



## The Effects of Cotyledons Count and Maternal Body Mass Index on Foetal Birth Weight: A Cross-sectional Study of Hospital-based in Dodoma central Region of Tanzania

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### Abstract

**Introduction:** The placenta is a fascinating organ of foetal origin; it plays a pivotal mediatory role during pregnancy by being intimately connected to the mother and foetus.

**Objectives:** To determine the effects of Cotyledons Count and Maternal Body mass index on Foetal Birth Weight.

**Methods:** Descriptive and inferential statistics for morphology of the placenta on foetal birth weight were done. A checklist was used for data collection. Data were analysed using SPSS version 20 for Window (SPSS Inc., Chicago, IL, USA). Frequency tables were generated and bivariate analyses were conducted to determine the effects of cotyledons count on foetal birth weight in Dodoma region, Tanzania using chi-squared statistics.

**Results:** Out of 236 women with singleton pregnancy at full term and live birth were recruited for the study and the findings showed that the mean score of the maternal BMI was  $24.25 \pm 131.605$ , which was positively correlated with cotyledons count which was again correlated positively with the foetal birth weight ( $R = 0.66$ ;  $p < 0.001$ ), number of cotyledons ( $R = 0.71$ ,  $p < 0.001$ ).

**Conclusion:** The maternal BMI, cotyledons count is positively correlation with foetal birth weight.

**Keywords:** Cotyledons; BMI; Birth Weight

### Introduction

The wellbeing of the foetus is influenced by a number of factors [9] including maternal characteristics, the placenta 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 [4]. It is the interface between mother and foetus and influences maternal and newborn mortality [3].

Careful examination of the placenta can shed light on the in-utero environment of the foetus [5] and can help to explain an abnormal neonatal outcome and might have consequences for treatment. It might identify a risk of recurrence resulting in preventive measures during subsequent pregnancies [13]. However, there is evidence that the quality of the investigations of the placenta is very variable [10].

### Objective of the Study

To determine the effects of cotyledons count and maternal body mass index on foetal birth weight.

### Methods

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 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 Cotyledons Count and Maternal Body mass index on Foetal Birth Weight.

### Results

The majority (58%) were in the age group between 18 - 24 while the rest were (24%) in the age group between 23 - 31, (14%) in the age group between 32 - 38, (4.2%) in the age group between 39 and above. The mean age of the mothers was 25.11 and the median 23.00 ± 6.625. Most of the study participants (47%) had primary education while a lesser proportion of the respondents (6%) had tertiary education.

The maternal body mass index was measured and the majorities (88%) of the study participants were within 18 - 24.9 which are normal ranges of body mass index, (9%) of the pregnant women were below 18.5 and were underweight, and the lesser proportion of (3%) was overweight at the ranges between 25.0 - 29.9 (Table 1).

Table 2 shows the ranges of placental indices, the findings of the current study showed that (n = 236) out of the total placentas, (11%) of placentas were classified as low weight placentas because they weighed below 400grams. Whereas those placentas which had normal weight constituted (83%) and the range was 400 - 700grams. Finally, those which were classified to have high weight constituted (6%) and had 701grams and above. The number of cotyledons was also examined and the findings showed that

(7.6%) of the placentas were classified as having low cotyledons count less than 15, (92.4%) of the placentas were classified as normal because the number ranged between 15 - 25 cotyledons. The range of the number of cotyledons was 12 - 25 whereas the mean cotyledon count was 19.61 ± 2.895 (Table 2).

Characteristics	Frequency	Percentage
<b>Age</b>		
18 - 24	136	57.6
25 - 31	56	23.7
32 - 38	34	14.4
39 and above	10	4.2
<b>Level of education</b>		
None	61	25.8
Primary	110	46.6
Secondary	51	21.6
Tertiary	14	5.9
<b>Marital status</b>		
Single	45	19.1
Married	189	80.1
Divorced/separated	2	0.8
<b>Parity</b>		
Primipara	117	49.6
Multipara	119	50.4
<b>Gestation age</b>		
37 - 39	155	65.7
40 - 42	81	34.3
<b>Occupation</b>		
Unemployed	218	92.4
Employed	18	7.6
<b>Antenatal visits</b>		
Early visit	8	3.4
Late visit	98	41.5
Complete visit	130	55.1
<b>BMI</b>		
< 18.5 = Underweight	20	8.5
18.5 - 24.9 = Normal	208	88.1
25.0 - 29.9 = Overweight	8	3.4
<b>PMTCT</b>		
One	5	2.1
Two	231	97.9
<b>ART Use</b>		
Yes	5	2.1
No	231	97.9

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

Variable	Frequency	Percentage
<b>Weight of the placenta</b>		
< 400 gms	26	11.0
400 - 700 gms	196	83.1
701gms	14	5.9
<b>Number of cotyledons</b>		
< 15 = Few cotyledons	18	7.6
15 - 25 = Normal	218	92.4
<b>Cord Length</b>		
< 32 cm = Short	3	1.3
32 - 70 cm = Normal length	205	86.9
> 70 cm = Long cord	28	11.8
<b>Cord around the neck</b>		
Yes	44	18.6
No	192	81.4
<b>Cord Entanglement</b>		
Yes	17	7.2
No	219	92.8
<b>Cord insertion</b>		
Centric	5	2.1
Eccentric	213	90.3
Marginal	18	7.6

**Table 2:** The spectrum of placental and umbilical cord indices.

**The association between maternal nutritional status based on body mass index versus morphology of the placenta**

When maternal body mass index and morphology of the placenta were analysed using chi-square to find the association between them, there was a significant association between maternal body mass index and morphology of the placenta since out of 26 low weight placentas with (< 400 grams), (61.5%) placentas were from underweight mothers ( $p < 0.001$ ). Similarly the number of cotyledons had an association with the maternal body mass index since the cotyledons with a few number were classified as less than 15 counts, thus among 18 placentas with few number of cotyledons below normal, (88.9%) of them were from the mothers who were underweight ( $p < 0.001$ ) (Table 4).

**The association between morphology of the placenta and foetal birth weight**

There was a significant positive association between the weight of the placenta and weight of the baby since out of 21 underweight babies, (61.5%) of them had low weight placentas below <400 grams ( $p < 0.001$ ). Similarly, the association between number of cotyledons and newborns birth weight was evident since the results showed that out of 21 underweight newborns, (94.4%) of them had the placentas with a few number of cotyledons below normal ( $p < 0.001$ ) (Table 5).

Variable	Mean	±SD	Max	Min	SE	Mode	Median	95% CI	
								Lower	Upper
Maternal age	25.11	6.625	48	18	0.431	18	23.00	24.6	25.96
BMI	22.64	2.805	32.0	18.0	0.160	24.8	23.400	-1.832	-1.201
Apgar in 5 <sup>th</sup> minute	8.76	1.162	10	3	0.08	9	9.00	0.11	0.41
Birth weight	3.051	0.511	4.6	1.5	0.033	3.0	3.000	-0.715	-0.584
Placental weight	524.24	131.61	1000	210	8.567	500	500.00	-42.64	-8.89
Cotyledons count	19.61	2.895	26	12	0.19	20	20.00	-0.76	-0.2
Cord length	57.10	11.574	99.0	29.0	0.753	59.0	56.000	-0.383	2.586

**Table 3:** Shows the descriptive statistics of maternal, foetal and placental indices (N = 236).

Variable	BMI			P-value
	Underweight n(%)	Normal weight n(%)	Overweight n(%)	
<b>Placenta Morphology</b>				
<b>Weight of placenta</b>				
< 400g	16 (61.5%)	10 (38.5%)	0 (0.0%)	
400 - 700g	3 (1.5%)	187 (95.4%)	6 (3.1%)	<0.001
701 and above	1 (7.1%)	11 (78.6%)	2 (14.3%)	
<b>No. of cotyledons</b>				
< 15 = Few cotyledons	16 (88.9%)	2 (11.1%)	0 (0.0%)	
15 - 25 = Normal cotyledon	4 (1.8%)	206 (94.5%)	8 (3.7%)	<0.001
<b>Cord length</b>				
< 31 cm = Short	0 (0.0%)	3 (100.0%)	0 (0.0%)	
32 - 70 cm = Normal	19 (9.3%)	178 (86.8%)	8 (3.9%)	0.606
> 70 cm = Long	1 (3.6%)	27 (96.4%)	0 (0.0%)	
<b>Cord around the neck</b>				
Yes	1 (2.3%)	43 (97.7%)	0 (0.0%)	
No	19 (9.9%)	165 (85.9%)	8 (4.2%)	0.088
<b>Cord entanglement</b>				
Yes	0 (0.0%)	16 (94.1%)	1 (5.9%)	
No	20 (9.1%)	192 (87.7%)	7 (3.2%)	0.375
<b>Cord insertion</b>				
Centric	0 (0.0%)	5 (100.0%)	0 (0.0%)	
Eccentric	20 (9.4%)	185 (86.9%)	8 (3.8%)	0.489
Marginal	0 (0.0%)	18 (100.0%)	0 (0.0%)	

**Table 4:** The association between maternal nutritional status based on body mass index versus morphology of the placenta.

Variable	Birth weight			p-value
	< 2.5 kg Underweight n (%)	2.5 - 3.9 kg Normal weight n (%)	4.0 kg and above Big baby n (%)	
<b>Placenta Morphology</b>				
<b>Weight of placenta</b>				
< 400 grams	16 (61.5%)	10 (38.5%)	0 (0.0%)	<0.001
400 - 700 grams	4 (2.0%)	187 (95.4%)	5 (2.6%)	
701 and above	1 (7.1%)	7 (50.0%)	6 (42.9%)	
<b>No. of cotyledons</b>				
< 15 = Few cotyledons	17 (94.4%)	1 (5.6%)	0 (0.0%)	<0.001
15 - 25 = Normal number	4 (1.8%)	203 (93.1%)	11 (5.0%)	
Above 25 = Many cotyledons	0 (0.0%)	0 (0.0%)	0 (0.0%)	
<b>Cord length</b>				
< 31 cm = Short	0 (0.0%)	3 (100.0%)	0 (0.0%)	0.407
32 - 70 cm = Normal	20 (9.8%)	177 (86.3%)	8 (3.9%)	
> 70 cm = Long	1 (3.6%)	24 (85.7%)	3 (10.7%)	

<b>Cord around the neck</b>				
Yes	1 (2.3%)	39 (88.6%)	4 (9.1%)	0.083
No	20 (10.4%)	165 (85.9%)	7 (3.6%)	
<b>Cord entanglement</b>				
Yes	0 (0.0%)	15 (88.2%)	2 (11.8%)	0.164
No	21 (9.6%)	189 (86.3%)	9 (4.1%)	
<b>Cord insertion</b>				
Centric	0 (0.0%)	5 (100.0%)	0 (0.0%)	0.703
Eccentric	20 (9.4%)	182 (85.4%)	11 (5.2%)	
Marginal	1 (5.6%)	17 (94.4%)	0 (0.0%)	

**Table 5:** Relationship between the morphology of the placenta and foetal birth outcome as signalled by birth weight.

**Summary of the Relationship of Major Maternal, Placental and Foetal Outcomes**

The relationship between maternal BMI, the morphology of the placenta and foetal birth weight was investigated using Pearson’s correlation. The findings showed that maternal body mass index 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 ( $R = 0.50$ ;  $p < 0.001$ ).

Finally, the placental weight was positively correlated with the foetal birth weight ( $R = 0.58$ ;  $p < 0.001$ ) hence the heavier the placenta the higher the number of cotyledons ( $R = 0.51$ ;  $p < 0.001$ ). Due to the strong correlation between placental weight and cotyledons count, the later was also positively correlated with foetal birth weight ( $R = 0.71$ ;  $p < 0.001$ ) (Table 6).

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**
Placental weight (g) vs	Foetal birth weight (kg)	0.58*	<0.001**
	Cotyledons count (n)	0.51*	<0.001**
	Apgar score 1 <sup>st</sup> min	-0.01	0.88
	Apgar score 5 <sup>th</sup> minute	-0.04	0.62
Cotyledons count (n) vs	Foetal birth weight (kg)	0.71*	<0.001**
	Apgar score 1 <sup>st</sup> min	0.11	0.10
	Apgar score 5 <sup>th</sup> min	0.10	0.13

**Table 6:** The results of Pearson’s correlation showing the summary of the relationship of maternal body mass index versus placental morphology versus foetal birth weight.

Key: \*\*Statistically significant correlation, \*Strong correlation.

**Discussion and Conclusion**

In this study, the percentage distribution of underweight and overweight mothers based on BMI was (8.5%) and (3.4%) respectively. The birth weight is a straight forward measure of birth outcome and it is affected by several factors. In this study, the reference means were as follows; placenta weight of  $524 \text{ g} \pm 132$ , mean cotyledons count of  $19.6 \pm 2.9$ . This is in line with [8] who found mean placental weight of  $528 \pm 11.09\text{g}$ , the mean cotyledon count of  $18.5 \pm 2.2$ , and mean placental diameter of  $18.48 \pm 2.09 \text{ cm}$ .

The results of this study were compared with the findings of previous work of other authors who obtained the mean placenta weight of  $580.8 \pm 130.6\text{g}$  [1] and  $578.8 \pm 8\text{g}$  [6]. The findings of the current study are consistent with those by [12] who revealed  $579.7 \pm 142\text{g}$ .

In the present study, there was a significant positive correlation between maternal body mass index with placental weight (50%), number of cotyledons (71%) and foetal birth weight (66%). This relationship is an indication that maternal underweight is an indication of low placental cotyledons count and this results in low foetal birth weight [7]. Revealed that there was positive correlation between maternal body mass index and placental weight and newborn’s birth weight.

Given the current findings which indicate that the maternal BMI influences placental morphology, the result are compatible with the concept that some of the effects of BMI on birth weight is mediated through the promotion of placental growth [11].

**Recommendation**

There is need of increased evaluation of placenta morphology in relation towards the body mass index and foetal birth weight.

Therefore, it is recommended that relevant placentas should be discussed regularly at perinatal mortality and morbidity meetings (Maternal Audit). This could reveal the new clinical pathological correlations between the body mass index and nutrients of mother and foetal by emphasized appreciation of the skilled health personnel and health care giver.

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### Competing Interests

The authors declare that they have no competing interests.

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