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Gauging the correlation between anthropometric measurements to birth weight in subjects of urban lower socioeconomic status in Mumbai

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***Abstract*---**Background: Birth weight is largely influenced by the mother's parity, gender of the baby, conceptus number, and maternal environment. The heavier weight is seen for male babies at full-term compared to females, in singleton compared to twins, and in later-born compared to the first baby. Low-weight babies are seen in mothers of lower socioeconomic status. In urban lower socioeconomic group females, the closest correlation is seen with neonatal calf circumference. Aim: The present study was conducted to perceive the anthropometric parameters that have the best correlation with the birth weight in the urban lower socioeconomic population of Mumbai. Methods: From the post-natal ward of Sir JJ group of hospital and Cama hospital, 200 newborns who were normal-delivered, newborns, singletons, born to females with no history of infections like tuberculosis, hypertension, and diabetes mellitus were assessed. In 200 included subjects, anthropometric parameters and birth weight were assessed. Results: Good correlation was seen in both females and males between birth weight and calf circumference, thigh circumference, mid-arm circumference, and abdominal circumference. However, poor correlation in females and good correlation in males was seen in chest circumference, head circumference, and crown to heel length. Conclusion: The present study concludes that in all

anthropometric parameters, the highest correlation coefficient was seen for calf circumference, and is found to be the best anthropometric parameter that can be correlated to the birth weight.

***Keywords*---**Anthropometric parameters, birth weight, calf circumference, low birth weight, low socioeconomic groups.

Introduction

Under-five deaths are most commonly caused by respiratory diseases followed by perinatal mortality. However, it constitutes the most common cause of death in subjects of all age groups in Indonesia besides neoplasms, cardiovascular disease, and infection. To reduce mortality and morbidity, high-risk identification is one of the most vital aspects.[1] Mortality and morbidity in newborn subjects are increased by various factors including the newborn baby problem, delivery problems, recent pregnancy problems, previous pregnancy history, maternal health, and sociodemographic factors. Newborn baby problems include a birth weight of <4000 grams or <2500 grams, congenital anomalies, and LGA (large for gestational age, and small for gestational age.[2]

The main cause of neonatal mortality is low-birth weight, which, added to lethal congenital anomaly affects child mortality and fetal mortality rate. Low birth weight infants are newborn babies weighing less than 2500 grams, mainly contributed by premature babies who were delivered before 37 weeks of gestation, and SGA babies who have intrauterine growth retardation. Birth weight, despite being the most sensitive and reliable indicator of neonatal health, immediately and in the later stages of life, was identified in earlier times. However, it was first reported in 1886 by Miller.[3]

Low coverage of babies assessed at birth is contributed by limited healthcare personnel availability in developing countries, the rapid turnover rate of newborn care, high delivery rate, and limited health facility. Hence, an alternative modality to assess low birth weight infants is needed. One such alternative is anthropometric measurement.[4] Previous data reported birth weight can be predicted by simple anthropometric measurement, which, in turn, can explain metabolic risk and intrauterine growth retardation possibility in newborn babies. Ylppo in 1991, suggested that high-risk babies can also be identified by various other anthropometric parameters other than birth weight.[5]

After Ylppo, various researchers have used different anthropometric parameters including foot length, crown-rump length, crown heel length, and head circumference. One such study of 1996 by Gupta et al reported that among all anthropometric parameters, low birth weight prediction can be accurately done with calf-circumference with it being a quick, reliable, and simple indicator for low-birth-weight prediction, and could be used by community healthcare workers.[6]

However, data assessing such correlation in the Mumbai population are scarce in the literature. Hence, the present study was conducted to perceive the

anthropometric parameters that have the best correlation with the birth weight in the urban lower socioeconomic population of Mumbai.

Materials and Methods

The present study was conducted at Sir JJ group of hospital and Cama hospital after clearance was taken from the Ethical committee of the Institute. The study population was comprised of neonates in the post-natal ward of the Institute. After the detailed structure of the study was explained, informed consent was taken from the parents of the neonates.

The study included 200 newborn babies of both genders. The inclusion criteria for the study were subjects who were normal-delivered, newborns, singletons, born to females with no history of infections like tuberculosis, hypertension, and diabetes mellitus. The exclusion criteria were subjects who were delivered by Cesarean section, had birth injuries/complications, or the subjects whose parents did not give consent to participate in the study.

After the inclusion of study subjects; detailed history of the mothers was recorded followed by a general clinical examination of both mothers and newborns. For assessing the weight and anthropometric parameters, the tools used in the present study were non-stretchable measuring tape, an infantometer, and a weighing machine. All the measurements for the study were taken by a single person well-versed with the protocol and were recorded within 48 hours of the delivery. The parameters were recorded twice to eliminate any error.

The anthropometric parameters recorded in the study were birth weight (BW) (grams) recorded by placing nude baby on a beam balance, to nearest 20 grams, CC (calf circumference) in cm in semi flexed leg position was the maximum diameter, MAC (mid-arm circumference) which was taken mid-way between olecranon process and acromion tip, CHL (crown to heel length) after placing the newborn on infantometer with soles of feet against footboard and fully extended knees, TC (thigh circumference) in cm in the supine position at lowest furrow level in gluteal position, HC (head circumference) in cm bypassing tape over external occipital protuberance and above supraorbital ridges, AC (abdominal circumference) at umbilicus level, and CHC (chest circumference) in cm at xiphisternum level below inferior scapula angle.

Comparison and correlation of birth weight were done with anthropometric parameters. The data collected were statistically analyzed using SPSS software version 21 (Chicago, IL, USA) using correlation coefficient, and the results were formulated.

Results

The present study was conducted at Sir JJ group of hospital and Cama hospital after clearance was taken from the Ethical committee of the Institute. The study population was comprised of neonates in the post-natal ward of the Institute. The study included 200 newborn babies of both genders. The demographics of the study subjects and mothers are described in Table 1.

Majority of the study subjects were in the age range of 20-30 years with 64% (n=128) females followed by 28% (n=56) subjects in >30 years of age, and 8% (n=16) subjects in <20 years. Among newborns, there were 51% (n=102) males and 49% (n=98) females in the study. Concerning educational status, 13% (n=26) mothers were uneducated, 37% (n=74) had education till primary schooling, secondary education was taken by 39% (n=78) mothers, and graduate or higher in 11% (n=22) mothers. 8% (n=16) females were unemployed and 92% (n=184) females were employed in either private or public sector. Birth weight of the neonates was <2000, 2000-2500, 2500-3000, 3000-3500, 3500-4000, and >4000 grams in 3% (n=6), 3% (n=6), 28% (n=56), 44% (n=88), 18% (n=36), and 4% (n=8) study subjects respectively (Table 1).

The highest correlation was found between birth weight and calf circumference (r=-0.85), followed by birth weight and thigh circumference (r-0.83) and birth weight and abdominal circumference (r=0.77). The abdominal circumference, mid-arm circumference, thigh circumference & calf circumference shows a good correlation with birth weight in both male and female babies. Whereas crown to heel length, head circumference and chest circumference showed a good correlation in males compared to females this is shown in Table 2.

Discussion

Birth weight is used as a measure of low birth weight because it correlates with gestation and ease of recording in the hospital setting. However, 74% of the Indian population resides in rural areas where most of the deliveries are conducted at home by traditional birth attendants and untrained people. Hence the weight of the newborn may not be recorded and low birth weight babies can be missed. Calf circumference can be used in these settings as the best substitute for birth weight to identify low birth weight babies. Calf circumference measurement is a simple, easily applicable, reliable, and inexpensive method Landicho et al 1985 included calf circumference with other anthropometric parameters to screen for low birth weights in Central America.[7] Neela et al in 1991 was the first Indian investigator to use calf circumference along with various other anthropometric parameters to screen for low birth weight and proved the efficacy of calf circumference over other anthropometric parameters for identification of low birth weight.[8]
The present study aimed to study the correlation between birth weight and calf circumference and to compare the efficacy of calf circumference with other commonly used parameters in the urban lower socioeconomic population of Mumbai. This was similar to Gupta et al[9] in 1996 where authors observed the maximum correlation coefficient between birth weight and calf circumference i.e., 0.98, where they studied 1600 newborns. Also, Samal et al 1956 studied 1580 babies and observed a correlation coefficient of 0.78 between birth weight and calf circumference.[10]

Landicho et al studied 1000 babies and observed a correlation coefficient of 0.77 between birth weight and calf circumference. In the present study anthropometric parameters of 200 newborns were recorded. The correlation coefficient observed

between calf circumference and birth weight was r=0.85. The values are less than that found by Gupta (0.98) and higher than that of Landicho (0.77).[7]

The highest correlation was found between birth weight and calf circumference (r=-0.85), followed by birth weight and thigh circumference (r-0.83) and birth weight and abdominal circumference (r=0.77). The abdominal circumference, mid-arm circumference, thigh circumference & calf circumference shows a good correlation with birth weight in both male & female babies. Whereas crown to heel length, head circumference & chest circumference showed a good correlation in males but a poor correlation in females. These results were in agreement with the studies of Elizabeth NL et al[11] in 2013 and Otupiri E et al[12] in 2014 where authors found a similar correlation between birth weight and anthropometric parameters.

This study validates that calf circumference is the best parameter to correlate with birth weight in the urban lower socioeconomic population of Mumbai and calf circumference can be used as an alternative to the birth weight for identification of the low-birth-weight babies.

Conclusion

Within its limits, the present study concludes that among all anthropometric parameters, the highest correlation coefficient was seen for calf circumference, and is found to be the best anthropometric parameter that can be correlated to the birth weight. However, the present study had a few limitations including small sample size, short monitoring time, and geographical area biases. Hence, more longitudinal studies with a larger sample size and longer monitoring period will help reach a definitive conclusion.

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Tables

Table 1
Demographic characteristics of the neonates and their mothers included in the study

S. No	Characteristics	Percentage (%)	Number (n)
Maternal age (years)	<20	8	16
	20-30	64	128
	>30	28	56
Gender of newborns	Males	51	102
	Females	49	98
Educational status of mothers	Uneducated	13	26
	Primary	37	74
	Secondary	39	78
	Graduate or higher	11	22
Occupation of mother	Unemployed	8	16
	Employed	92	184
Birth weight (grams)	<2000	3	6
	2000-2500	3	6
	2500-3000	28	56
	3000-3500	44	88
	3500-4000	18	36
	>4000	4	8

Table 2
Correlation coefficient between birth weight and other anthropometric parameters for male babies, female babies, and all newborns

Anthropometric parameters	BW		
	Males (n=98)	Females(n=102)	All (n=200)
CHL	0.75	0.58	0.66
HC	0.64	0.43	0.52
CHC	0.75	0.73	0.77
AC	0.78	0.77	0.77
MAC(Rt)	0.76	0.77	0.76
MAC(Lt)	0.77	0.77	0.77
TC(Rt)	0.83	0.83	0.83
TC(Lt)	0.83	0.83	0.83
CC(Rt)	0.85	0.85	0.85
CC(Lt)	0.85	0.84	0.84