Original Research Article

A study to determine the effect of maternal prepregnancy body mass index on the anthropometric measurements of the newborn

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ABSTRACT

Background: Maternal pre-pregnancy BMI is well established to be a detrimental factor for prenatal development and neonatal anthropometric measures. Objectives of the study was to study the association between maternal pre-pregnancy Body Mass Index (BMI) and the anthropometry of the newborn.

Methods: A hospital based cross-sectional, observational study was conducted that included 236 normal newborns and their mothers. A pre-designed questionnaire was used to collect relevant socio-demographic data and obstetric history. Details regarding maternal pre-pregnancy weight was collected from antenatal records at first antenatal visit, maternal height was measured and BMI was calculated. Neonatal anthropometric measurements including birth weight, recumbent length, head circumference, chest circumference and the mid arm circumference was measured.

Results: In this study 49.6% of the women were in the age group of 21-25 years, 52.5% of them were multi-gravida and 56.4% had normal vaginal delivery. Among the newborns included in the study 25.8% had low birth weight. We saw a significant positive correlation between BMI and age, BMI and birth weight, BMI and chest circumference that is with increase in BMI there was significant increase in the age, birth weight and chest circumference and vice versa. There was no association between maternal BMI and mid-arm circumference or head circumference of the newborn.

Conclusions: Study showed the association between maternal BMI and anthropometry of the newborn especially with respect to the BMI and birth weight, BMI and chest circumference. Thereby, establishing that interventions aimed at improving the nutritional status of the mother have a direct impact on the fetal growth outcomes.

Keywords: Anthropometry, Body Mass Index, Newborn, Pre-pregnancy

INTRODUCTION

It is well established that maternal nutrition plays an important role in pregnancy and fetal outcomes: underweight mothers have a risk of preterm delivery and small for gestational age infants whereas obesity in pregnancy is associated with increased incidence of hypertensive disorders, gestational diabetes, stillbirths, thromboembolic complications, caesarean section, macrosomia and complicated deliveries.^{1,2}

It is observed that childhood obesity is of highest incidence among children of mothers who were overweight/ obese before pregnancy, bearing long term neuro-endocrine and cardiovascular adverse effects.³ It is also noted that infants of underweight mothers with low birth weight are more prone to impaired neurodevelopment, hypertension and diabetes mellitus in adult life.⁴ Therefore, pre-pregnancy nourishment of the mother has not only immediate but also significant long term effect on the wellbeing of the infant.

Assessment of maternal nutritional status relies on the simple measurement of pre-pregnancy BMI. Various studies have assessed maternal anthropometric measures as predictors of birth weight alone. Data for comparison of pre-pregnancy BMI with all the anthropometric measures of the newborn including birth weight, length, head circumference, chest circumference and mid arm circumference is insufficient.

Maternal BMI and fetal anthropometry as an overall predictor of maternal nutrition and fetal health respectively provides policy makers and health care providers evidence about the current state of maternal and child health in order to plan health care interventions in the benefit of pregnant women. Hence, authors undertake the current study with the following objectives.

Authors aimed to study the association between maternal pre-pregnancy Body Mass Index (BMI) and the anthropometry of the newborn.

METHODS

The current study was a hospital based cross-sectional, observational study, conducted in Rajarajeswari Medical College and Hospital, Bangalore for a duration of three months between May to August 2019.

Inclusion criteria

The study included all consenting mothers with singleton, full-term births born live with a gestational age of ≥ 37 weeks.

Exclusion criteria

Women with any apparent pathological condition or risk factor which might impair the fetal intra uterine development such as hypertension, diabetes or renal disease were excluded from the study.

The current study was a cross-sectional, observational study of normal newborns and their mothers. All the mothers of the newborns included in the study were informed about the purpose and objectives of the study and their informed verbal consent was obtained. A total of 236 normal newborns and their mothers were included in the database.

A predesigned simple questionnaire was used to collect relevant socio-demographic data and obstetric history. Details regarding maternal pre-pregnancy weight was collected from antenatal records at first antenatal visit and maternal height was measured to the nearest 0.1cm and weight was recorded to the nearest 0.1kg. BMI was calculated using the formula $BMI = \text{Weight(kg)} / \text{Height(m)}^2$.

Neonatal birth weight was recorded within one hour of birth to the nearest 0.01kg using an electronic scale.

Recumbent length (crown heel length) was measured to the nearest 0.1cm using an infantometer. The head circumference, chest circumference and the mid arm circumference was measured to the nearest 0.1cm using a flexible non-stretchable tape.

Statistical analysis

Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Chi-square test was used as the test of significance for qualitative data. Continuous data was represented as mean and standard deviation. ANOVA (Analysis of Variance) was used as the test of significance to identify the mean difference between more than two groups for quantitative data.

Graphical representation of data

MS Excel and MS word was used to obtain various types of graphs such as bar diagram, Pie diagram.

The p value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

RESULTS

In the current study a total of 236 women and their newborns participated, of which majority of the women (49.6%) were in the age group of 21-25 years. In the study 36.9% of the mothers had secondary level of education. Majority of them were multi-gravida (52.5%) and had normal vaginal delivery (56.4%). Majority of the mothers (62.7%) had normal hemoglobin levels and 0.4% were found to have severe anemia with a hemoglobin level of $<7\text{mg/dl}$ as depicted in Table 1. Among the newborns included in the study 25.8% had low birth weight, 73.3% had normal birth weight and 0.8% were found to have macrosomia.

Among those in the age group <20 years, majority had normal BMI (69.2%), among those in the age group 21 to 25 years, majority had normal BMI (49.6%), among those in the age group 26 to 30 years, majority had normal and overweight BMI (46.9% respectively) and among those in the age group, majority had overweight BMI (56.2%). There was significant association between BMI and age distribution (Table 2).

In the study Mean Chest circumference among those with underweight BMI was 30.32 ± 1.77 , those with normal BMI was 30.92 ± 1.62 and those with overweight, mean chest circumference was 31.27 ± 1.91 cm. There was no significant association between BMI of the mother and Mid arm circumference of the infant. There was significant difference in mean chest circumference between three groups of BMI as shown in Table 3.

Table 1: Socio-demographic profile and anthropometric measures.

Particulars		Count	Percentages
Age	<20 years	39	16.5%
	21 to 25 years	117	49.6%
	26 to 30 years	64	27.1%
	>30 years	16	6.8%
Education	Illiterate	11	4.7%
	Primary	22	9.3%
	Secondary	87	36.9%
	PUC	80	33.9%
	Graduate	36	15.3%
Obstetric score	Primigravida	112	47.5%
	Multigravida	124	52.5%
Mode of delivery	Elective LSCS	72	30.5%
	Emergency LSCS	31	13.1%
	Vaginal	133	56.4%
Hb	<7 Severe	1	0.4%
	7 to 9.9 Moderate	36	15.3%
	10 to 10.9 Mild	51	21.6%
	>11 Normal	148	62.7%
BMI	<18.5 (Underweight)	28	11.9%
	18.5 to 24.9 (Normal)	121	51.3%
	>25 (Overweight)	87	36.9%
Birth Weight	<2.5 Kg	61	25.8%
	2.5 to 4 Kg	173	73.3%
	>4 Kg	2	0.8%

Table 2: Association between BMI and age.

Particulars		Age							
		<20 years		21 to 25 years		26 to 30 years		>30 years	
		Count	%	Count	%	Count	%	Count	%
BMI	<18.5 (Underweight)	4	10.3%	19	16.2%	4	6.2%	1	6.2%
	18.5 to 24.9 (Normal)	27	69.2%	58	49.6%	30	46.9%	6	37.5%
	>25 (Overweight)	8	20.5%	40	34.2%	30	46.9%	9	56.2%

$\chi^2 = 13.877$, df = 6, p = 0.031*

Table 3: Anthropometric parameters comparison with respect to BMI.

Particulars	BMI						p value
	<18.5 (Underweight)		18.5 to 24.9 (Normal)		>25 (Overweight)		
	Mean	SD	Mean	SD	Mean	SD	
Length	47.96	2.56	48.62	2.50	48.74	2.51	0.361
Head Circumference	32.74	1.41	33.08	1.51	32.96	2.88	0.733
Chest Circumference	30.32	1.77	30.92	1.62	31.27	1.91	0.04*
Mid arm circumference	9.02	1.08	9.28	0.82	9.82	2.90	0.059

Table 4: Correlation between BMI and various parameters.

Correlations									
Particulars		BMI	Age	Gestational age	Birth weight	Length	HC	CC	MAC
BMI	Pearson correlation	1	0.242	-0.122	0.129	0.010	-0.025	0.131	0.127
	P value		0.000	0.061	0.047*	0.873	0.697	0.044	0.052
	N	236	236	236	236	236	236	236	236

In the study a significant positive correlation was seen ($p < 0.05$) between BMI and age, BMI and birth weight, BMI and chest circumference (CC). That is with increase in BMI there was significant increase in the age, birth weight and chest circumference and vice versa (Table 4, Figure 1, Figure 2 and Figure 3). There was no association between maternal BMI and mid arm circumference or head circumference of the newborn.

Figure 1: Correlation between BMI and age.

Figure 2: Correlation between BMI and birth weight.

Figure 3: Positive correlation between BMI and chest circumference.

DISCUSSION

There is considerable variation in the prevalence of low birth weight across regions and within countries; Regional estimates of LBW by WHO shows a prevalence of 28% in South Asia.⁵ The prevalence of LBW was found to be 25.8%. Majority (76.7%) of the women were in the age range of 21 to 30 years, similar to a study conducted in Sri Lanka.⁶

This study established the interrelations between the body stature of the mother and her nutritional status prior to pregnancy with the intrauterine growth and birth weight of the newborn. This result is in agreement with many other studies conducted in London, Indonesia, Egypt and Nigeria which showed that intrauterine growth as reflected by birth weight is strongly influenced by maternal size.⁷⁻¹⁰

Present study also showed a positive correlation between maternal BMI and chest circumference of the newborn. A similar result was obtained in another study conducted in Belagaum.¹¹ The predictors for neonatal birth weight were different from those of neonatal birth length and this finding was similar to the observation made by Gonzalez-Cossio et al, and Haschke F. Van't Hof MA.^{12,13}

A study conducted in Egypt showed an association between maternal size and head circumference of the infant, which is in contrast to our study where no such findings were noted.⁹ Current study, similar to another study did not show any association between maternal BMI and mid arm circumference of the newborn.¹¹

CONCLUSION

Present study showed the association between maternal BMI and anthropometry of the newborn especially with respect to the BMI and birth weight, BMI and chest circumference. Thereby establishing that interventions aimed at improving the nutritional status of the mother have a direct impact on the fetal growth outcomes.

The primary limitation to the generalization of these results is that it was conducted for a period of three months and therefore the data may not be representative of the general population.

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Ethical approval: The study was approved by the Institutional Ethics Committee of Rajarajeswari Medical College, Bangalore

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