

Influence of Maternal Anthropometry on the Birthweight of the Newborn: A Hospital Based Prospective Study

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Abstract

Objective: The aim of the study is to determine the influence of maternal anthropometry on the birth weight of the newborn. **Materials and Methods:** The present study was undertaken at Dr. BR Ambedkar medical college and KC General Hospital Bangalore. Hundred and eight mothers who gave birth to uncomplicated singleton pregnancy, and their newborn were examined. Maternal anthropometry like height, weight, BMI, symphysis fundal height, abdominal circumference, upper mid arm circumference and neonatal parameters like birthweight, head, chest and abdominal circumference were recorded. Mothers were classified on the basis of BMI into 3 groups: Group I BMI < 22.57, Group II BMI 22.57-26.52 and Group III BMI > 26.52. **Results:** Mothers with a body mass index (Kg/m^2) of < 22.57 belonging to group I gave birth to male babies with a mean birth weight (in Kgs) of 2.59 ± 0.14 or female babies weighing 2.38 ± 0.40 . Mothers with a body mass index (kg/m^2) of 22.57-26.52 belonging to group II gave birth to male babies with a mean birth weight (in kgs) of 3.40 ± 0.26 or female babies weighing 2.67 ± 0.24 . Mothers with a body mass index (Kg/m^2) of >26.52 belonging to group III gave birth to male babies with a mean birth weight (in Kgs) of 3.40 ± 0.30 or female babies weighing 2.87 ± 0.67 . **Conclusion:** There was a statistically significant positive correlation between maternal body mass index with birth weight in Group I and Group II ($P < 0.05$) However in Group III male and female babies were non-significant ($P > 0.05$).

Keywords: Maternal anthropometry, Body mass index (BMI), Birthweight, Symphysis fundal height. Mid upper arm circumference.

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INTRODUCTION

Pregnancy is a physiologically demanding condition. The birthweight of the newborn is strongly influenced by the maternal biosocial factors, intrauterine age, genetic and biological characters of the fetus. The Birth weight of the newborn has been used as an important tool to measure the outcome of pregnancy. It is the most sensitive and reliable indicator of the health of the community [1]. The growth of the fetus is influenced by the availability of the nutrients and the supply of oxygen. Thus during pregnancy there is an increased nutritional demand. The factors that affect the supply of nutrition to the fetus depend on the maternal body composition, size as assessed by the pregnancy weight and the weight gain during pregnancy. The height of the mother could also be a contributory factor to decide the outcome. The fetal growth is also influenced by maternal nutritional stores the calorie and the protein intake, socio-economic status, cultural and educational background. The anthropometric characters of the expectant mother like, the pre pregnancy weight and height can be an important factor influencing the birth weight [2- 5].

Many studies have been investigated the role of maternal nutritional status, indicated by maternal anthropometry, to predict infant as well as maternal outcomes of pregnancy[2-5]. Indicators such as maternal height, pre-pregnancy weight, weight gain during pregnancy, Body mass index(BMI) and mid upper arm circumference are considered as measures of current or past nutritional status of the mothers[2-5]. However it is not very clear whether the weight gain during pregnancy has any impact on the outcome of pregnancy. There is no direct connection between the maternal and fetal circulation. However, in developing countries weight gain monitoring in pregnancy may not be feasible due to the limited availability of prenatal care and screening of mothers with anthropometric measurements. We attempted to study the Influence of Maternal anthropometry on the birth weight of the newborn.

MATERIALS AND METHODS

Study design

A hundred and eight healthy mothers who gave birth to uncomplicated singleton pregnancy, and

their newborns were included in the study. It was a hospital based prospective study carried out at Dr .B.R. Ambedkar Medical College Hospital, and K.C. General Hospital, Bangalore. The study protocol was approved by Institutional ethical committee.

Participants

The participants were pregnant women delivering at full term, majority of the pregnant women participated in the study were in the age group of 20-30 years. However 4 subjects were between 31 & 35 years of age. The subjects considered for the study were screened for the following inclusion and exclusion criteria. Normal healthy pregnant women attending AMC Hospital and K.C. General Hospital below the age of 35 years and delivered full term normal deliveries with gestational of 37-42 weeks were included. Mothers with twins, age above 35 years, bad obstetric history, pre-eclampsia, Diabetes, Hypertension and newborns with congenital anomalies and still birth were excluded from the study. The relevant details pertaining to the subjects were obtained by a questionnaire. The Personal details of the subject like Name, age address Educational status and occupation was noted.

Maternal Anthropometry

Height of the mother was recorded to the nearest centimeter by using a Stadiometer. It was recorded with bare feet the height was measured by using the guidelines [6]. Weight of the mother was recorded to the nearest 500 gms using UNICEF adult weighing machine. The Instrument was standardized with known weights before every weighing session. Same grown of known weight was used for each women and this weight was deduced from the observed value [6]. Body mass index (BMI) was calculated by considering the weight and height of the mother [7]. $BMI = \text{Weight (kgs)} / \text{height (meters)}^2$. The subjects were classified into three groups on the basis of Body mass Index (BMI). Group I < 22.57, Group II 22.57-26.52, Group III >26.52.

Symphysis fundal height

The upper border of the fundus was located by the ulnar border the left hand and this point was marked. The distance between the marked point and the upper border of symphysis pubis was measured in centimeters by a flexible tape in supine position [8].

Abdominal circumference

Abdominal circumference was measured by using a flexible tape to the nearest centimeter at the level of the umbilicus in supine position [8].

Upper mid arm circumference

Upper mid arm circumference is measured by a flexible tape at a point midway between the tip of the acromion process of the scapula and the olecranon

process of the ulna with the flexion at the elbow joint [9].

Neonatal Anthropometric parameters

The parameters Birth weight, crown to heel length, head circumference, chest circumference was measured immediately after delivery. Birth weight was recorded by using an electronic balance which has sensitivity ± 5 gms (Electromedik Pvt. Ltd.). Crown to heel Length was recorded to supine position by using an Infantometer scale in centimeters by standard technique [10]. Head Circumference of the Baby was measured to the nearest centimeter by using soft tape at the level of most prominent part of the occiput posteriorly and just above the supraorbital ridges anteriorly [10]. Chest Circumference of the baby was measured to the nearest centimeter by a soft tape at the level of nipples anteriorly and midway between inspiration and expiration in the supine position [10].

Statistical Analysis

The data obtained was tabulated and was analyzed by SPSS programme and Graph pad prism version 5.0. Analysis of variance (ANOVA) and student's 't' test were used for analysis .The level of significance of P value ($P < 0.05$) between the groups was considered significant. The continuous variables were expressed as Mean \pm SE values.

RESULTS

58 female and 50 male babies were considered for the study, they had a mean birth weight (in kgs) of 2.60 ± 0.28 and 3.01 ± 0.41 respectively (Figure 1), Male babies weighted more than female babies. Mothers with a body mass index (kg/m^2) < 22.57 belonging to group I gave birth to male babies with a mean birth weight (in Kgs) of 2.59 ± 0.14 or female babies weighing 2.38 ± 0.40 . Women aged below 20 years gave birth to male babies with a mean birth weight (in kgs) of 3.05 ± 0.31 or female babies with a mean birth weight (in Kgs) of 2.47 ± 0.46 . Women in the range of 21-29 years gave birth to male babies with a mean birth weight (in Kgs) of 2.99 ± 0.26 or female babies with a mean birth weight (in Kgs) of 2.66 ± 0.37 . Women aged more than 30 years gave birth to female babies with a mean birth weight (in Kgs) of 2.28 ± 0.56 . However there were no male babies (Table 1) .There was a no significant correlation between maternal and birth weight of male or female babies in all the 3 groups ($P > 0.05$). Mothers with a body mass index (kg/m^2) of 22.57-26.52 belonging to group II gave birth to male babies with a mean birth weight (in kgs) of 3.40 ± 0.26 or female babies weighing 2.67 ± 0.24 . Mothers with a body mass index (kg/m^2) of >26.52 belonging to group III gave birth to male babies with a mean birth weight (in kgs) of 3.40 ± 0.30 or female babies weighing 2.87 ± 0.67 (Figure 2). There was a statistically significant positive correlation between maternal body mass index with birth weight in Group I and Group II ($P < 0.05$) However

in Group III male and female babies were non-significant ($P>0.05$).

Mothers with uterine fundal Height (in cms) of < 34 gave birth to male babies with a mean birth weight (in kgs) of 3.05 ± 0.26 or female babies with a mean birth weight (in Kgs) of 2.49 ± 0.31 mothers with uterine fundal height (in cms) of >34 gave birth to male babies with a mean birth weight (in kgs) of 2.91 ± 0.30 or female babies with a mean birth weight (in Kgs) of 2.89 ± 0.51 (Figure 3). There was no significant correlation between uterine fundal height and birth weight of the male babies ($P>0.05$). And there was a significant correlation between uterine fundal height and birth weight of female babies ($P<0.05$). Mothers with abdominal circumference (in cms) of < 92 gave birth to male babies with a mean birth weight (in kgs) of 3.02 ± 0.27 or female babies with a mean birth weight (in kgs) of 2.51 ± 0.40 . Mothers with abdominal circumference (in cms) of > 92 gave birth to male babies with a mean birth weight (in Kgs) of 3.00 ± 0.30 or female babies with a mean birth weight (in Kgs) of 2.75 ± 0.39 (Figure 4). There was no significant correlation found between abdominal circumference

and birth weight of Male babies ($P>0.05$). Female babies showed a significant correlation between abdominal circumference and birth weight ($P<0.05$). Mothers with midarm circumference (in cms) with < 23 gave birth to male babies with a mean birth weight of 2.98 ± 0.30 or female babies with a mean birth weight of 2.44 ± 0.32 . Mothers with midarm circumference (in cms) with > 23 gave birth to male babies with a mean birth weight of 3.09 ± 0.21 or with female babies with a mean birth weight of 2.94 ± 0.40 (Figure 5). There was no significant correlation between mid-arm circumference with birth weight of male babies ($P>0.05$) and there was significant correlation between mid-arm circumference with birth weight of female babies ($P<0.05$).

Neonatal parameters

The mean values \pm SE of the male babies and female babies of Crown to heel length were 48.01 ± 0.20 and 47.28 ± 0.29 respectively. The mean values \pm SD of the male babies and female babies of Head, Chest and abdominal circumference were 33.68 ± 1.67 , 32.82 ± 2.87 , 32.79 ± 2.84 , 32.16 ± 2.56 and 30.45 ± 2.38 , 30.25 ± 1.51 respectively [Table 2].

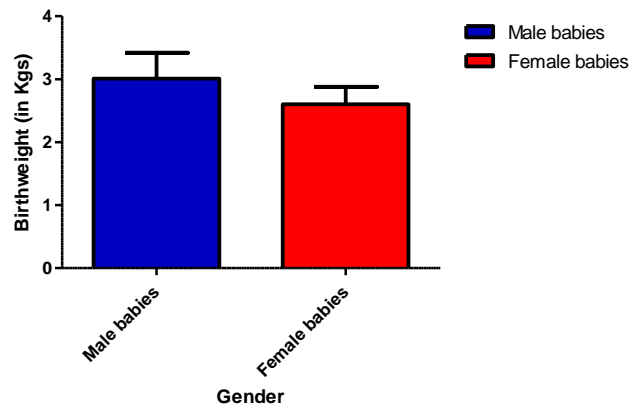


Figure 1. Gender distribution of the babies and birthweight

Table-1: Correlation of maternal age and birth weight

Group	Maternal age (in years)	Mean birth weight (In kgs) \pm SE			
		Number(n)	Male	Number(n)	Female
I	< 20	18	3.05 ± 0.31	12	2.47 ± 0.46
II	21-29	32	2.99 ± 0.26	42	2.66 ± 0.37
III	> 30	0	0	4	2.28 ± 0.55

Group I vs. II	$P>0.05$	$P>0.05$
I vs. III	$P>0.05$	$P>0.05$
II vs. III	$P>0.05$	$P>0.05$

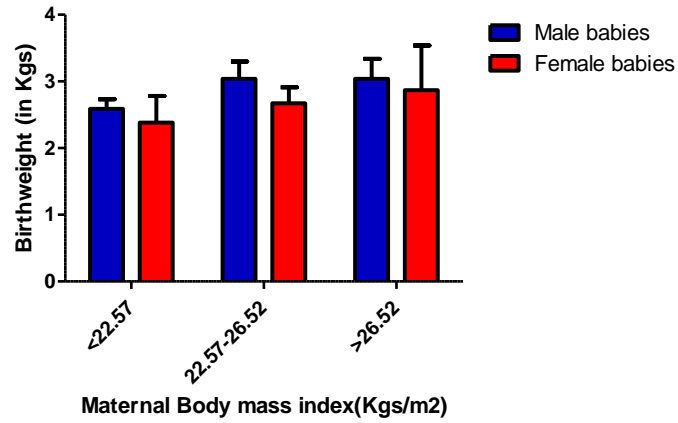


Figure 2. Correlation of maternal body mass index and birth weight

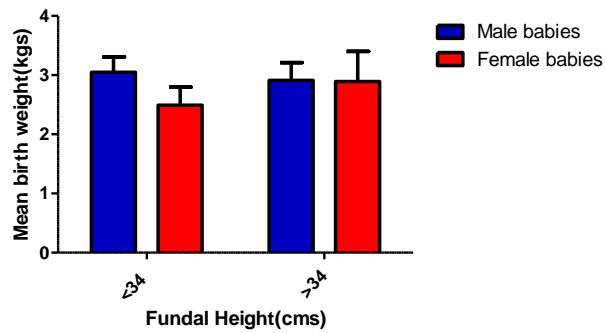


Figure 3. Comparison of Symphysis fundal height and Birth weight

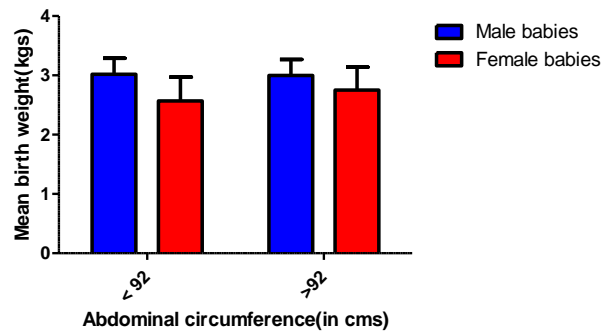


Figure 4. Comparison of Maternal Abdominal circumference and Birthweight

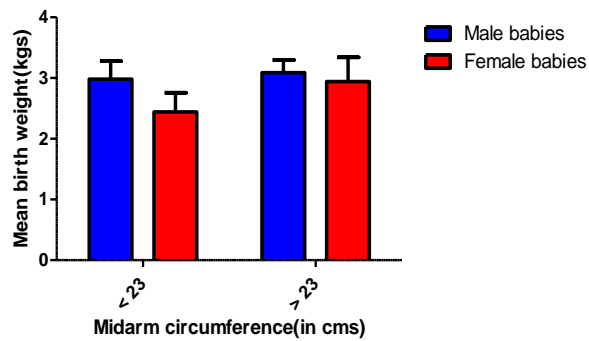


Figure 5. Comparison of maternal midarm circumference and birthweight

Neonatal Parameters

Table-2: Anthropometric Parameters of Newborn

Neonatal Anthropometric Parameters (cms)	Mean values \pm SE	
	Male babies	Female babies
Crown to heel length	48.01 \pm 0.20	47.28 \pm 0.29
Head circumference	33.68 \pm 1.67	32.82 \pm 2.87
Chest Circumference	32.79 \pm 2.84	32.16 \pm 2.56
Abdominal Circumference	30.45 \pm 2.38	30.25 \pm 1.51

DISCUSSION

Pregnancy, a physiologically stressful condition is influenced by a number of maternal and fetal factors. However the extent to which these factors influence, the birth weight of the baby appear variable. In our study maternal age was predominantly between 20 and 30 years with a very few cases above 30 years. In this age groups the birth weight did not show significant variation with respect to age. However it is reported in earlier studies that extremes of age could adversely influence weight of the newborn. Adolescent girls and mothers below the age of 15 years exhibit a biological immaturity influenced by chronologic and gynecologic age. Although the girls are capable of conceiving immediately after menarche, growth of the mother competes with the development of the fetus. Thus competition between mother and fetus for the available nutrients result in higher incidence of intrauterine growth retardation. The retarded growth of the new born could also be attributed to the improper skeletal growth of the mother and underdeveloped reproductive organs. The older mothers also gave birth to small babies with or without the congenital abnormalities due to higher Incidence of metabolic disorders like Diabetes, with Hypertension and other cardiovascular disorder. Low birth weight babies in elder women could also be attributed to the condition of the uterus and endometrium which is not conducive for a satisfactory fetal development [11].

The height and weight of the mother, therefore the body mass index is an important factor in deciding the weight of the newborn. The earlier reports [12] indicate mothers weighing less than 40 kg with a height of less than 145 cms (BMI = 19.04 kgs / mtrs²) gave birth to low birth weight babies. In the present study women with a body mass index less than 22.57, gave birth to babies with a lower birth weight when compared to the mothers with a BMI more than 22.57. It is also observed that extremes of age resulted in low birth weight babies. The mothers who had a low body mass index evidenced by a small stature had inadequate skeletal growth, a small sized uterus resulting in a compromised placental size. These maternal limitations could adversely affect the development of the fetus due to poor fetoplacental perfusion [13]. Fetus, a true parasite depends on the mother for its nutritional requirement this exerts an extra load on maternal nutritional intake. In conditions of unsatisfactory calorie

intake there is a competition between mother and her growing fetus to satisfy the individual requirement [12]. Maternal weight at term as the best single predictor of low birth weight with a correlation coefficient of 0.49 [2].

The fundal height and the abdominal circumference can be considered as indirect evidence for the development of fetus during pregnancy. It has been observed that there is a significant correlation between the increase in fundal height and gain in the abdominal circumference during pregnancy. The relationship was more pronounced for the female babies weighing far less than 3 kg's. It can be presumed that fetal weight of 3 kg's could be a critical factor above which these anthropometric measurements do not seem to significantly correlate with the fetal development and hence the birth weight. The female babies generally weighed around 2.5 kgs and the male babies weigh around 3 kgs. The size of the female baby correlated well with the fundal height. However a similar correlation did not exist for the male babies. Analysis of these results indicate that the size of the uterus and babies' weight could be acting as critical and complementary factors in influencing the progressive increase in the fundal height.

In our study mothers with upper midarm circumference (in cms), there was no significant correlation between mid-arm circumference with birth weight of male babies ($P > 0.05$) and there was significant correlation between mid-arm circumference with birth weight of female babies ($P < 0.05$). Our results were in partial agreement with other studies [14, 15].

The mean values of neonatal parameters like Birth weight, Head circumference, chest circumference, abdominal circumference were greater in male babies in comparison with the female babies. Our results were in concordance with other studies [16].

Maternal BMI, age, symphysis fundal height, abdominal circumference, upper mid arm circumference are correlated with the birthweight of the newborn. This emphasizes the importance of maternal obesity as a risk factor for macrosomia. Our study had few limitations we were unable record pre-pregnancy weight, as the patients first arrived to the hospital during the antenatal checkups.

CONCLUSION

The maternal anthropometry exhibited a demonstrable influence on the birth weight of male and female babies. There was a statistically significant positive correlation between maternal body mass index with birth weight in Group I and Group II ($P < 0.05$). However in Group III male and female babies were non-significant ($P > 0.05$). The birth weight of the babies demonstrated an increase with that of the abdominal circumference and fundal height. However this relationship was not demonstrable when the birth weight was beyond 3kgs.

Conflict of interest

The author reports no conflict of interest.

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