

# ASSOCIATION OF MATERNAL BMI WITH FETAL BIRTH WEIGHT AND MATERNAL HEIGHT WITH FETAL CROWN HEEL LENGTH

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## ABSTRACT

**Background:** The nutritional status of a woman before and during pregnancy is important for a healthy pregnancy outcome. The objective of the study was to determine association of maternal BMI with newborn birth weight and maternal height with baby crown heel length.

**Material & Methods:** This cross-sectional study was conducted in the department of Community Health Sciences, Peshawar Medical & Dental College, Peshawar, Pakistan from November 2015 to April 2016. A sample of 250 pregnant females in their third trimester and their 250 newborn babies was taken from the labour rooms. Pregnant females with past medical history of diseases like diabetes, hypertension, past history of surgical intervention, pre-eclampsia and eclampsia were excluded. The demographic variable was age group. The research variables were maternal BMI, newborn birth weight, maternal height and fetal crown heel length. The categorical variables were analyzed by using frequency and percentages whereas numeric variables were analyzed through mean, SD. A structured questionnaire was used to collect the data and analyzed by SPSS Version-16.

**Results:** Out of 250 pregnant women, 48.8% were in 15-25 years, 46.8% in 25-35 years & 4.4% in 35-45 years. Maternal BMI was  $26.96 \pm 4.44$  kg/m<sup>2</sup> with a range of 26 kg/m<sup>2</sup> (18-44). Maternal height was  $61.35 \pm 3.43$  inches with a range of 31 inch(47-78). Newborn weight was  $3.41 \pm 0.56$  kg with a range of 3.5 kg(1.5-5.0). Fetal crown heel length was  $47.53 \pm 4.05$  cm with a range of 22 cm(35-57). There was a positive significant association between maternal BMI and newborn birth weight. There was a positive significant association between maternal height and newborn crown heel length.

**Conclusion:** The study concluded that healthy mothers deliver healthy babies.

**KEY WORDS:** Pregnancy outcome; Pregnancy; Nutritional Assessment.

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## INTRODUCTION

Maternal nutrition and health are considered to be the most important regulators of fetal growth. The nutritional status of a woman before and during pregnancy is important for a healthy pregnancy

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outcome having a crucial effect upon fetal growth and birth outcomes. Factors such as body mass index and parity have a pronounced effect on health of new born.<sup>1-3</sup> Poor nutritional status of the mother leads to adverse birth outcomes such as low birth weight babies, preterm deliveries and intrauterine growth retardation.<sup>4</sup> Poor maternal nutritional status is influenced by biological, socioeconomic and demographic factors. The relation between maternal nutrition and birth outcomes may provide a basis for developing nutritional interventions that will improve birth outcomes and long term quality of life and reduce mortality, morbidity and health care cost. Pregnancy in total duration consumes 60,000 kcal. Child survival is correlated with age to birth weight which depends upon weight gain in pregnancy; the

average weight gain in pregnancy is 12 kg. Results of studies show that 23.8% babies born with lower than optimal weights at birth are due to lack of proper nutrition. Anemic mothers have a high incidence of premature births, postpartum hemorrhages and puerperal sepsis.<sup>5</sup> Dietary intake is associated with weight of developing fetus but this association is more pronounced in third trimester of pregnancy. Intake of micronutrient rich food is associated with neonatal length, birth weight, and skin fold thickness when adjusted for sex, parity, and gestational age. Thus healthy mothers produce healthy children and if women are not well nourished they are likely to give birth to weak babies resulting in high infant mortality.<sup>5</sup>

Maternal nutrition has direct association with fetal nutrition. In low and middle income countries maternal under nutrition is leading cause of maternal and child mortality and morbidity. According to Pakistan National Nutritional Survey 2011 nutritional indicators of pregnant women in Pakistan are very poor.<sup>6</sup> Studies show link between maternal health and newborn health. An American study concluded that maternal under nutrition have an influence on fetal body while such effects were more pronounced in late /third trimester of gestation. The same study also showed little correlation between maternal stature and fetal growth but mother's pre gravid weight as well as weight gain in pregnancy shows more correlation. The effects of extremes of maternal weight were substantial in late gestation. Factors not affecting fetal organs and body include mother's age, work status during pregnancy and interval since last pregnancy. Studies also show that overweight mothers irrespective of their height will have large fetus which may lead to bad outcomes of pregnancy.<sup>7</sup>

During World War-II a six month period of starvation in Holland reduced birth weights to about 10 %.<sup>8</sup> No association between parity and dietary diversity score was shown in a study along with socioeconomic and diet diversity scores although it was deduced that for an increase of one score of dietary diversity the pregnant female gained 0.24 kg in 2<sup>nd</sup> trimester and 0.71kg in the 3<sup>rd</sup> trimester. However a strong association between hemoglobin level and supplement (iron and folic acid) intake were seen. This indicated that increasing dietary diversity can result in healthy birth outcome, thus health care provider should emphasize on dietary diversity in quantity as well as quality to achieve healthy outcomes for mother and the newborn.<sup>9,10</sup>

In the course of pregnancy, anthropometric measures such as maternal weight, weight for height or BMI, height or arm circumference have been shown to be good predictors of birth weight and survival.<sup>11,12</sup> MUAC is a good indicator of the protein reserves of a body, and a thinner arm reflects wasted lean mass, i.e. malnutrition. A Multi-Centre Study has

provided cut-off values of maternal anthropometry as a risk for poor infant outcome; these are maternal height less than 148 cm and pre-pregnancy weight less than 45 kg. Similarly the incidence of pre-term deliveries is higher in the group of mothers who are above 50 kg of pre-pregnancy weight and 150 cm height. At a cut-off point of 145 cm for maternal height, the association with full-term low birth weight (LBW) becomes stronger.<sup>13</sup>

Body mass index has been shown to reflect body composition of pregnant women; lower body mass index relates to wasting of both fat and lean tissue.<sup>14,15</sup> Body Mass Index is a composite indicator that needs two measurements (weight, height) and skilled staff to calculate it. In a recently published large meta-analysis it was found that pregnant women with a body mass index ranging from  $\leq 18.3$  to  $\leq 23$  kg/m<sup>2</sup> (but  $< 20$  kg/m<sup>2</sup> in most studies) increased the risk of having a low birth weight infant (RR 1.52, 95%CI: 1.25–1.85) in developing countries. Body mass index can vary substantially during pregnancy, but it is an indicator of risk for LBW.<sup>16-18</sup>

The objective of the study was to determine association of maternal BMI with newborn birth weight and maternal height with baby crown heel length.

## MATERIALS AND METHODS

This cross-sectional study was conducted in the department of Community Health Sciences, Peshawar Medical & Dental College, Peshawar, Pakistan from November 2015 to April 2016. A sample of 250 pregnant females in their third trimester (36- 40 weeks gestation) and their 250 newborn babies was taken from the labour rooms of Khyber Teaching Hospital, Hayatabad Medical Complex and Lady Reading Hospital, Peshawar. Pregnant females with past medical history of diseases like diabetes, hypertension, past history of surgical intervention, pre-eclampsia and eclampsia were excluded. After taking verbal consent, questionnaires were delivered and the respective measurements taken. Ethical clearance was taken from the Institutional Ethical Review Committee of Peshawar Medical College and written permission from the Medical Superintendents and Head of Departments of Gynecology & Obstetric units of the including hospitals.

The demographic variables were age groups (15-25 years, 26-35 years, 36-45 years). The research variables were maternal BMI, newborn birth weight, maternal height and fetal crown heel length. Age groups was categorical variable whereas maternal BMI, fetal birth weight, maternal height and fetal crown heel length were numeric variables. The categorical variables were analyzed by using frequency and percentages whereas numeric variables were analyzed through mean, SD, range, minimum and maximum. Maternal BMI was calculated by measur-

ing weight using a calibrated weighing scale to the nearest kilogram and height to the nearest inches and interpreted according to Center for Disease Control & Prevention. Newborn birth weight and fetal crown heel length were measured<sup>19</sup> soon after birth.

A structured questionnaire with maternal and fetal forms separately was used to collect the data. Data was entered and analyzed in SPSS Version- 16 and associations between maternal nutritional status and health of newborn were computed through Pearson correlation test with significance level set as ( $p < 0.05$ ).

**RESULTS**

Out of 250 pregnant women, 122 (48.8%) were in 15-25 years, 117 (46.8%) in 25-35 years & 11 (4.4%) in 35-45 years. Maternal BMI was  $26.96 \pm 4.44 \text{ kg/m}^2$  with a range of 26 (18-44). Maternal height was  $61.35 \pm 3.43$  inch with a range of 31 inch (47-78). Newborn weight was  $3.41 \pm 0.56 \text{ mg}$  with a range of 3.5kg (1.5-5.0). Fetal crown heel length was  $47.53 \pm 4.05 \text{ cm}$  with a range of 22cm (35-57) Table 1.

There was a non significant association between maternal BMI and newborn birth weight. Figure 1

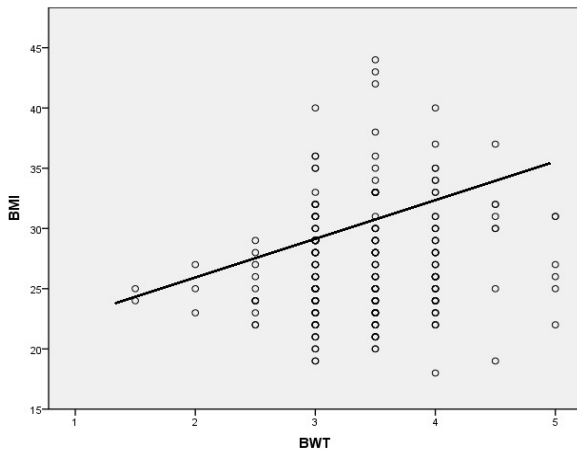


Figure- 1; Correlation of Maternal Body Mass Index and Newborn birth weight.

There was a moderately positive significant association between maternal height and newborn crown heel length. Figure 2

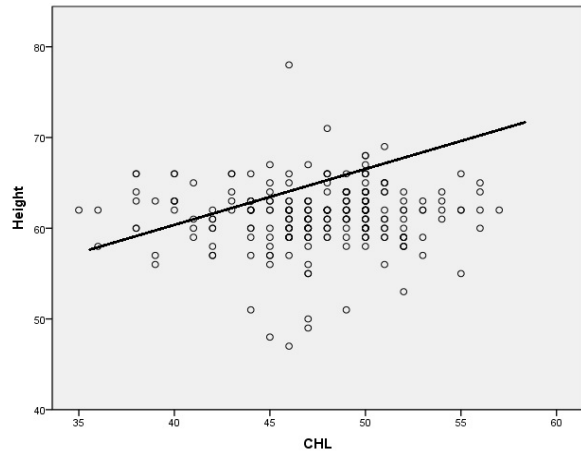


Figure- 2. Association of maternal height and fetal crown heel length.

**DISCUSSION**

Maternal nutrition plays an important role in influencing fetal growth and birth outcome. The effect of maternal body mass index on newborn weight is one of the parameter of assessment. Present study found positive association between maternal nutritional status and birth outcomes in variables like maternal body mass index with birth weight and maternal height with crown heel length.

A study conducted in Charite University hospital concluded that pregnancy outcome was worst in babies from mothers with low body mass index as compared to normal weight mothers with respect to increase incidence of preterm birth. The study further demonstrated that maternal outcome was worst in obese mothers and delivered preterm babies.<sup>20</sup> Moreover high maternal body mass index was associated with increased risk of complications like cesarean section and fetal macrosomia, whereas low body mass index with preterm and lower birth weight,<sup>20</sup> which is not in contrast with present study as complications were not taken into account with BMI however results showed positive association between normal maternal BMI and healthy newborns.

The relation between maternal anemia and birth weight has been reviewed in a study of rural Nepal. Neonatal weight was associated with maternal hemoglobin i-e mothers of low hemoglobin levels had low birth weight babies. A large number

**Table- 1: Descriptive statistics of all study variables regarding association of maternal BMI with fetal birth weight and maternal height with fetal crown heel length (n=250).**

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
Height (inch)	250	31	47	78	61.35	3.444	11.860
BMI (kg/m <sup>2</sup> )	250	26	18	44	27.05	4.456	19.853
BWT (kg)	250	4	2	5	3.42	.569	.324
CHL (cm)	250	22	35	57	47.52	4.042	16.339

of iron deficient women showed that regular intake of supplementation has an impact on newborn's birth weight.<sup>21</sup> Also there is an association between maternal anemia and lower infant APGAR score as reported 102 by an Indian study. High maternal Hb level was related to better APGAR scores lowering the risk of birth asphyxia.<sup>21,22</sup> This is in contrast with our study results. A study found no statistical relationship between the infant and maternal hemoglobin levels but the subjects suffered from varying degrees of calorie protein deficiency though they did not exhibit any gross clinical evidence of calorie-protein malnutrition.<sup>23</sup> But we did not take into account fetal hemoglobin levels.

Large proportions of women (37.8%) in a study were underweight before pregnancy. Birth weight was related to maternal pre-pregnancy body mass index and pregnancy weight gain. Women who were underweight before pregnancy and those whose weight gain was too low gave birth to smaller infants than women who were not underweight before pregnancy and those who gained more weight during pregnancy, which is contradictory to our study results as we did not take into account pre-pregnancy weights of the women.<sup>24</sup> Analysis of a study suggested that the current total deaths in children younger than 5 years could be reduced by 15% if populations could access ten evidence-based nutrition interventions at 90% coverage. Accelerated gains are possible and about a fifth of the existing burden of stunting can be averted using these approaches.<sup>25</sup> Trials that included large numbers of iron deficient women showed that iron supplementation improved birth weights is in contrast with our study findings.<sup>26</sup> Among Swedish women, decreasing height was associated with a progressive increase in the odds of having an infant born preterm,<sup>27</sup> not in association with our study as we compared maternal height with baby's crown heel length. Overweight/obese women may experience higher incidence of delivering larger babies. Multi-variable regression analysis in a study showed that maternal body mass index and height, parity, and gestational age are associated with newborn's birth weight<sup>28</sup> in contrast with our study results though we only calculated p values.

## CONCLUSION

The study concluded that healthy mothers deliver healthy babies.

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**CONFLICT OF INTEREST**

Authors declare no conflict of interest.

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None declared.

**AUTHORS' CONTRIBUTION**

Conception and Design:	FK
Data collection, analysis & interpretation:	ZUAS, AA, TS, HHZ, KG, HQ, AK, GA, YA
Manuscript writing:	FRM