

## The relationship between placental weight and birth weight: A cross sectional study

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### Abstract

**Objective:** Various studies have been conducted outside the country to assess the association of fetal outcomes with placental weight but there is very little data available locally. Therefore, the objectives of this study was to establish and determine the relationship between placental and birth weight in the well-being and final outcomes of the fetus in Pakistan population.

**Material and methods:** This was a cross-sectional observational study using non-probability convenient sampling technique carried out at the Obstetrics and Gynaecological Department of Hamdard Hospital, Karachi for a period of six months. Ethical permission was taken from the Institutional review board of the hospital. Healthy pregnant mothers with either singleton or multiple pregnancies having at least 3 ante natal checkups were included in the study. Mothers giving birth at gestational age less than 34 weeks or above 41 weeks and 6 days, with complicated pregnancy were excluded from the study. Data was analyzed using SPSS version 20.0. Quantitative data was presented as mean  $\pm$  SD while qualitative was presented as frequency (%). Independent T-test was used to assess the significance and p-value was set at 0.05. **Results:** In the total of 200 pregnant females, mean maternal age was  $29.29 \pm 5.28$  years with mean gestational age  $37.14 \pm 1.65$  weeks. Mean gravid was  $3.09 \pm 1.63$  and parity  $1.41 \pm 0.49$ , mean birth weight of their babies was  $2.88 \pm 0.43$  kg. 109 (54.5%) were male and 91 (45.5%) were female. 126 (73.3%) of babies that had a placental weight of  $< 500$  were found to have a birth weight of 2.5 kg having a significant difference of p-value 0.045.

**Conclusion:** It was concluded in our study that there is association of the placental weight and birth weight. It may be attributed to the consequences of growth of the fetus and improved nutritional status of the mother. Furthermore, it was predicted that nutritional status of the mother had a significant association with the placental weight.

**Keywords:** Placental weight, low birth weight, fetal well-being

### Introduction:

A vital indication for chronic disease in adult life like coronary heart disease, hypertension and diabetes mellitus is the weight at birth or birth-weight (BW).<sup>1</sup> This birth-weight in turn depends on the placental weight (PW). Neonates which are small for gestational age (SGA) are at a greater risk for development of cardiac disorders as well as for type-II diabetes mellitus in adult life as compared with neonates that are appropriate for gestational age (AGA).<sup>2,3</sup> Although, weight at birth might seldom be misleading, SGA neo-

nates might be conventionally be small, while contrarily, AGA neonates might suffer subtle intra-uterine growth retardation (IUGR) or any other intrauterine abnormality apparently showing no decreases in birth-weight. This is a reason as to why weight at birth is not always a single or sole indication for adverse health outcome.<sup>4</sup>

Placenta is a transient organ having the function of nutritional transport from maternal to fetal circulation, is reported to be related to on weight at birth is.<sup>5,6</sup> As a result, ratios between placen-

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tal weight and birth-weight have been largely researched for determining their associations to future outcome of fetal health. Never the less, a higher PW/ BW has been linked with a higher risk for cardiovascular mortality, hypertension in adult life, coronary heart disease as well as impaired glucose tolerance.<sup>7-9</sup> Recently, PW/BW ratios are thought to be a predictor of future outcomes of fetal health risk as compared to placental weight or weight at birth considered alone.<sup>10</sup>

Various researches have studied the path-physiology between high PW/BW associations and contrary health outcome. Few have advised that higher PW/BW ratios signify adaptive hypertrophy of placenta, responding to malnourishment of the fetus, although final weight at birth being in normal range. Some state that it might be an indicator of decreased growth of skeleton but rather than SGA: but many of the researches agree that it might be linked with obstetric stress risk factor like mother's haemoglobin status, smoking status as well as gestational diabetes mellitus (GDM).<sup>11-14</sup>

On the contrary to extended research in linking PW/BW ratios and life-long fetal outcome, the linkage in between ratios as well as short-term fetal outcome have not gained much consideration. One of the study reported that a higher frequency of Apgar score lower than 7 in a minute population of non-diabetic mother had higher PW/BW ratio.<sup>15</sup> This shows that weight at birth as well placental weight play an important role in infant mortality not only in adult life but also during the first month as well as first year of life, while also influencing future developmental processes in adult life.<sup>16</sup>

As the fetal well-being needs higher nutrition and oxygen demand as the period of gestation increases, any relatively small dysfunction in placental function might be very closely linked to death of the fetus especially in the last part of pregnancy, as compared to in early pregnancy. PW is proposed to be an indication for showing functionality of the placenta where smaller placenta might be lesser functional. It is believed that higher risk of death of fetus at term or in

post-term pregnancy might be in relation with impairment of placental function. Therefore, placenta in pregnancy with death of fetus at term might be small in relation to weight at birth in comparison to pregnancies having death of fetus at an earlier gestation.<sup>17</sup>

Various studies have been conducted outside the country to assess the association of fetal outcomes with placental weight but there is very little data available locally. Therefore, the objectives of this study was to establish and determine the relationship between placental and birth weight in the well-being and final outcomes of the fetus in Pakistan population.

### **Material and Methods:**

This was a cross-sectional observational study using non-probability convenient sampling technique carried out at the Obstetrics and Gynaecological Department of Hamdard Hospital, Karachi for a period of six months from 1<sup>st</sup> January 2018 till 30<sup>th</sup> June 2018. Ethical permission was taken from the Institutional review board of the hospital. Healthy pregnant mothers with either singleton or multiple pregnancies having at least 3 ante-natal check-ups were included in the study. Mothers giving birth at gestational age less than 34-weeks or above 41-weeks and 6-days, with complicated pregnancy were excluded from the study.

The independent variables included parity, last menstrual period, spacing between pregnancies, ectopic pregnancy, BMI prior to pregnancy and maternal height. Dependent variables included fetal birth weight, mid-arm circumference, birth status and type or parturition. Interventional variables included Antenatal care recipient, resting in pregnancy, physical activity, complications in pregnancy, intake of multi-vitamins, consumption of meals, smoking, chewing of tobacco. Background variables were maternal age, gestational age and gender of the infant. Data was collected after taking informed and written consent by trained data collectors. No monetary benefit was given to the participants of this study.

Table-1a: Descriptive analysis of maternal and fetal variables:

Variables (n=200)	Mean	SD
Maternal Age (years)	29.29	5.28
Gestational Age (years)	37.14	1.65
Parity	1.41	0.49
Gravida	3.09	1.63
Birth Weight (kg)	2.88	0.43
Placental Weight (gm)	2611.55	520.32

Table-1a: Descriptive analysis of maternal and fetal variables:

		n%
<b>Infant Gender</b>	Male	109 (54.5)
	Female	91 (45.5)
<b>Spacing in Pregnancies</b>	<24 Months	161 (80.5)
	>24 Months	39 (19.5)
<b>Ectopic Pregnancy</b>	Yes	26 (13)
	No	174 (87)
<b>Abortions</b>	Yes	132 (66)
	No	98 (34)
<b>BMI before Pregnancy</b>	13.5 to 24.9	55 (27.5)
	25 to 29.9	141 (70.5)
	30 or more	4 (2)
<b>Mothers Height</b>	<145cm	14 (7)
	>145cm	186 (93)
<b>Birth Height</b>	<48cm	102 (51)
	>48cm	98 (49)
<b>Birth Weight (kg)</b>	1.5-2.5	56 (28)
	>2.5	140 (70)
<b>Placental Weight (gm)</b>	<500	172 (86)
	>500	28 (14)

Data analysis: For data analysis SPSS version 20.0 was used. Quantitative data was presented as mean  $\pm$  SD while qualitative was presented as frequency (%). Chi square test was used to assess the significance and p-value was set at 0.05.

### Results:

The mean maternal age in the study was 29.29 $\pm$ 5.28 years having a mean gestational age of 37.14 $\pm$ 1.65 weeks. The mean gravida was 3.09 $\pm$ 1.63 and parity 1.41 $\pm$ 0.49. The mean birth weight of the babies was 2.88 $\pm$ 0.43 kg. Among the 200 babies delivered, 109(54.5%) were male and 91(45.5%) female. 161(80.5%) mothers had a spacing of less than 24 months between pregnancies while 39(19.5%) mothers had spacing greater than 24 months between pregnancies. Only 26(13%) had ectopic pregnancy.

132(66%) had abortions. Underweight BMI before pregnancy was observed in 55(27.5%) of mothers while 141(70.5%) were in the normal BMI range and only 04(2%) mothers were overweight. 14(7%) of mothers were found to be <145cm while 186(93) were >145cm in height. A birth height of <48cm was observed in 102(51%) of babies while >48cm was found in 98(49%) of babies. 04(2%) babies were observed to have a birth weight of <1.5 kg while 56 (28%) of babies had birth weight between 1.5-2.5 kg and 140(70%) of babies had >2.5 kg birth weight. A placental weight of <500 gm was found in 172(86%) of babies while >500 gm was observed in 28(14%) [table Ia].

A normal mid arm circumference of >12cm was observed in 92(46%) of babies while <12cm was found in 108(54%) of babies. A hemoglobin of <10 gm/dl was seen in 45(22.5%) patients, between 10-11gm/dl in 106(53%) and >11 gm/dl in 49(24.5%) of babies. 144(72%) of babies were alive while only 02 (1%) died, 21 (10.5%) were pre-term and 33 (16.5%) were term babies. 60 (30 %) were delivered normally and 140 (70 %) through cesarean. Hypertension was found in 31(15.5 %) of mothers, 75(37.5%) had anemia, 22(11%) had diabetes, 07(3.5%) had thyroid dysfunction and 65(32.5%) had other disorders. 172(86%) of mothers ate iron and vitamin-C daily. Extra meal were consumed by 137(68.5%) of mothers. Only 05(2.5%) mother's smoked or chewed cigarette. Ante-natal care was received by 188(94%) through doctor (consultant), 10(5%) through midwife (Lady Health Worker). Adequate rest during pregnancy was taken by 159(79.5%) of mothers. Mild physical activity was done by 117(58.5%) mothers and moderate activity by 83(41.5%) of mothers [table Ib].

In babies having placental weight <500, 93(54.1%) were male while 79(45.9%) were female and in the babies with placental weight >500, 16(57.1%) were male and 12(42.9%) were females having an insignificant difference between the two groups (p-value 0.76). 126(73.3%) of babies that had a placental weight of <500 were found to have a birth weight of 2.5

Table-1b: Descriptive analysis of maternal and fetal variables:

Variables		n	%
<b>Mid Arm Circumference</b>	>22cm (normal)	92	46.0
	<22cm	108	54.0
<b>Hemoglobin</b>	<10 mg/dl	45	22.5
	10-11 mg/dl	106	53.0
	>11 mg/dl	49	24.5
<b>Status of Birth</b>	Alive	144	72.0
	Dead	2	1.0
	Preterm	21	10.5
	Term	33	16.5
<b>Type of Parturition</b>	Normal	60	30.0
	Cesarean	140	70.0
<b>Present Pregnancy Complications</b>	HTN	31	15.5
	Anemia	75	37.5
	DM	22	11.0
	Thyroid	7	3.5
	Other	65	32.5
<b>Vitamin C Intake</b>	Yes	172	86.0
	No	28	14.0
<b>Iron Intake</b>	Yes	172	86.0
	No	28	14.0
<b>Meals Consumed</b>	One Extra Meal Taken	137	68.5
	No Extra Meal Taken	63	31.5
<b>Tobacco Smoking</b>	Yes	5	2.5
	No	195	97.5
<b>Tobacco Chewing</b>	Yes	5	2.5
	No	195	97.5
<b>Antenatal Care Received by</b>	Midwife (LHV)	10	5.0
	Doctor (Consultant)	188	94.0
	Not Receive	2	1.0
<b>Adequate Rest Taken During Pregnancy</b>	Yes	159	79.5
	No	41	20.5
<b>Physical Activity</b>	Mild	117	58.5
	Moderate	83	41.5

kg having a significant difference of p-value 0.05. 135(78.5%) of mothers with babies having <500 placental weight had a spacing between pregnancies of <24 months and 26(92.9%) of mothers with babies having >500 placental weight had a spacing between pregnancies of <24 months with an insignificant p-value of 0.08. In babies having placental weight <500, 125(72.7%) of mothers had a BMI in the normal range while 16 (57.1%) of mothers whose baby's placental weight was >500 had normal BMI, having an in-

significant p-value of 0.24. In babies having placental weight <500, the maternal hemoglobin between 10-11 gm/dl was observed in 86(50%) of mothers while in 20(71.4%) of mothers whose placental weight was >500, having a significant p-value of 0.05. 121(70.3%) babies with placental weight of <500 were alive and healthy and in with placental weight of >500, 23(82.1%) were alive and healthy, having an insignificant p-value of 0.20. In babies having placental weight <500, 172(100%) mothers took vitamin-C, having a highly significant p-value of <0.001. In babies having placental weight <500 171(99.4%) of mothers took iron supplement, with a highly significant p-value of <0.001. In babies having placental weight <500, 130(75.6%) mothers ate an extra meal while 07(25%) mothers having placental weight >500 ate an extra meal, having a highly significant p-value of <0.001. With regards to physical activity, 110(64%) of mothers having placental weight <500, mild activity was observed and in 62(36%), moderate activity was reported. 07(25%) of mothers having placental weight >500 reported mild physical activity while 21(75%) reported moderate physical activity having a highly significant p-value of <0.001.

#### Discussion:

In a study of 1,031 pregnant mothers having a mean age of 31.3±3.9 years while the mean gestational age of babies were reported to be 39.5±1.8 weeks. The mean birth weight of the babies was recorded at 3.59±0.60 kg while the mean placental weight was recorded at 711±156gm. The study not only reported a significant difference between birth weight and placental weight but also showed that a significant difference existed between birth weight and parity, BMI, weight gain of mother during pregnancy, fasting plasma glucose levels.<sup>18</sup> In our study, the mean age 29.29±5.25 years with a mean gestational age was 37.14±1.65 weeks. The mean birth weight of 2.88±0.43 kg. Although our study also reported a significant difference between birth weight and placental weight, the difference between mean maternal age, gestational age between both studies might be a reason for increased

Table-1b: Descriptive analysis of maternal and fetal variables:

	Variable	Placental Weight		p-value
		<500 gm (n=172) n(%)	>500 gm (n=28) n(%)	
Infant Gender	Male	93(54.1)	16(57.1)	0.762
	Female	79(45.9)	12(42.9)	
Birth Weight	<1.5 kg	3(1.7)	1(3.6)	0.045
	1.5-2.5 kg	43(25.0)	13(46.4)	
	2.5 kg	126(73.3)	14(50.0)	
Spacing in Pregnancies	<24 Months	135(78.5)	26(92.9)	0.075
	>24 Months	37(21.5)	2(7.1)	
BMI before Pregnancy	13.5 to 24.9	44(25.6)	11(39.3)	0.238
	25 to 29.9	125(72.7)	16(57.1)	
	30 or more	3(1.7)	1(3.6)	
Hemoglobin	<10 mg/dl	39(22.7)	6(21.4)	0.047
	10-11 mg/dl	86(50.0)	20(71.4)	
	>11 mg/dl	47(27.3)	2(7.1)	
Status of Birth	Alive	121(70.3)	23(82.1)	0.196
	Dead	1(0.6)	1(3.6)	
	Preterm	19(11.0)	2(7.1)	
	Term	31(18.0)	2(7.1)	
Vitamin C Intake	Yes	172(100.0)	0(0.0)	<0.001
	No	28(100.0)	0(0.0)	
Iron Intake	Yes	171(99.4)	1(3.6)	<0.001
	No	1(0.6)	27(96.4)	
Meals Consumed	One Extra Meal Taken	130 (75.6)	7(25.0)	<0.001
	No Extra Meal Taken	42(24.4)	21(75.0)	
Physical Activity	Mild	110(64.0)	7(25.0)	<0.001
	Moderate	62(36.0)	21(75.0)	

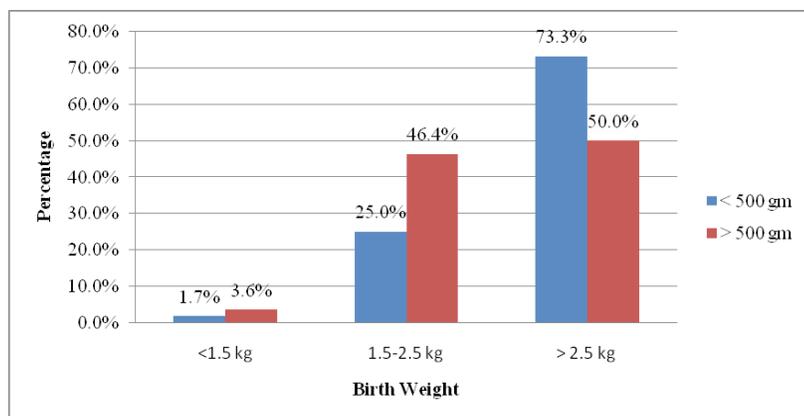


Figure 1: Association of birth weight with placental weight

birth weight and decreased placental weight in the above study as compared with our study.

The placental weight has been recognized as a significant independent determinant for both-birth weight and for fetal growth. Studies have reported that nutritional state of the pregnant women at the beginning of pregnancy is important for several measures of pregnancy outcome, including birth weight. BMI at the beginning of pregnancy may be considered as a surrogate for the nutritional status of the mother. Weight gain during pregnancy is related to fetal growth.<sup>19</sup> Our study only reported BMI of mothers before or at the start of pregnancy, however our study reported an in-significant difference between placental weight with BMI of mothers. It has been reported that maternal metabolic factors including BMI, weight gain and glucose values are modifiable determinants of fetal growth. Avoiding abnormal fetal growth may reduce the number of new born experiencing adverse outcome both in short and long term. However, findings indicate that placental weight markedly modifies the effect of determinants on both birth weight and fetal growth parameters.<sup>20</sup> Studies have reported that the placental weight is in close correlation with birth weight.<sup>21</sup> Similarly, our study also reported a strong association between placental weight and birth weight.

Placental efficiency is commonly defined by birth weight: placental weight ratio (BW: PW ratio) i.e., the grams of fetus produced per gram placenta.<sup>22</sup> Placental efficiency acts as a proxy measure of how placental development/function has adapted to meet fetal nutritional requirements. There is substantial evidence from studies that the placenta regulates its nutrient transfer efficiency by morphological and functional adaptations which result in optimal fetal growth.<sup>23</sup> In our study, mothers that have taken vitamin-C, iron supplements, consumed an extra meal per day showed a strong significance with association to placental weight of babies.

Wallace JM et al reported in a study that the placental weight and BW: PW ratio was greater in males although parity had no substantial effect.

This was in contrast that the placental weight in multiparous women was significantly heavier as compared with nulliparous women. In addition, placentas of males showed significant heaviness as regards to females but this effect was less marked as compared with that of parity.<sup>24</sup> Our study did not evaluate the association of birth weight: placental weight with regards to parity or gender.

The BW: PW differences by gender have been reported by a study by Almog et al. Although the study did not compare BW, PW ratio between males and females but did reported that the median placental weight at term was higher for males (679g) than for females (668g). Additionally, there was a correlation between gestational age and BW: PW ratio in both genders.<sup>12</sup>

One of the largest studies quoting BW: PW ratio examined over 500,000 singleton births. This study considered the relative risk of fetal death in the lowest and highest inters quartiles of BW: PW ratio in both pre-term (23–36 weeks) and term (37–42 weeks) pregnancies.<sup>17</sup> The decreased BW: PW ratio earlier in gestation in the small for gestational age group would be indicative of a fetus that is undergrown relative to placental size and thus imply functional inefficiency of the placenta, which may imply a pathological process.<sup>25</sup>

Even though our study findings have reported the various factors affecting birth, placental weight, however our study might not be immune from observer or selection bias. We did not evaluate the multiple causes of increased or decreased placental weight leading to changes in the birth weight.

### Conclusion:

It was concluded in our study that there is association of the placental weight and birth weight. It may be attributed to the consequences of growth of the fetus and improved nutritional status of the mother. Furthermore, it was predicted that nutritional status of the mother had a significant association with the placental weight.

Future Recommendations: Further studies in under-developed countries such as Pakistan to find the causes of variation in placental weight and its impact on not only birth weight or fetal well-being as well as maternal health would be enlightened to develop such strategies which may help to improve the overall health status of the pregnant mothers and fetus.

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### Role and contribution of authors:

Dr Saira Jamshed, conceived the study, data collection, study design, manuscript writing, wrote discussion.

Dr Farah Khan, helped in manuscript writing, data collection, design of study, and also helped in discussion writing.

Dr Naureen Waleem, helped in writing the introduction and also helped in collecting references.

Dr Munira Murtaza Khomusi, helped in discussion writing and also helped in literature search.

Adnan Anwar, statistical analysis, and critically review the article.

Dr Zainab S Khan, helped in collection the references.

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