# The effects of maternal Body Mass Index on placental morphology and foetal birth weight: a study from Dodoma Central Region,Tanzania

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**Introduction:** The placenta plays a pivotal role during pregnancy by being intimately connected to the mother and foetus.

**Objective:** To determine the effects of maternal Body Mass Index (BMI) on placental morphology and foetal birth weight.

**Method:** The placental samples were obtained with consent from 236 mothers with a singleton full term pregnancy and who had a live birth between January 2017 and June 2018. Statistics on maternal BMI, placental morphology and foetal birth weight were collected and analysed using SPSS version 20 for Window (SPSS Inc., Chicago, IL, USA).

**Results:** The mean maternal BMI was 24.25 ± 131.605 and was positively correlated with the foetal birth weight (r=0.66; p<0.001), number of cotyledons (r=0.71, p<0.001), placental weight (r=0.50; p <0.001) and placental thickness (r=0.42; p<0.001).

**Conclusion:** The study supports the hypothesis that maternal factors which are known to influence foetal growth, birth weight and neonatal body composition are also the determinants of the placental morphology. Therefore, all the parameters can be clinically used in the prediction of birth outcome

**Key words:** placenta, morphology, birth weight, maternal BMI, Tanzania

## INTRODUCTION

The wellbeing of the foetus is influenced by a number of factors[1] including maternal characteristics, the placenta and umbilical cord morphology and functions.[2]

The placenta is a fantastic organ yet often neglected due to its transient existence; it performs functions that are later taken on by separate organs, including the lungs, liver, gut, kidneys and endocrine glands.[3] It is the interface between mother and foetus and influences maternal and newborn mortality.[4]

Careful examination of the placenta can shed light on the in-utero environment of the foetus [5, 6] and can help to explain an abnormal neonatal outcome and might have consequences for treatment.[8,7] It might identify a risk of recurrence resulting in preventive measures during subsequent pregnancies.[8] However, there is evidence that the quality of the investigations of the placenta is very variable.[7]

## OBJECTIVE

To determine the effects of maternal (BMI) on placental morphology and foetal birth weight.

## METHOD

Gravid mothers at full term admitted to the labour wards of Dodoma Regional Referral Hospital, Chamwino District Hospital and Makole Urban Health Centre, for spontaneous vertex delivery were selected through simple random sampling. With the mothers' consent the freshly delivered placentas were examined consecutively until the sample size of 236 was achieved. The mothers were weighed prior to delivery (with 12 kg deducted to give pre-pregnancy

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**Table 1. The demographics and clinical characteristics of the mothers (n=236)**

| Characteristics | n (%) |
|---|---|
| **Age years** | |
| 18-24 | 136 (57.6) |
| 25-31 | 56 (23.7) |
| 32-38 | 34 (14.4) |
| 39 and above | 10 (4.3) |
| **Parity** | |
| Primipara | 117 (49.6) |
| Multipara | 119 (50.4) |
| **Gestation age weeks** | |
| 37-39 | 155 (65.7) |
| 40-42 | 81 (34.3) |
| **BMI** | |
| <18.5=Underweight | 20 (8.5) |
| 18.5-24.9=Normal | 208 (88.1) |
| 25.0-29.9=Overweight | 8 (3.4) |

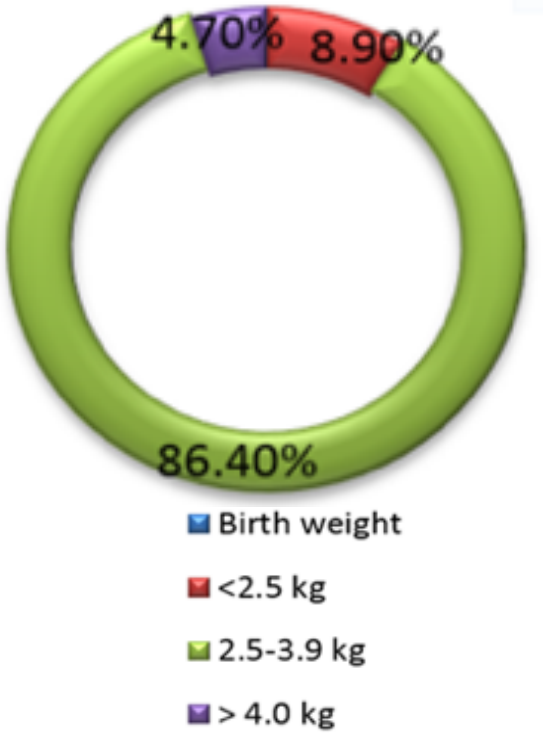


*Figure 1. Neonatal birth weights*

**Table 2. Chi-square analysis of the maternal BMI versus morphology of the placenta and foetal birth weight.**

| | BMI | | | Chi-Square | |
|---|---|---|---|---|---|
| **Placental morphology** | **Underweight n %** | **Normal weight n %** | **Overweight n %** | **Chi-Square test** | **p-value** |
| **Weight of placenta g** | | | | | |
| <400 | 16 (61.5%) | 10 (38.5%) | 0 (0.0%) | 112.017a | 0.001 |
| 400-700 | 3 (1.5%) | 187 (95.4%) | 6 (3.1%) | | |
| ≥701 | 1 (7.1%) | 11 (78.6%) | 2 (14.3%) | | |
| **No. of cotyledons** | | | | | |
| <15 (few cotyledons) | 16 (88.9) | 2 (11.1%) | 0 (0.0%) | 162.466a | 0.001 |
| 15-25(normal no. of cotyledons) | 4 (1.8%) | 206 (94.5%) | 8 (3.7%) | | |
| **Placental thickness** | | | | | |
| <2.0 cm (thin) | 9 (56.2%) | 7 (43.8%) | 0 (0.0%) | 58.859a | 0.001 |
| 2.0-4.0 cm (normal) | 11 (5.1%) | 199 (91.7%) | 7 (3.2%) | | |
| ≥4.1cm (thick) | 0 (0.0%) | 2 (66.7%) | 1 (33.3%) | | |
| **Diameter of the placenta** | | | | | |
| 11-22 cm (normal) | 20 (8.8%) | 201 (88.2%) | 7 (3.1%) | 2.730a | 0.255 |
| ≥23 cm (large) | 0 (0.0%) | 7 (87.5%) | 1 (12.5%) | | |
| **Cord length** | | | | | |
| <31cm (short) | 0 (0.0%) | 3 (100.0%) | 0 (0.0%) | 2.717a | 0.606 |
| 32-70 cm (normal) | 19 (9.3%) | 178 (86.8%) | 8 (3.9%) | | |
| >70 cm (long) | 1 (3.6%) | 27 (96.4%) | 0 (0.0%) | | |

| | | | | | |
|---|---|---|---|---|---|
| **Cord diameter** | | | | | |
| <1 cm (thin) | 0 (0.0%) | 1 (100.0%) | 0 (0.0%) | 0.829a | 0.935 |
| 1-2 cm (normal) | 20 (8.7%) | 202 (87.8%) | 8 (3.5%) | | |
| >2 cm (thick) | 0 (0.0%) | 5 (100.0%) | 0 (0.0%) | | |
| **No. of umbilical vessels** | | | | | |
| 2 vessels (SUA) | 0 (0.0%) | 6 (100.0%) | 0 (0.0%) | 0.829a | 0.661 |
| 3 vessels (normal) | 20 (8.7%) | 202 (87.8%) | 8 (3.5%) | | |
| **Cord around the neck** | | | | | |
| Yes | 1 (2.3%) | 43 (97.7%) | 0 (0.0%) | 4.853a | 0.088 |
| No | 19 (9.9%) | 165 (85.9%) | 8 (4.2%) | | |
| **Cord entanglement** | | | | | |
| Yes | 0 (0.0%) | 16 (94.1%) | 1 (5.9%) | 1.963a | 0.375 |
| No | 20 (9.1%) | 192 (87.7%) | 7 (3.2%) | | |
| **Cord insertion** | | | | | |
| Centric | 0 (0.0%) | 5 (100.0%) | 0 (0.0%) | 3.430a | 0.489 |
| Eccentric | 20 (9.4%) | 185 (86.9%) | 8 (3.8%) | | |
| Marginal | 0 (0.0%) | 18 (100.0%) | 0 (0.0%) | | |
| **Newborn weight** | | | | | |
| <2.5 kg (underweight) | 17 (81.0%) | 4 (19.0%) | 0 (0.0%) | 175.792a | 0.001 |
| 2.5-3.9 kg (normal weight) | 3 (1.5%) | 196 (96.1%) | 5 (2.5%) | | |
| ≥4.0 kg (big baby) | 0 (0.0%) | 8 (72.7%) | 3 (27.3%) | | |

weights) and their BMIs calculated.

The nurse-midwife who delivered the placenta gave it to the researcher who cleaned off the blood using running tap water. The placenta was put in a plastic bag and weighed, using a scale which recorded to 0.01 kg, after the umbilical cord was cut 3 cm from the neonate (after the cord had been measured). Cord length was considered short when< 32 cm and long when>70 cm.

Data management and analysis were performed using Statistical Package for Social Sciences (SPSS) version 20 and the results presented in frequency tables; bivariate analyses were conducted to determine the effects of maternal BMI on placental morphology and foetal birth weight.

## RESULTS

Table 1 shows the age, parity, gestation age and BMI of the mothers.

Twenty six (11%) of the placentas weigh <400g, and 14 (5.9%) weigh >701g. Most of the placentas 196 (83%) were of normal weight (400 - 700g); the range was 210-1000 g and the mean weight was 524.24 ± 131.605 g.

Most (92.4%) of the placentas had a normal cotyledon count (15-25 cotyledons), the range was 12 – 25 cotyledons and the mean cotyledon count was 19.61 ± 2.895; most (96.8%) had the normal range of thickness of 2 – 4 cm with a mean of 2.888 ± 0.6472 cm and most (96.6%) had a diameter in the normal range of 11 – 22 cm with a mean of 16.86 ±2.359 cm. Most (86.9%) umbilical cords had a normal length of 32 – 70cm with a mean of 57.102 and ± 11.5739 cm. Most (90.3%) had eccentric umbilical cord insertions in the chorionic plate.

Half (50.4%) of the 236 neonates were female and 49.6% were male. Figure 1 shows that the majority had a normal birth weight of 2.5 - 3.9 kg; the mean birth weight was 3.051±0.051.

Table 2 shows that there was a significant association between maternal BMI and morphology of the placenta:

- Out of 26 low weight placentas (<400 grams), 61.5% were from underweight mothers (p<0.001).
- Among 16 placentas with a number of cotyledons below normal, 88.9% of them were from the mothers who were underweight (p<0.001).
- Out of 16 placentas less than 2.0cm, 56.2% were from underweight mothers (p<0.001).

The placental diameter, umbilical cord length, umbilical cord diameter, number of umbilical vessels, cord insertion and status of the cord did not show any association with the maternal BMI (p=0.489).

**Table 3. Relationship of maternal BMI versus placental morphology versus foetal birth weight**

| Variable 1 | Variable 2 | Pearson's r | P-value |
|---|---|---|---|
| Body Mass Index vs | Foetal birth weight (kg) | 0.66* | <0.001** |
| | Cotyledons count (n) | 0.71* | <0.001** |
| | Placental weight (g) | 0.50* | <0.001** |
| | Placental thickness (cm) | 0.42 | <0.001** |

There was a significant association between maternal BMI and birth weight since out of 21 babies who were underweight 17 (81.0%) were from underweight mothers (p<0.001).

The relationship between maternal BMI, placenta morphology and foetal birth weight was investigated using Pearson's correlation. Table 3 shows that maternal BMI was positively correlated with the foetal birth weight.

## DISCUSSION

In our study the mean placental weight was 524 ± 132 g. We found a significant positive correlation between maternal BMI with placental weight (50%), and foetal birth weight (66%). This suggests that maternal underweight is an indication of low placental indices and this results in low foetal birth weight. Thus the results are compatible with the concept that some of the effects of BMI on foetal birth weight are mediated through the promotion of placental growth.

## CONCLUSION

The study supports the hypothesis that maternal factors which are known to influence foetal growth, birth weight and neonatal body composition are also the determinants of the placental morphology. Therefore, all the parameters can be clinically used in the prediction of birth outcome.

## RECOMMENDATIONS

Better understanding of the placenta is needed. Therefore, it is recommended that, midwives, doctors and delivery assistants should check the placenta to make sure it is complete because if some is missing the woman is in danger of bleeding or infection. If anything unusual is noticed it should be documented with measurements and photographs if possible. In places where there are sophisticated scans showing things like placental blood flow and growth of the foetus information gained allows more individual diagnosis and management of problems. Therefore the relevant authorities should encourage protocols and develop guides/checklists for placenta examination in health facilities.

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**Competing interest**

The authors declare that they have no competing interests.

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