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**Original Research Article**

# A MORPHOMETRIC CORRELATIONAL STUDY OF PLACENTA AND UMBILICAL CORD WITH FETUS

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## ABSTRACT

**Background:** The placenta is a dynamic organ to maintain the fetal homeostasis by performing a wide range of physiological functions. It undergoes various changes in terms of shape, size, surface area and structure during pregnancy to support growth of the fetus. The efficiency in transfer of nutrients and oxygen through the placenta is the primary determinant of birth weight. Detailed study of placenta gives a wide scope of knowledge on fetal growth. This study has attempted to find the correlation between umbilical cord length with birthweight and fetal length along with the correlation between other placental parameters and fetal parameters.

**Materials and methods:** The placentas required for this study were collected from the labor room. After thorough inspection of the placenta, shape and presence of any anomalies were noted and then the size of the placenta, which includes weight, thickness and diameter were measured. The length of the umbilical cord was measured with a tape calibrated in centimeters from cut end to placental end and also from cut end to fetal end. Summation of these two values gave the total length of the umbilical cord. The fetal parameters like birth weight was measured by using a digital weighing machine, while the crown-heel length was measured with the help of an infantometer.

**Results:** 35% of placentas are round shape and 65% are of oval shape. Mean ± SD of placenta weight is 458±49.5gm, umbilical cord length is 56.2 ± 3.2cm, birth weight is 2.4 ± 0.4kg and crown-heel length is 45.8 ± 4.2cm.

**Conclusion:** A significant relation was found between placenta size and birth weight. A non-significant relation was found between umbilical cord length and birth weight along with umbilical cord length and crown heel length.

**KEY WORDS:** Placenta, umbilical cord, birth weight, feto-placental ratio, crown-heel length.

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## INTRODUCTION

Placenta is a discoidal structure developed from cytotrophoblast and extra embryonic mesoderm and is normally attached to the endometrium of the upper uterine segment. Placenta has two surfaces, which are maternal and fetal surfaces. The maternal surface of placenta has several lobular projections variable in shape and size named as cotyledons varying from 15 – 20 in number. The fetal surface of the placenta is lined

by the amnion, which is smooth and connected to the fetus by umbilical cord in which blood vessels are present, surrounded by Wharton's jelly.

Placenta maintains fetal homeostasis by performing wide range of physiological functions and undergoes various changes in terms of size, shape, surface area and structure during gestation [1]. The efficiency in transfer of nutrients and oxygen through the placenta is the primary determinant of birth weight [2]. So, the variation in the size of placenta will show its impact on the fetus as the effectiveness of the nutrient transfer is altered due to alteration in the surface area available for exchange. The growth and efficacy of the placenta is predicted principally by placental area and thickness, because area indicates the lateral expansion of the anchoring villi, while the thickness reflects the vertical arborisation of the villous tree. From 30-32 weeks of gestation onwards, the primary dimension of growth of placenta is formed by thickness due to arborisation of villous tree [3].

The growth of the fetus depends not only on the placenta, but also the umbilical cord. Overcoiling of umbilical cord can result in IUGR, cardiac arrhythmias, heart failure, placental insufficiency etc., [4]. An excessively coiled umbilical cord can compress the umbilical vein due to its thin walled nature but not an artery because of its thick wall. The compression of umbilical vein can manifest as congestion of villous vessels in placenta due to disturbance in normal blood flow from placenta to the fetus [5]. The activity of the fetus can be reflected in the form of length of the umbilical cord because a fetus with active movements will have a longer umbilical cord while the fetus with reduced activities will have short umbilical cord. The fetus with normal umbilical cord were found to have good bone strength when compared to the fetus with short umbilical cord and is likely due to the fetal activity [6].

Although, several studies were conducted to find out the relationship between the placenta and fetus with differences of opinion, very few studies were done to find the relation between the umbilical cord and fetus. This study has attempted to find the correlation between umbilical cord length with birthweight and fetal length along with the correlation between other placental parameters and fetal parameters.

## MATERIALS AND METHODS

This study was done in Siddhartha Medical College, Vijayawada between the years 2016 and 2018. A sample size of 200 placentas were collected at the time of delivery from the labor room in the Dept. of Obstetrics & Gynaecology, Siddhartha Medical College, Vijayawada.

**Inclusion criteria:** Placenta of term babies

**Exclusion criteria:** Placenta of stillborn babies, Placenta of aborted fetus

**Parameters:** The parameters measured in this study were categorized as follows;

**Placental parameters:** Shape, Size (weight, thickness and diameter), Number of cotyledons, Feto-placental ratio, Umbilical cord length

**Fetal parameters:** Birth weight, Crown heel length.

The placenta required for this study were collected from the labor room in the Dept. of Obstetrics & Gynaecology, in a container with 10% formalin solution. After collection of placenta, they were washed thoroughly in running tap water to remove blood clots and then patted dry. The placental membranes were trimmed close to the placental surface. The placenta were tagged with numbers for identification.

After thorough inspection of the placenta, shape and presence of any anomalies were noted and then the size of the placenta, which includes weight, thickness and diameter were measured. After measuring weight by using a digital weighing scale, the placenta was kept in a tray with flat surface and the maximum diameter was measured. Then another maximum diameter passing perpendicular to the first diameter was also measured. The average of both diameters was considered as the diameter of the placenta. Thickness was measured by passing a needle at four arbitrarily selected points in which two were from centre and two from peripheral regions of the placenta. The average of these four points was taken as thickness of the placenta. Number of cotyledons were measured by fixing the placenta in formalin solution to avail a view of eminent cotyledons. After holding placenta

in both hands, gentle pressure was applied on the fetal surface so as to produce prominence in the cotyledons due to separation in borders of cotyledons on the maternal surface. Then, the number of cotyledons were counted starting from left side proceeding to right side of the placenta. The feto-placental ratio was calculated from the values obtained by measuring the weight of the placenta and fetus.

The length of the umbilical cord was measured in the labor room during the time of labor. The length of the umbilical cord was measured with a tape calibrated in centimeters from cut end to placental end and also from cut end to fetal end. Summation of these two values gave the total length of the umbilical cord.

The fetal parameters like birth weight was measured by using a digital weighing machine, while the crown-heel length was measured with the help of an infantometer.

**Statistical analysis:** Continuous data like placental weight, birth weight, umbilical cord length, fetal length, feto-placental ratio were described as Mean ± SD. Pearson's correlation was used to assess the correlation between birth weight with placental size, and umbilical cord length with fetal length and birth weight. A "p value <0.05" was taken as significant.

## RESULTS

During the study period 200 placentas were collected for analysis which constituted 104 male babies and 96 female babies. The average number of placental cotyledons noted in the present study was 16. The remaining parameters along with the correlation results observed in this study are tabulated below.

**Table 1:** Shape of the placenta.

| Shape of placenta | Total 200 | Percentage |
|---|---|---|
| Round | 70 | 35% |
| Oval | 130 | 65% |

**Table 2:** Mean ± SD of various parameters.

| Parameter | Mean ± SD (n=200) |
|---|---|
| Weight of placenta (gms) | 458.2 ± 49.5 |
| Thickness of placenta (cms) | 2.5 ± 0.3 |
| Diameter of placenta (cms) | 16.1 ± 2.8 |
| Umbilical cord length (cms) | 56.2 ± 3.2 |
| Birth weight (kg) | 2.4 ± 0.4 |
| Crown – heel length (cms) | 45.8 ± 4.2 |
| Fetoplacental ratio | 5.1 ± 0.6 |

**Table 3:** Correlation between placenta weight & birth weight.

| Parameters | Mean ± SD | r value |
|---|---|---|
| Placenta weight (gms) | 458.2 ± 49.5 | 0.7 |
| Birth weight (kg) | 2.4 ± 0.4 | |

**Table 4:** Correlation between placenta thickness & birth weight.

| Parameters | Mean ± SD | r value |
|---|---|---|
| Placenta thickness (cms) | 2.5 ± 0.3 | 0.7 |
| Birth weight (kg) | 2.4 ± 0.4 | |

**Table 5:** Correlation between placenta diameter & birth weight.

| Parameters | Mean ± SD | r value |
|---|---|---|
| Placenta diameter (cms) | 16.1 ± 2.8 | 0.9 |
| Birth weight (kg) | 2.4 ± 0.4 | |

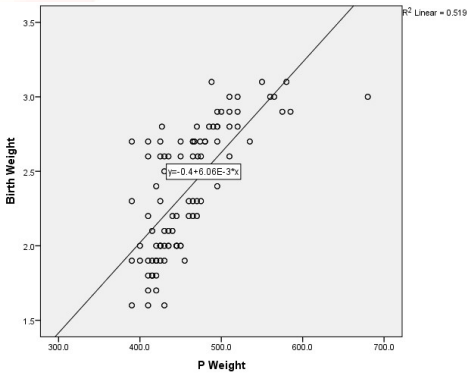
**Table 6:** Correlation between umbilical cord length & birth weight.

| Parameters | Mean ± SD | r value |
|---|---|---|
| Umbilical cord length (cms) | 56.2 ± 3.2 | 0.1 |
| Birth weight (kg) | 2.4 ± 0.4 | |

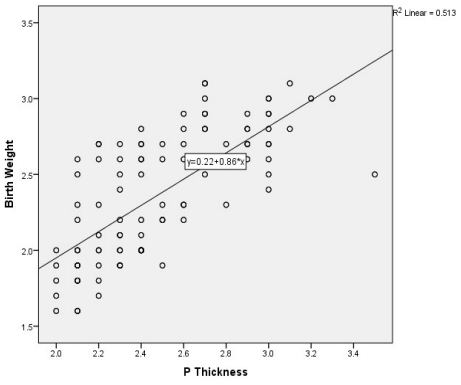
**Table 7:** Correlation between umbilical cord length & crown-heel length.

| Parameters | Mean ± SD | r value |
|---|---|---|
| Umbilical cord length (cms) | 56.2 ± 3.2 | 0.1 |
| Crown-heel length (cms) | 45.8 ± 4.2 | |

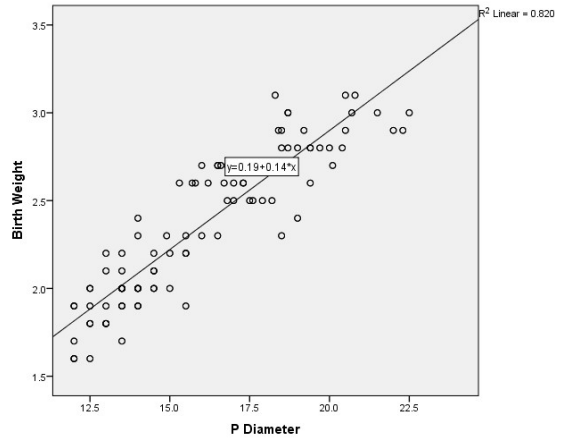
**Graph 1:** Correlation between placenta weight and birth weight.



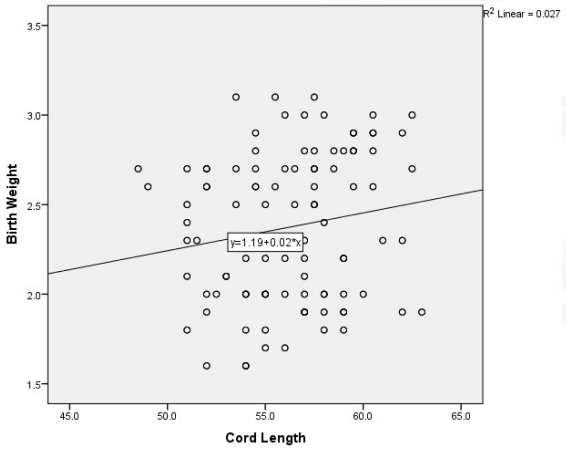

**Graph 2:** Correlation between placenta thickness and birth weight.



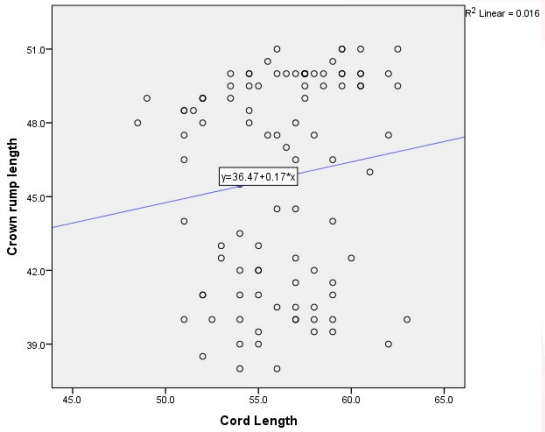
**Graph 3:** Correlation between placenta diameter and birth weight.




**Graph 4:** Correlation between umbilical cord length and birth weight.




**Graph 5:** Correlation between umbilical cord length and crown rump length.




## DISCUSSION

Even though, the standard textbooks describe that the normal shape of the placenta is round, variability in the shapes of the placenta are common. In reality, only few placentas appear truly round with a central insertion of umbilical cord. But, large variations in the size of placenta will result in reduced placental efficiency manifested as small birth weight for the given placental weight. Abnormal shapes of placenta are related with altered architecture of blood vessels leading to reduction in the efficacy of the placenta [7]. A study done by Gunapriya et al, [8] reported 94% circular shaped and 7% oval shaped placenta, while Abhilasha et al, [9] reported 24% oval shaped placenta, 56% discoid shape placenta and 20% irregular shaped placenta. In the present study 35% placentas had round shape and 65% placentas had oval shape (Table I). Thus, showing variations in the shape of placenta from one study to another study.

Mean ± SD of Weight of placenta observed in the present study is 458.2 ± 49.5 (Table II), which is similar to that obtained by Carolyn et al [3] i.e., 452 ± 102gms, but lower than the values reported by Abdelrahman et al which is 528 ± 110gms [10].

The mean thickness of placenta of normal babies in the present study is 2.5 ± 0.3 cms (Table II). The value observed in the present study is higher than the values reported by Vijayalakshmi et al [11] i.e., 2.02 ± 0.2cms and Abhilasha et al [9] i.e., 2.1 ± 0.6cms.

The mean diameter of placenta in the current study is 16.1 ± 2.8cms (Table II), which is lower than mean ± standard deviation of 17.77 ± 1.26cms observed by Abhilasha et al [9] and also 18.48 ± 2.1cms by Abdelrahman et al [10].

The average number of cotyledons found in the present study is 16 which is closely similar to the findings of Majumdar et al [12], i.e., 17. The current study values are higher than 15 observed by Kowsalya et al [13].

The ratio of the fetal weight to the placental weight is known as the feto-placental ratio, which is normally 6:1. In the current study feto-placental ratio was 5.1 ± 0.6 (Table II). The findings obtained in the present study is close to the findings reported by Pushpa et al [14], but lower than that reported (5.9 ± 0.8) by Vijayalakshmi et al [11].

The mean ± standard deviation of umbilical cord length observed in the present study is 56.2 ± 3.2cms (Table II) which is lower than the findings reported by Balkawade et al, i.e., 63.44±11.93cms [15]. A study done by Jick fuu et al, reported umbilical cord length of male babies as 56.4±9.7cms and female babies as 55±9.4cms [16].

Birth weight of babies in the present study is 2.4 ± 0.4kg (Table II). A study conducted by Kowsalya et al [13], reported mean birth weight as 2.8 ± 0.2kg. Gunapriya et al [8] have also observed similar average weight of 2.8kg. In a study conducted by Abdelrahman et al [10], the mean weight of babies was 3.0 ± 0.4 kg.

The average crown-heel length obtained in this study was 45.8 ± 4.2 cms (Table II), which is lower than the findings of Mary Beth Terry et al [17] i.e., 50 ± 2.2cms and Robin Whyatt et al [18] i.e., 51 ± 2.6cms.

Weight, diameter and thickness of the placenta are the parameters which were measured under placental size in this study. Weight, diameter and thickness of the placenta were found to be significantly related to the birth weight (Table III – V and Graph I – III). Our findings are similar to those reported by Abdelrahman et al, Majumdar et al, and Carolyn et al (10,13,3). Reduction in the exchange surface area of placenta alters the ability of nutrient transfer to fetus forming the basis for decrease in weight of fetus, when the placental weight is reduced. The findings about placental thickness in the present study was similar to the findings of Vijayalakshmi et al, who found significant relation between placental thickness and birth weight [11], while Abhilasha et al observed a non-significant relation between placental thickness and birth weight in contrast to observation in the present study [9].

A study conducted by Abhilasha et al, showed no correlation between placenta diameter and birth weight but in present study a significant relation was found between placental diameter and birth weight [9].

A significant relation between umbilical cord length and birth weight was observed by Suzuki et al, and also by Airas et al [19, 20].

In the present study a non-significant relation was found between umbilical cord length and birth weight (Table VI & Graph IV) similar to Balkawade et al [15].

In current study, a non-significant relation was observed between umbilical cord length and crown-heel length (Table VII & Graph V) which is similar to the observations of Balkawade et al [15].

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**Conflicts of Interests: None**

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