly associated with neonate's birth weight, birth length and chest circumference ($p < 0.05$). The neonate's weight and length increased with the increase in maternal weight, but as the maternal weight reaches overweight category the baby weight decreases. The head circumference though increased with the increase in maternal weight but the association was statistically insignificant ($p > 0.05$).

Table 4: Association between maternal parity and various new-born anthropometric parameters

Neonatal parameters	Parity			p value
	1	2	3	
	Mean \pm SD	Mean \pm SD	Mean \pm SD	
Weight	2.61 \pm 0.39	2.77 \pm 0.39	3.05 \pm 0.52	0.005
Length	49.26 \pm 1.17	49.27 \pm 1.32	50.34 \pm 1.98	0.041
HC	34.04 \pm 0.94	33.74 \pm 0.94	34.34 \pm 1.67	0.139
CC	31.75 \pm 1.16	31.22 \pm 0.96	31.63 \pm 1.60	0.087

Above table revealed a statistically significant association of parity with neonate's weight and length ($p < 0.05$) but the association was insignificant with head and chest circumference ($p > 0.05$).

Table 5: Correlation of maternal height with neonatal parameters

Neonatal parameters	R	R ²	Adjusted R ²	SE	ANOVA	P value
Weight	0.239	0.057	0.048	0.415	5.952	0.017
Length	0.078	0.006	-0.004	1.392	0.594	0.443
HC	0.316	0.100	0.091	1.011	10.87	0.001
CC	0.218	0.047	0.038	1.117	4.880	0.030

Above table revealed correlation between maternal height and neonatal parameters. We observed a statistically significant positive correlation of maternal height with birth weight ($r=0.239$; $p=0.017$), head circumference ($r=0.316$, $p=0.001$) and chest circumference ($r=0.218$; $p=0.030$). However, no significant correlation could be observed between maternal height and neonatal height ($p > 0.05$)

Discussion

Nutritional and anthropometric status of mother as well as neonate has received considerable attention particularly in developing countries. Nutritional status of neonate is an indicator of socioeconomic development of the country. Low birth weight neonates are susceptible to various infections and have been linked adversely with morbidity and mortality.[8] Maternal nutritional status has significant bearing on neonatal outcome as it influences infant's birth weight, cognitive ability and risk of infectious and non-infectious disease in later life.[9]

In our study, ANOVA test was used to assess the mean neonatal anthropometric variables among mothers belonging to different weight range. Pearson correlation was used to correlate the increase/decrease of neonatal variables with increase in maternal weight. Mean weight and length of neonate were significantly higher in mother with weight in the range of 50 to 55 kg. Thus lower maternal weight as well as higher maternal weight was significantly associated with lower birth weight and length ($p < 0.05$). Mean chest circumference increased significantly with increase in mother weight ($p < 0.05$). Though, mean head circumference was also increasing with increase in maternal weight range but the difference was statistically insignificant ($p > 0.05$).

The findings of our study were supported by findings of Krishna C et al (2018) in which the authors observed no significant correlation of maternal weight with neonate's birth weight and length ($p > 0.05$).[10] Though our study documented significant correlation of maternal weight with head circumference, the reference study documented no significant correlation of maternal weight with head circumference ($p > 0.05$).

Maternal age is an important determinant of health and well-being of neonate. Our study documented that mean birth weight and length was significantly higher in neonates of mother belonging to age range of 26 to 30 years ($p < 0.05$) whereas mean chest circumference was significantly higher in neonates of mother belonging to 21 to 25 years of age ($p < 0.05$). Thus, age has significant influence on fetal anthropometric measurements. However, on regression analysis, we observed no significant correlation between maternal age and neonatal anthropometric parameters. This could be attributed to reduction in neonatal weight and length with younger as well as advanced maternal age.

Krishna C et al (2018) also documented no significant correlation between maternal age and neonatal anthropometric parameters, supporting the findings of present study.[11] Similar to present study, Kheir AE et al (2013) observed no significant association of maternal age with neonatal weight, length or head circumference ($p > 0.05$).[12]

These findings were also concordant with the findings of Mitra S et al (2012) in which the authors observed no significant correlation between maternal age and neonatal parameters such as birth weight, length, head and chest circumference ($p > 0.05$).[13-14]

Conclusion

Our study aimed to determine the correlation of neonatal anthropometry such as birth weight, length, head circumference and chest circumference with maternal factors. The mean age of mothers' was 25.34 ± 2.56 years. Parity and birth weight showed a significant positive

correlation ($r=0.318$; $p=0.001$). No significant correlation was found between maternal age and neonatal anthropometry. Based upon the findings of our study, it could be concluded that maternal nutritional status as observed by maternal weight and height, as well as parity has significant impact on neonatal health and may help in predicting neonatal outcome. Birth weight of neonate showed a significant positive correlation with maternal height and parity. Head circumference and chest circumference of neonate also showed a significant positive correlation with maternal weight and maternal height. We found no correlation between neonatal length and maternal parameters.

References

1. Herron RE. Anthropometry: Definition. International Encyclopedia of Ergonomics and Human Factors-3 Volume Set. 2000 Dec 14:879.
2. WHO Expert Committee. Physical status: the use and interpretation of anthropometry. <http://helid.digicollection.Org/en/d/Jh0211e/>. 1995.
3. Kramer MS. Determinants of low birth weight: methodological assessment and meta-analysis. Bulletin of the world health organization. 1987;65(5):663.
4. Committee to Study the Prevention of Low Birthweight; Division of Health Promotion and Disease Prevention; Institute of Medicine. Preventing Low Birthweight. Washington (DC): National Academies Press (US); 1985 Jan 1. 1, The Significance of Low Birthweight. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK214473/>
5. Calkins K, Devaskar SU. Fetal origins of adult disease. Curr Probl Pediatr Adolesc Health Care. 2011 Jul;41(6):158-76.
6. Barker DJ. The developmental origins of adult disease. Journal of the American College of Nutrition. 2004 Dec 1;23(sup6):588S-95S.
7. Nahar S, Mascie-Taylor CG, Begum HA. Maternal anthropometry as a predictor of birth weight. Public Health Nutrition. 2007 Sep;10(9):965-70.
8. Agbozo F, Abubakari A, Der J, Jahn A. Prevalence of low birth weight, macrosomia and stillbirth and their relationship to associated maternal risk factors in Hohoe Municipality, Ghana. Midwifery. 2016;40:200–6.
9. Mathewson KJ, Chow CH, Dobson KG, Pope EI, Schmidt LA, Van Lieshout RJ. Mental health of extremely low birth weight survivors: A systematic review and meta-analysis. Psychological bulletin. 2017;143(4):347–83.
10. Krishna C, Prakruthi N, Parmar PV et al. Maternal anthropometry and its relationship to birth weight. Int J Preven Curat Comm Med 2018; 4(4): 49-54.
11. Devaki G, Shobha R. Maternal anthropometry and low birth weight: a review. Biomedical and Pharmacology Journal. 2018 Jun 25;11(2):815-20.
12. Kheir AE, Abozied EE, Mohamed SH, Salih AA. The pattern of anthropometric measurements among term newborn infants in Khartoum state in relation to maternal factors. Sudanese journal of paediatrics. 2013;13(2):31.
13. Mitra S, Misra S, Nayak PK, Sahoo JP. Effect of maternal anthropometry and metabolic parameters on fetal growth. Indian J Endocr Metab 2012;16:754-8
14. Datti S, Taura MG, Modibbo MH, Adamu LH, Tela IA, Gudaji A, Asuku AY. Evaluation of the influence of maternal parity on neonatal anthropometric parameters among Hausas in Kano state. Bayero Journal of Pure and Applied Sciences. 2016;9(2):90-4.