

# Morphometrical Changes in Placenta of Undernourished Mothers and It's Effect on Foetal Weight

Kiran Kumar P<sup>1</sup>, Raj Kumar Srivastava<sup>2</sup>, Shirin Jahan<sup>2</sup>, Sapna Singh<sup>3</sup>

<sup>1</sup>.Ph.D. Scholar, Department of Anatomy, <sup>2</sup>Professor, Department of Anatomy, <sup>3</sup>Associate Professor, Department of Obstetrics & Gynecology, Rama Medical College, Hospital and Research Centre, Kanpur, Rama University (India).

Corresponding Author: Kiran Kumar P

## ABSTRACT

**Introduction:** Placenta is a membranous vascular organ that develops in female mammals and mediates maternofoetal exchange of gases, nutrients and metabolites. The examination of placenta during period of pregnancy and post-partum provides valuable information about the state of foetus well-being. Maternal nutrition during pregnancy has a pivot role in the regulation of placental-fetal development, there by affects the lifetime health and yield of offspring.

**Materials and methods:** In the present study 194 placentae were collected under 2 groups. Group-I (Control group): normal pregnant women. Group II (Study group) consists of Subgroup IIA - Undernourished mothers with anaemia, Subgroup-IIB: Undernourished mothers without anaemia, Subgroup-IIC: Anaemic mothers with pre-pregnancy BMI>18.5kg/m<sup>2</sup>. Out of 194 placentae, 92 were of group I, 41 of group IIA, 15 were of group IIB and 46 were of IIC.

**Results:** The weight, diameter, the number of maternal cotyledons of placentae and fetal weight were significantly decreased in undernourished group particularly in undernourished mothers with anemia (Subgroup IIA).

**Conclusion:** Within the limitations of the present study it can be concluded that in undernourished mothers, there was reduction of placental weight, placental diameter, and the number of maternal cotyledons leads to placental insufficiency which impact on the foetal growth resulting to low birth weight.

**Key Words:** Placenta, undernourished mothers, anaemia, morphometric changes, foetal weight

## INTRODUCTION

Placenta is a membranovascular organ that develops in female mammals and mediates maternofoetal exchange. In humans, it is developed from two sources – foetal and maternal. <sup>[1]</sup> Survival and growth of foetus are essentially dependent on the formation, full development, and functioning of the placenta. It undergoes different changes in weight, volume, structure, shape, and functions continuously throughout the gestation to support the

prenatal life. <sup>[2]</sup> The examination of placenta during period of pregnancy and post-partum provides valuable information about the state of foetus well-being. It depicts the most accurate record of the prenatal experience of an infant. <sup>[3]</sup> Careful examination of the placenta can give information which can be useful in the management of complications in mother and new born. <sup>[4]</sup>

Malnutrition is like an iceberg, most people in the developing countries like India

live under the burden of malnutrition. Pregnant women, nursing mothers and children are particularly vulnerable to the effect of malnutrition. The adverse effects of maternal malnutrition have been well-documented maternal depletion, low birth weight, anaemia, toxemia of pregnancy, postpartum hemorrhage, all leading to high mortality and morbidity of mother as well as neonates. Previously, it was thought that malnutrition was largely concentrated in school age children and the toddlers. Now it is realized that the intrauterine period of life is a very important period from the nutritional viewpoint. [5] Maternal nutrition during pregnancy has a pivot role in the regulation of placental-fetal development, there by affects the lifetime health and yield of offspring. [6] According to NFHS 2005-06, malnutrition among married women in India is 20.8%, where as in Uttar Pradesh state is 18.5%. [7]

Malnutrition results from eating a diet in which nutrients are either not enough or excessive which leads to health complications. [8,9] It may involve calories, proteins, carbohydrates, vitamins or minerals. [9] If not enough nutrients are called undernutrition while excessive are called overnutrition. [10] Malnutrition frequently is used to denote the undernutrition where there are insufficient calories, protein or micronutrients. [10,11] If undernourishment during either pregnancy or two years before pregnancy, it may result in lifelong problems with physical and mental development of foetus. [9]

World Health Organization (WHO) definition for underweight/undernutrition is BMI <18.50kg/m<sup>2</sup>. Undernutrition could be classified as mild, moderate and severe. The BMI level for each class of undernutrition in pre-pregnancy are 17.00-18.49kg/m<sup>2</sup> (mild), 16.00-16.99kg/m<sup>2</sup> (moderate) and <16.00kg/m<sup>2</sup> (severe). [12]

According to 2009 IOM/NRC guidelines for rate of total weight gain during pregnancy for women with singleton fetus are: [13]

Underweight (< 18.5 kg/m<sup>2</sup>) ----- 28–40lb (12.7Kg -18.1Kg)

Normal-weight (18.5–24.9 kg/m<sup>2</sup>) ----- 25–35lb (11.3Kg-15.8Kg)

World Health Organization (WHO) definition for anaemia in pregnant women is Haemoglobin (Hb) level <11g/dl. [14]

## MATERIALS AND METHODS

This study was conducted at the Department of Anatomy, Rama Medical College, Hospital and Research Centre, Rama University, Kanpur (India). The material for the study consists of 194 placentae collected from the department of Obstetrics and Gynecology at Rama hospital with permission from the institutional ethical committee and consent of mothers. In the present study, 2 groups were made. Control group (Group I): normal pregnant women (Prepregnancy BMI between 18.5 kg/m<sup>2</sup> - 25 kg/m<sup>2</sup>, Total weight gain during pregnancy between 11.3Kg – 15.8Kg and Hb level is >11grms/dl). Study group (Group II) consist of subgroup IIA - Undernourished mothers with anaemia (Pre-pregnancy BMI <18.5 kg/m<sup>2</sup>, Total weight gain during pregnancy <12.7Kg and, Hb level is <11grms/dl) Subgroup-IIB: Undernourished mothers without anaemia: (Pre-pregnancy BMI <18.5 kg/m<sup>2</sup>, total weight gain during pregnancy <12.7Kg and, Hb level is >11g/dl). Subgroup-IIC: Anaemic mothers with pre-pregnancy BMI>18.5kg/m<sup>2</sup>. Out of 194 placentae, 92 were of group I, 41 of group IIA, 15 were of group IIB and 46 were of IIC. Non-anaemic mothers with pre-pregnancy BMI >25kg/m<sup>2</sup> and Antenatal mothers suffering from preeclampsia and eclampsia were excluded from this study. The specimens were washed under running tap water to remove the blood clots and examined the placentae for the following morphometrical data: Weight, diameter, the number of maternal cotyledons. Placental weight measured in grams by weighing machine. The diameter of the placenta (d) was taken by the mean of the two maximum diameters in centimeters right angles to each other by metallic scale. The number of maternal cotyledons has counted on the maternal surface. Fetal

weight also examined in grams by weighing machine.

## RESULTS

The present study revealed the morphometrical changes in the placenta of undernourished mothers. In this study, analysis of placental weight, diameter, the number of maternal cotyledons and fetal weight is demonstrated in Table 1. The difference in weight of placenta was statistically significant between group I and subgroup IIA ( $p < 0.0001$ ), group I and group IIB ( $p = 0.0146$ ). But the borderline difference can be seen between group I and subgroup IIC ( $p = 0.0528$ ). The difference in

diameter of placenta was statistically significant between group I and subgroup IIA ( $p < 0.0001$ ), group I and group IIB ( $p = 0.0107$ ), group I and subgroup IIC ( $p = 0.0086$ ). The difference in the number of maternal cotyledons was statistically significant between group I and subgroup IIA ( $p < 0.0001$ ), group I and group IIB ( $p = 0.0013$ ), but not significant between group I and subgroup IIC ( $p = 0.1547$ ). The difference of fetal weight was statistically significant between group I and subgroup IIA ( $p < 0.0001$ ), group I and group IIB ( $p = 0.001$ ), group I and subgroup IIC ( $p = 0.03$ ) (Table 2).

TABLE: 1

VARIABLES	CONTROL GROUP-I (n=92)	GROUP-II		
		SUBGROUP-IIA (n=41)	SUBGROUP-IIB (n=15)	SUBGROUP-IIC (n=46)
Placental weight in grams	475.65+/-83.02	392.17+/-103.63	416.2+/-103.22	445.67+/-88.77
Placental Diameter in cm	17.01+/-1.63	15.47+/-1.92	15.71+/-2.63	16.25+/-1.47
No. of Maternal Cotyledons	23.02+/-5.48	17.17+/-5.02	18.2+/-3.18	21.73+/-3.82
Fetal weight in grams.	2804.89+/-373.13	2367.19+/-411.07	2444.66+/-446.42	2661.28+/-388.8

TABLE: 2

Variables	Group I Vs. Subgroup IIA	Group I Vs. Subgroup IIB	Group I Vs. Subgroup IIV
Placental weight in grams	<0.0001	0.0146	0.0528
Placental Diameter in cm	<0.0001	0.0107	0.0086
No of Maternal Cotyledons	<0.0001	0.0013	0.1547
Fetal weight in grams.	<0.0001	0.001	0.0374

## DISCUSSION

The placenta is an important vital organ between the mother and fetus for the purpose of physiological transfer of nutrients and oxygen from mother to fetus. The present study has been conducted to compare the morphometrical changes of the placenta and fetal weight between normal and undernourished mothers. The weight, diameter, the number of maternal cotyledons of the placenta and fetal weight were statistically decreased in undernourished group particularly in undernourished mothers with anemia (Subgroup IIA). Several studies were conducted regarding the weight of placenta in anemic mothers; few studies exhibited increased placental weight while some other studies had shown decrease in placental weight. Lao and Wong 1997, Sharmistha Biswas et al., 2014, Danial et al., 2015 observed that mean placental weight was significantly increased in anaemia. [14-16]

Lao and Tam 2000, observed increase in placental size relative to infant size in pregnancies complicated by anaemia, but whether this phenomenon reflected actual placental hypertrophy or failure of fetal growth to keep up with placental growth has to be determined. [17] Beischer et al., (1970) analyzed data and demonstrated that in all the studies, placental weight in maternal anemia was higher than the control. This increase in placental weight was higher with increasing parity. The placental hypertrophy did not correspond to the foetal size and had no correlation with maternal serum protein, [18] where as in the study of Krishna M, Agarwal KN (1979), placental weight was significantly reduced in malnourished mother and this reduction is due to decrease in cell number. [19] Soni et al., (2016) also observed that the mean placental weight was reduced in malnourished mothers. [20] K.N Agarwal et al., (2013) reported that maternal anemia was associated with low maternal

serum albumin. Both deficiencies were associated with the reduced weight of placenta. [21] Mongia et al., (2011) found that there was a significant decrease in placental weight with the severity of anaemia. [22] Rohini et al., (2013) and Dhall (1994) also concluded that the weight of placenta was reduced in the anaemic group. [23,24] J. C Osgerby et al., (2004) observed in the study of pregnant ewes that total placental weight tended to be lower in undernourished ewes. [25] Khalida Khadhim, Hassna Bader Jawad (2007) observed that reduction of placental weight in mice due to maternal protein free diet supplementation. [26] In the present study, it was found that reduced placental weight in the undernourished group than control group. In the undernourished group, mean placental weight is greatly reduced in SG-IIA than the SG-IIB and SG-IIC.

Mahamuda begum et al., (2009) studied that diameter of placenta was significantly greater in anaemic groups than the control group, [27] whereas, Danial et al., (2015) observed that the mean diameter of the placenta is decreased significantly in anaemia as compared to normal pregnancy. [16] In the study of Soni et al., (2016), the mean placental diameter was reduced in malnourished mothers. [20] In the present study, the diameter of placenta was statistically reduced in undernourished mothers particularly in undernourished with anemia with statistically highly significant ( $<0.0001$ ).

In the study of Murthy et al., (1976), maternal cotyledons were significantly decreased in maternal malnutrition, [28] whereas Daniel et al., (2015) observed that the mean number of cotyledons increased in anaemic group than control group. [16] The present study revealed that maternal cotyledons were statistically reduced than the control group ( $P<0.0001$ ). This study correlated with the study of Murthy et al 1976. [28] Normal Pre-pregnancy weight, body mass index (BMI) and proper gestational weight gain altogether have strong, positive effects

on foetal growth suggesting that energy balance is an important determinant of birth outcomes. [29,30]

Bell (2002) and Barkar (1997) stated that maternal undernutrition during gestation reduces the placental and fetal growth of both domestic animals and humans. [31,32] Sharmista Biswas et al., (2014) mean fetal weight in maternal anaemia group was significantly less than that of the control group. [15] Sony et al., (2016) found that mean foetal weight was decreased in malnourished mothers. [20] Present study also revealed that foetal weight was reduced in maternal undernutrition which is statistically highly significant in undernourished with anemia ( $p<0.0001$ ) which is correlated with studies of Bell, [31] Barkar, [32] Sharmista Biswas [15] and Sony et al. [20]

## CONCLUSION

Within the limitations of the present study it can be concluded that maternal undernutrition causes the reduction of placental weight, placental diameter, and number of maternal cotyledons leads to placental insufficiency which impact on the foetal growth resulting to low birth weight.

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