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A STUDY OF CORRELATION BETWEEN UMBILICAL CORD DIAMETER & FETAL BIRTH WEIGHT

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Abstract

AIM: This study investigated the relationship between umbilical cord diameter (UCD) measurements and neonatal birth weight outcomes in Indian neonates. The aim was to elucidate the potential correlation between UCD and neonatal weight, providing insights into predicting birth weight during delivery. Conducted at Padmashree Dr.D.Y.Patil Medical College, Hospital and Research Centre ,Pune, the study involved a sample of all single neonates born to both primigravida and multigravida mothers.

Materials and Methods: The study included 100 neonates (42 primigravida, 58 multigravida) born through vaginal delivery & cesarean section, excluding stillbirths, and neonates with abnormal health conditions. UCD measurements were taken immediately after birth from five different points along the cord length, and neonatal weights were measured using an electronic baby weighing scale.

Objectives: The primary objective was to assess the correlation between UCD and neonatal birth weight in Indian neonates. The study aimed to identify potential associations between UCD and birth weight, considering factors such as gravidity and gender distribution.

Results: The significant correlation ($p < 0.05$) between UCD and neonatal birth weight was noted. Larger cord diameters were associated with higher birth weights. Gender distribution showed more males had larger cord diameters and neonatal weights compared to female neonates. The study indicates that for every 1mm increase in cord diameter, there is a corresponding 217-gram increase in birth weight (1 = 217). Therefore, measuring the cord diameter at birth can be utilized to estimate neonatal weight. The conclusion drawn is that neonatal weight can be determined in the delivery room by measuring cord diameters in millimeters, followed by multiplying the cord measurement in millimeters by 217 to obtain the weight in grams.

Conclusion: In conclusion, the study demonstrated a meaningful association between UCD and neonatal birth weight, emphasizing the potential use of UCD measurement as a predictor for neonatal weight during delivery. These findings contribute valuable insights into understanding fetal growth patterns and could aid in refining strategies for neonatal care. Further research in this area may enhance our ability to predict neonatal outcomes and implement targeted interventions.

Keywords: *Umbilical cord diameter, Birth weight, Primigravida, Multigravida, Vaginal delivery, male, female.*

INTRODUCTION:

Human innovation, driven by intellect and inspiration, has yielded numerous inventions. However, the most extraordinary creation is human life itself. Specifically, the formation of a new life intricately relies on the umbilical cord and placenta. These organs, with their unique anatomy and histology, play a crucial role in nourishing the developing baby.[1] Because the human umbilical cord is crucial to the intrauterine survival of the foetus, it is important to study its morphological features both before and after delivery. The umbilical cord is an essential part of delivery because it acts as a necessary supply connection between the growing foetus and the mother. It is surprising that this is still one of the least researched parts of the anatomy of the foetal membrane during delivery. [2] The umbilical cord, comprising two arteries and one vein, establishes a crucial connection between the fetus and the placenta, facilitating blood circulation and significantly influencing fetal development .[3,4] Wharton's jelly, a gelatinous substance rich in mucous polysaccharides, is present in it and helps to shield the blood vessels that are confined. Reduced Wharton's jelly levels have been linked to foetal problems including single umbilical artery, which is characterised by aberrant coiling of the three blood vessels without enough jelly, which can cause the foetal to die.[5] Although it is widely accepted that the umbilical cord stops

working after delivery, a number of studies published in international nursing publications have demonstrated that there are three distinct umbilicus states: healthy, at-risk, and unhealthy. Each state requires a different approach to care. This tailored care is essential as it directly impacts the health of newborns.[6]

The presumed function of the umbilical cord and placenta is to facilitate the fetus's growth and well-being in the uterus. The diameter of the umbilical cord (UCD) plays a crucial role in the circulation of fetal blood and the subsequent weight gain of the fetus.[7] Birth weight has a major impact on a child's ability to survive, grow healthily, and develop as a whole. A known risk factor for poor long-term health outcomes is low birth weight, particularly when it comes to metabolic syndrome and cardiovascular disease.

Morbid placental factors are associated with reduced umbilical cord diameter. The risk of complications such an emergency caesarean surgery, foetal hypoxia, meconium-stained amniotic fluid, poor Apgar score, and neonatal death increases when there is a genuine knot in the umbilical cord, which is frequently brought on by high amniotic fluid levels or foetal movement.[8,9]

The umbilical cord is essential for providing the foetus with oxygen and nourishment. Problems with the cord can entangle it or cause oxygen deprivation, which may result in intrauterine growth retardation or premature birth and require extensive medical care.

In human neonates, the umbilical cord conventionally exhibits an average diameter ranging from 1.06 ± 0.2 cm and a circumference approximately measuring 3.6 cm at the time of birth.[10] Variability in cord thickness is notable, with diameters occasionally exceeding 4 cm, particularly near the umbilicus, or conversely, thinning to less than 1 cm, often characterized by a deficiency of Wharton's jelly.[11] The diameter of the umbilical cord is subject to modulation by the concentration of Wharton's jelly; diminished diameters may signify insufficient fetal tissue glycogen levels and suboptimal prenatal nutrition. Wharton's jelly is a gelatinous material that provides elastic and cushioning effects to withstand foetal movement. It is made up of fibroblasts, macrophages, and mucopolysaccharides.[5] It is essential for maintaining the health of the foetus, controlling blood flow in the umbilical vessels, storing chemicals for the commencement of labour and making it easier to clamp the umbilical cord after delivery. Wharton's jelly content tends to be higher in males and is influenced by good nutrition but decreases with gestational age, potentially disappearing beyond 40 weeks of pregnancy.

Worldwide, there is a significant prevalence of perianal morbidity and mortality, with a more pronounced burden in low-resource countries. The precise functioning of the placenta is crucial for fetal growth, and in India, there is a scarcity of comprehensive studies examining fetal death as well as abnormalities in the placenta and umbilical cord. [12]

Numerous studies have focused on measuring cord diameter[8], with a majority utilizing prenatal sonographic methods for evaluation. However, these approaches face technical challenges and time constraints. Postnatally, the umbilical cord is fully visible, allowing for more accurate measurement of its diameter in various regions or points along its length. This postnatal assessment of umbilical diameter was the objective of a study conducted on neonates born through vaginal delivery & cesarean section, including both primigravida & multigravida mothers. The present investigation ascertained the potential correlation between umbilical cord size and the birth weight of neonates of Indian descent within the delivery room setting.

MATERIALS AND METHODS:

The study involved measuring the diameters of 100 umbilical cords, considering both male and female neonates, utilizing Vernier Calipers. The research was carried out in the Obstetrics and Gynecology department of Padmashree Dr.D.Y.Patil Medical College,Hospital and Research Centre ,Pune which serves as a major referral maternity center with a high volume of deliveries, encompassing various cases from different areas.

Inclusion criteria comprised full-term, apparently healthy neonates of both sexes delivered through normal vaginal delivery, singleton pregnancy and baby's delivered by caesarean during the study period. Exclusion criteria involved cases of stillbirth, placenta previa, multi-fetal gestation, abruption placentae , cord prolapse ,abnormal vaginal deliveries, medical disorders like diabetes mellitus P.I.H, anemia, renal disease, liver ,cardiac disease, neonates with apgar score less than 8 and neonates appearing unhealthy. To ensure accurate measurements and prevent structural changes in the umbilical cord post-birth, diameters were promptly measured within the first two minutes after delivery. The peripheral ends (foetal and placental) and three intermediate locations were among the five chosen points along the length of the cord that were the subject of the study. After then, the average measurement was ascertained. A Siltec electronic baby weighing scale, model number BS1, was also used to measure newborn weight.

STATISTICAL ANALYSIS - The collected data were entered into Microsoft Excel, and subsequent analysis was performed using SPSS software. For categorical data, descriptive statistics such as mean and standard deviation were calculated. Correlation analysis was employed to identify associations between variables. A confidence interval with a P-value equal to or less than 0.05 was considered statistically significant.

RESULTS:

Table 1 shows the correlation between the weight of neonates (in kilograms) and the diameter of the umbilical cord (in millimeters) using the Pearson 'r' correlation coefficient, resulting in a strong positive correlation with a Pearson 'r' value of 0.725 and a highly statistically significant p-value of less than 0.001. This indicates that as the weight of neonates increases, there is a corresponding increase in the diameter of the umbilical cord, suggesting a robust and significant positive association between these two variables.

Table 1: Correlation of weight of neonates (kg) and diameter of umbilical cord (mm) using Pearson 'r' correlation coefficient.

	Pearson 'r' correlation coefficient	P value, Significance
WEIGHT OF NEONATES (KG) **x** DIAMETER OF UMBILICAL CORD (MM)	r =0.725 (Strong positive correlation)	p< 0.001** (highly statistical significant correlation)

In the present investigation, for primigravida mothers (n=42), the maximum neonatal weight was 3.8 kg, and the maximum umbilical cord diameter was 17 mm, while for multigravida mothers (n=58), the corresponding values were 4.2 kg and 18 mm. The minimum neonatal weight for primigravida and multigravida was 1.8 kg and 1.3 kg, respectively, with minimum umbilical cord diameters of 8 mm and 7 mm. Gender distribution showed 63% males and 37% females overall, with 42% primigravida and 58% multigravida mothers. The mean age of the mothers was 25.92 years with a standard deviation of 4.3 years.

Table 2: Distribution of weight of neonates (kg) and diameter of umbilical cord (mm) according to obstetric score and gender of fetus.

	Primigravida (42)				**Multigravida (58)**			
	Male (27)		**Female (15)**		**Male (36)**		**Female (22)**	
	Wt	**Dia**	**Wt**	**Dia**	**Wt**	**Dia**	**Wt**	**Dia**
Max	3.8	17	3.8	16	4.2	18	3.3	18
Min	1.8	8	2	9	1.3	7	1.7	8

Gender Distribution: Males – 63/100 (63%) Females- 37/100 (37%)
PRIMIGRAVIDA – 42 /100(42%) MULTIGRAVIDA – 58/100 (58%)
Mean age of mother – 25.92 (4.3). (Table 2).

The comparison of neonatal weights between primigravida and multigravida mothers, as assessed by an unpaired t-test with a p-value of 0.634, reveals no statistically significant difference in mean weights, indicating that observed variations are likely due to random chance rather than a meaningful effect. (Table 3).

Table 3: Comparison of weight of neonates (kg) between different obstetric score type.

	Primigravida Mean (SD)	Multigravada Mean (SD)	Unpaired t test	P value , Significance
Weight of neonates (kg)	**2.64 (0.47)**	**2.59 (0.51)**	**t = 0.478**	**p =0.634 (no statistical significant difference)**

The comparison of neonatal weights based on fetal gender, as indicated in Table 4 with an unpaired t-test yielding a p-value of 0.470, reveals no statistically significant difference in mean weights between male (2.59 kg, SD 0.53) and female (2.66 kg, SD 0.43) neonates, suggesting that the observed variations are not likely due to a meaningful effect but rather attributable to random chance.

Table 4: Comparison of weight of neonates (kg) among gender of fetus.

	Male Mean (SD)	Female Mean (SD)	Unpaired t test	P value , Significance
Weight of neonates (kg)	**2.59 (0.53)**	**2.66 (0.43)**	**t = -0.725**	**p =0.470 (no statistical significant difference)**

The comparison of umbilical cord diameters (in millimeters) between primigravida and multigravida mothers, as demonstrated in Table 5 with an unpaired t-test resulting in a p-value of 0.466, indicates no statistically significant difference in mean diameters (primigravida: 12.16 mm, SD 2.14; multigravida: 11.84 mm, SD 2.19), suggesting that the observed variations are likely due to random chance rather than a significant obstetric score-related effect (Table 5).

Table 5: Comparison of diameter of umbilical cord (in mm) between different obstetric score type.

	Primigravida Mean (SD)	Multigravada Mean (SD)	Unpaired t test	P value , Significance
Diameter of umbilical cord (in mm)	**12.16 (2.14)**	**11.84 (2.19)**	**t = 0.732**	**P =0.466 (no statistical significant difference)**

The comparison of umbilical cord diameters (in millimeters) between male and female fetuses, as presented in Table 6 with an unpaired t-test yielding a p-value of 0.653, indicates no statistically significant difference in mean diameters (male: 11.9 mm, SD 2.23; female: 12.1 mm, SD 2.06), suggesting that the observed variations are likely due to random chance rather than a significant gender-related effect.

Table 6: Comparison of diameter of umbilical cord (in mm) among gender of fetus

	Male Mean (SD)	Female Mean (SD)	Unpaired t test	P value , Significance
Diameter of umbilical cord (in mm)	**11.9 (2.23)**	**12.1 (2.06)**	**t = -0.451**	**p =0.653 (no statistical significant difference)**

DISCUSSION:

This study aimed to explore the correlations between umbilical cord diameter and neonatal health status post-birth. The findings emphasize the importance of vigilant monitoring of newborns' umbilical cords after delivery. A thin umbilical cord in pregnancy may be dangerous to the developing foetus, increasing the risk of stunted growth and low birth weight—small for gestational age—at delivery. The cord's diameter is dependent on the amount of Wharton's jelly present; a lower jelly content causes the diameter to decrease.

Goodlin (1987) conducted a study examining the associations among Wharton's jelly volume, umbilical cord diameter, preterm birth, fetal loss and inadequate fetal growth. The findings revealed a robust correlation between the volume of Wharton's jelly and umbilical cord diameter. Goodlin concluded that umbilical cord diameter serves as an indicator of the quantity of Wharton's jelly present.[13]

Studies conducted by Sepulveda in 2003[14] and Barbieri in 2011 [15] demonstrated that the amount of Wharton's jelly increased with gestational age until around 32 weeks, after which it remained relatively stable until the end of pregnancy. In our study we reported an average cord diameter of approximately 1.5 cm at birth. Among primigravida mothers (n=42), the highest neonatal weight recorded was 3.8 kg, with a maximum umbilical cord diameter of 17 mm. In comparison, multigravida mothers (n=58) had a maximum neonatal weight of 4.2 kg and a maximum umbilical cord diameter of 18 mm. The lowest neonatal weight observed for primigravida and multigravida mothers was 1.8 kg and 1.3 kg, respectively, accompanied by minimum umbilical cord diameters of 8 mm and 7 mm. The gender distribution across all cases included 63% males and 37% females, with 42% of mothers being primigravida and 58% being multigravida. The average age of the mothers was 25.92 years, with a standard deviation of 4.3 years.

The results of this study align with previous research, supporting the findings of Sepulveda et al. in 2003[14] and Barbieri et al. in 2011.[15] It is consistent with the belief that males generally have a higher content of Wharton's jelly compared to females. Togni et al.[16] in 2007 studied umbilical cords (UC) and reported a weak correlation between the amount of Wharton's jelly, cord diameter, and neonatal weight. Conversely, Barbieri et al. in 2011[15] found a direct relationship between gestational age, fetal

weight, and the amount of Wharton's jelly in the UC. In our study ,the values indicates that as the weight of neonates increases, there is a corresponding increase in the diameter of the umbilical cord, suggesting a robust and significant positive association between these two variables. This aligns with Barbieri et al.'s 2011[15] study, indicating that larger cord diameters are associated with higher birth weights. These findings are consistent with Sepulveda et al.'s 2003 study[14], which showed that larger cords are linked to higher birth weights, contrasting with smaller cords. This association is attributed to the increase in Wharton's jelly, expanding cord diameter and blood vessel size, leading to enhanced blood flow and fetal weight gain.

This finding could be valuable in predicting birth weight during delivery, especially for normocoiled cords. Hypercoiled cords may reduce blood flow, potentially resulting in slower fetal weight gain. In summary, the average cord diameter in newborns born in India is 1 to 1.3 cm; it is higher in males and singleton babies and is related to birth weight. Measuring cord diameter may aid in predicting neonatal weight at birth and could serve as one of the methods for neonatal weight assessment during delivery.

CONCLUSION:

In conclusion, this study highlights a significant correlation between umbilical cord diameter and neonatal birth weight in Indian neonates. The findings support previous research indicating that larger cord diameters are associated with higher birth weights. The results may contribute to effective strategies for predicting neonatal weight during delivery. The study emphasizes the potential utility of cord diameter measurement as a method for neonatal weight assessment at birth. Further research and application of these findings could enhance our understanding of fetal growth and contribute to improved neonatal care strategies.

REFERENCE:

1. Sadler,T.A .Langman's medical embryology (12 ed.). Philadelphia: Wolters.2006.

2. Chitra T, Sushanth Y S, Raghavan S. Umbilical coiling index as a marker of perinatal outcome: an analytical study. Journal of ObstetGynecol Int. 2012; 21(10): 1155-58.

3.Binbir B, Yeniel AO, Ergenoglu AM, Kazandi M, Akercan F, Sagol S. The role of umbilical cord thickness and HbA1c levels for the prediction of fetal macrosomia in patients with gestational diabetes mellitus. Archives of Gynecology Obstetrics. 2012;285(3):635–639. doi: 10.1007/s00404-011-1961-3.

4.López-Medina MD, López-Araque AB, Linares-Abad M, López-Medina IM. Umbilical cord separation time, predictors and healing complications in newborns with dry care. PLoS One. 2020;15(1):e0227209. doi: 10.1371/journal.pone.0227209.

5.Damasceno EB, de Lima PP. Wharton's jelly absence: A possible cause of stillbirth. Autopsy and Case Reports. 2013;3(4):43–47. doi: 10.4322/acr.2013.038.

6.Nosan G, Paro-Panjan D. Umbilical cord care: National survey, literature review and recommendations. The Journal of MaternalFetal & Neonatal Medicine. 2017;30(14):1655–1658. doi: 10.1080/14767058.2016.1220530.

7.Ikechebelu J, Eleje G, Ofojebe C. True umbilical cord knot leading to fetal demise. Annals of Medical and Health Sciences Research. 2014;4(Suppl 2):S155–158. doi: 10.4103/2141-9248.138044.

8.Proctor L, Fitzgerald B, Whittle W, Mokhtari N, Lee E, Machin G, et al. Umbilical cord diameter percentile curves and their correlation to birth weight and placental pathology. Placenta. 2013;34(1):62–66.

9.Duman NB, Topuz S, Bostanci MO, Gorkem U, Kocak DY, Togrul C, et al. The effects of umbilical cord entanglement upon labor management and fetal health: Retrospective case control study. The Journal of Maternal-Fetal & Neonatal Medicine. 2018;31(5):656–660. doi: 10.1080/14767058.2017.1293033.

10. Lee SM, Kim DY, Cho S, Noh SM, Park HL, Lee G. Correlations between the Status of the Umbilical Cord and Neonatal Health Status. Child Health Nurs Res. 2020 Jul;26(3):348-356. doi: 10.4094/chnr.2020.26.3.348. Epub 2020 Jul 31. PMID: 35004478; PMCID: PMC8650973.

11. Botezatu R, Raduteanu S, Ciobanu AM, Gica N, Peltecu G, Panaitescu AM. Absence of Wharton's Jelly at the Abdominal Site of the Umbilical Cord Insertion. Rare Case Report and Review of the Literature. Medicina (Kaunas). 2021 Nov 18;57(11):1268. doi: 10.3390/medicina57111268. PMID: 34833486; PMCID: PMC8625092.

12. Meskele S, Mulu A, GebreMickael A, Ena L. Placental and Umbilical Cord Indices and Their Association with Fetal Distress in Hadiya Zone Public Hospitals, Southern Ethiopia: A Cross-Sectional Study. Int J Gen Med. 2021 Dec 18;14:10045-10053. doi: 10.2147/IJGM.S346544. PMID: 34955653; PMCID: PMC8694399.

13.Goodlin RC. Fetal dysmaturity, lean cord, and fetal distress. Am J Obstet Gynecol. 1987; 156 (5):1357-59

14. Sepulveda W, Alcalde JL, Schnapp C, Bravo M. Prenatal outcome after diagnoses of chorioangioma. Obstetric Gynecology. 2003,102(5):1028–33.

15. Barbieri C, Cecatti JG, Krupa F, Marussi EF, Costa JV. Area of Wharton's jelly as an estimate of the thickness of the umbilical cord and its relationship with estimated fetal weight.Reprod Health. 2011; 32(8):1186-8.

16. Togni FA, Araújo E, Jr, Vasques FA, Moron AF, Torloni MR, Nardozza LM. The crosssectional area of umbilical cord components in normal pregnancy. International Journal of Obstetrics and Gynecology. 2007; 96(3):156-161