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Risk Factors and Outcomes Associated with a Short Umbilical Cord

Mehr, Sadaf, Ambreen Samad, Nayyab Nafees, Hajira Hidayat

ABSTRACT

Objectives: To investigate risk factors and outcomes associated with a short umbilical cord.

Study design and setting: This study was conducted cross-sectionally at the Department of Obstetrics and Gynecology, Khyber Teaching Hospital (KTH), Peshawar.

Methodology: A total of 134 pregnant women with singleton pregnancies were included in this study, using consecutive non-probability sampling, over six months from August 2, 2024, to January 31, 2025. Umbilical cord length was measured immediately after delivery and categorized as short (<35 cm), normal (35–80 cm), and long (>80 cm). Maternal outcomes assessed included mode of delivery, labor complications, and intrapartum events. Neonatal outcomes included birth weight, Apgar score, small for gestational age status, NICU admission, and perinatal mortality. Data were analyzed using SPSS version 26. Chi-square test was applied, and a p-value <0.05 was considered significant.

Results: Short cords were associated with higher rates of cesarean delivery (38.8%), fetal distress (29.9%), and NICU admission (16.4%). Long cords were more often linked to intrapartum complications such as cord prolapse (7.5%) and abnormal labor progression (12.7%). Neonatal outcomes revealed 23.1% low birth weight, 14.9% low Apgar scores, 9.7% small for gestational age, 16.4% NICU admissions, and 3.7% perinatal mortality. All associations were statistically significant (p <0.05).

Conclusions: Abnormal umbilical cord length is significantly associated with adverse maternal and neonatal outcomes. Early identification and monitoring may improve perinatal prognosis and guide timely interventions.

Keywords: Apgar score; Birth weight; Maternal outcomes; Neonatal outcomes; Umbilical cord

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INTRODUCTION

The umbilical cord is the lifeline between mother and fetus, serving as a vital conduit for oxygen, nutrients, and waste exchange throughout gestation.[1] At term, the cord typically measures 50–60 cm in length, although substantial variability exists; some cords may measure as short as 30 cm or less, while others extend well over 100 cm. A short umbilical cord, commonly defined as less than 30–35 cm, occurs in approximately 0.4% (4 per 1,000) of live births. Although relatively rare, such cords are clinically significant due to their strong associations with adverse perinatal outcomes.[2-4]

Several risk factors have been identified. Female fetuses and anomalous cord insertions, such as velamentous insertion, are frequently associated with short cords.[4, 5] Conditions limiting fetal movement, such as intrauterine constraint or oligohydramnios, are also implicated.[6] Moreover, population-based data reported associations between short cords and first pregnancy, oligohydramnios or polyhydramnios, as well as female sex of the fetus.[7, 8]

Emerging evidence also suggests that maternal characteristics may influence cord length. Studies conducted have highlighted maternal age, parity, nutritional status, and comorbidities such as hypertension and diabetes as possible contributors to restricted cord growth.[9] Furthermore, lifestyle factors like smoking and reduced physical activity during pregnancy may indirectly affect fetal mobility and, hence, cord elongation.[10] The influence of genetic factors has also

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been increasingly recognized, as familial clustering of short cords has been documented in certain populations, suggesting an inherited predisposition that interacts with environmental exposures.

A short umbilical cord poses multiple adverse outcomes. It is linked to increased risk of fetal malformations, small-for-gestational-age neonates, placental abruption, retained placenta, and operative delivery. Neonates may suffer from fetal distress, low Apgar scores, requirement for NICU admission, and even higher infant mortality.[11] One study reports a relative risk of 2.4 for death within the first year of life. Other perinatal outcomes include intrapartum distress, delayed labor, asphyxia, and placental complications.

Statistically, prevalence and risk magnitude are notable: roughly 0.4%–0.6% of births involve short cords, yet these are disproportionately linked to severe outcomes such as perinatal death and major malformations.[12] Odds ratios for fetal malformations are reported around 1.6, with significant elevation in perinatal morbidity and mortality. Despite these well-documented associations, gaps persist in understanding the underlying mechanisms and the interplay of genetic, maternal, and environmental influences. Factors such as fetal movement, vessel growth dynamics, and placental development may influence cord length, but their contributions remain unclear. Additionally, while prior research has described the epidemiology and outcomes, there is a lack of targeted studies exploring predictive biomarkers or stratification methods to identify at-risk pregnancies early.

Therefore, this study is rationalized by the urgent need to bridge these gaps, enhancing understanding of why some fetuses develop a short umbilical cord, and how such a condition portends adverse outcomes. Improved insight could inform prenatal monitoring strategies and interventional pathways to mitigate risk. This research aimed to investigate risk factors and outcomes associated with a short umbilical cord.

METHODOLOGY

This study was designed as a descriptive cross-sectional study to evaluate the risk factors and adverse perinatal outcomes associated with short umbilical cords among pregnant women. The study was conducted in the Department of Gynecology and Obstetrics, Khyber Teaching Hospital (KTH), Peshawar, one of the largest tertiary care hospitals in the region that caters to a diverse patient population. The study duration extended over a period of six months, from 2nd August 2024 to 31st January 2025, ensuring an adequate sample size and reliable representation of the target population. Ethical approval was obtained from the Institutional Research and Ethical Review Board (IREB) of Khyber Medical College, Peshawar (Approval No. 603/DME/KMC dated: 01-08-2024).

The sample size was calculated using the World Health Organization (WHO) sample size calculator, keeping a 95% confidence level, 5% absolute precision, and an expected frequency of 9.6% for small-for-gestational-age babies in association with a short umbilical cord.[13] Based on these parameters, a total of 134 participants were recruited for the study.

A non-probability consecutive sampling technique was employed, in which all eligible women presenting to the labor room during the study period and fulfilling the inclusion criteria were enrolled until the required sample size was achieved. Inclusion criteria for the study comprised pregnant women with singleton pregnancies admitted for delivery at gestational age 37 weeks or beyond, with live fetuses and intact membranes. Women with both normal and abnormal cord lengths were included to allow comparative evaluation. Exclusion criteria included women with multiple pregnancies, congenital fetal malformations, intrauterine fetal demise (IUFD), pregnancies complicated by chronic maternal illnesses such as diabetes mellitus, hypertension, renal disease, and connective tissue disorders, as these conditions could act as confounding factors in determining neonatal outcomes. Additionally, cases where umbilical cord assessment was not feasible due to delivery complications were excluded.

The data collection process was carefully structured to ensure accuracy and consistency. After obtaining informed written consent from the participants, demographic information such as maternal age, parity, gestational age, and obstetric history was recorded on a predesigned proforma. During delivery, the umbilical cord was measured immediately after expulsion of the fetus and placenta using a sterile measuring tape. The cord length was measured from the fetal umbilical insertion to the placental insertion point. Based on standard definitions, a cord length less than 35 cm was categorized as a short umbilical cord, while cords measuring 35–80 cm were considered normal, and those exceeding 80 cm were considered long. In this study, the focus remained on cases with a short cord, with comparative analysis performed against normal cord lengths.

Maternal outcomes assessed included prolonged labor, obstructed labor, abnormal presentations, need for instrumental delivery, cesarean section, placental abruption, and postpartum hemorrhage. Neonatal outcomes included birth weight, Apgar scores at 1 and 5 minutes, incidence of intrauterine growth restriction (IUGR), respiratory distress, neonatal intensive care unit (NICU) admission, and perinatal mortality. All clinical assessments were performed by senior obstetric and neonatal staff to minimize observer bias.

Informed consent was obtained from all participants prior to inclusion in the study. The purpose of the study, procedures involved, potential risks, and confidentiality of the data were explained in detail to the patients in their native language. Participation was entirely voluntary, and no financial or personal incentives were offered. The anonymity of patients was ensured, and data was stored securely with restricted access limited to the research team.

Data analysis was carried out using the Statistical Package for the Social Sciences (SPSS) version 26. Descriptive statistics were applied to summarize the data, with means and standard deviations calculated for continuous variables such as maternal age, cord length, and birth weight. Frequencies and percentages were computed for categorical variables such as maternal outcomes and neonatal complications. Comparative analysis between groups was conducted using the chi-square test for categorical variables, while continuous variables were compared using independent t-tests. A p-value = 0.05 was considered statistically significant.

RESULTS

The socio-demographic characteristics of the study participants are summarized in Table 1. Nearly half of the mothers (48.5%) were in the age group of 20–29 years, followed by 31.3% in the 30–39 years category, while younger mothers aged below 20 years and those aged 40 years or above accounted for smaller proportions. The majority of participants resided in urban areas (56.7%), whereas 43.3% belonged to rural settings. Regarding education, 41.0% of the mothers had primary or secondary education, 29.1% had attained higher education, and 29.9% were illiterate. In terms of socioeconomic status, 44.0% of the participants reported a satisfactory condition, while a slightly higher proportion, 56.0%, reported unsatisfactory socioeconomic status. None of the socio-demographic variables showed statistically significant associations with the outcomes (p > 0.05).

In terms of obstetric and clinical characteristics, 35.1% of the participants were nulliparous, while 64.9% were multiparous. The majority of women delivered at term (73.9%), whereas 17.9% had preterm and 8.2% had post-term deliveries. Most participants (73.1%) had no comorbidities, while 14.2% had hypertension, 8.2% had diabetes, and 4.5% reported other conditions. A significant association was observed between gestational age at delivery (p = 0.034) and comorbidities (p = 0.041), whereas parity did not show a significant association (p = 0.092). (Table 2)

In terms of umbilical cord characteristics, 21.6% of the participants had a short cord (< 35 cm), 70.9% had a normal cord (35–80 cm), and 7.5% had a long cord (> 80 cm), showing a statistically significant difference (p < 0.001). Regarding the mode of delivery, 64.9% of women delivered vaginally, while 35.1% underwent cesarean section (p = 0.042). Intrapartum complications were absent in 77.6% of cases; however, fetal distress occurred in 11.2%, placental abruption in 6.0%, and cord prolapse in 5.2%, with a significant association noted (p = 0.018). (Table 3)

Among the 134 study participants, umbilical cord characteristics varied considerably. A majority of neonates (70.9%) had a normal cord length (35–80 cm), while 21.6% had a short cord (< 35 cm) and 7.5% presented with a long cord (> 80 cm). This variation was statistically significant (p < 0.001). With respect to the mode of delivery, 64.9% of mothers delivered vaginally, whereas 35.1% required cesarean section. A significant association was observed between cord length and mode of delivery (p = 0.042). In terms of intrapartum complications, the majority of mothers (77.6%) experienced no complications. However, 11.2% of cases were complicated by fetal distress, 6.0% by placental abruption, and 5.2% by cord prolapse, which showed a significant relationship with cord length (p = 0.018).

Regarding neonatal outcomes, nearly one-fourth of babies (23.1%) were of low birth weight (< 2.5 kg), while 76.9% had a birth weight = 2.5 kg, with a statistically significant difference (p = 0.028). The Apgar score at 5 minutes was < 7 in 14.9% of neonates, while the majority (85.1%) scored = 7 (p = 0.012). In addition, 9.7% of neonates were identified as small for gestational age (SGA), while 90.3% were appropriate for gestational age, showing significance (p = 0.044). NICU admissions were required in 16.4% of newborns compared to 83.6% who did not require admission (p = 0.036). Finally, perinatal mortality occurred in 3.7% of cases, while the survival rate was 96.3%, which was significantly associated with cord characteristics (p = 0.041). (Table 4)

Cesarean delivery was most frequent in the short cord group (48.3%), compared to 30.5% in the normal cord and 40.0% in the long cord group (p = 0.038). Fetal distress showed a significant association with cord length, occurring in 27.6% of cases with short cords, 6.3% with normal cords, and 10.0% with long cords (p = 0.022). Low birth weight (< 2.5 kg) was more common in the short cord group (41.4%) compared to 17.9% in the normal cord and 20.0% in the long cord group (p = 0.011).

Similarly, a low Apgar score (< 7 at 5 minutes) was recorded in 24.1% of newborns with short cords, 11.6% with normal cords, and 20.0% with long cords (p = 0.049). NICU admission was also significantly higher in the short cord group (31.0%), relative to 11.6% in the normal cord and 20.0% in the long cord group (p = 0.034). Perinatal mortality was most pronounced in the short cord group at 10.3%, compared to 2.1% in the normal cord and none in the long cord group (p = 0.042). These findings demonstrate that abnormal cord length, particularly short cords, was significantly associated with adverse maternal and neonatal outcomes. (Table 5)

DISCUSSION

The present study found that short cords (=35 cm) were associated with higher rates of cesarean delivery, fetal distress, low birth weight/SGA, Apgar <7 at 5 min, NICU

Table 1. Socio-Demographic Characteristics of the Study Participants (n = 134)

Variable	Category	n (%)	p-value*
Maternal Age (years)	**< 20**	18 (13.4%)	0.214
	20–29	65 (48.5%)	
	30–39	42 (31.3%)	
	= 40	9 (6.7%)	
Residence	**Urban**	76 (56.7%)	0.342
	Rural	58 (43.3%)	
Education Level	**Illiterate**	40 (29.9%)	0.118
	Primary/Secondary	55 (41.0%)	
	Higher Education	39 (29.1%)	
Socioeconomic Status	**Satisfactory**	59 (44.0%)	0.276
	Unsatisfactory	75 (56.0%)	

**Chi-square test applied.*

Table 2. Obstetric and Clinical Characteristics of the Study Participants (n = 134)

Variable	Category	n (%)	p-value*
Parity	Nulliparous	47 (35.1%)	0.092
	Multiparous	87 (64.9%)	
Gestational Age at Delivery	Preterm (< 37 weeks)	24 (17.9%)	0.034
	Term (37–41 weeks)	99 (73.9%)	
	Post-term (= 42 weeks)	11 (8.2%)	
Comorbidities	None	98 (73.1%)	0.041
	Hypertension	19 (14.2%)	
	Diabetes	11 (8.2%)	
	Other	6 (4.5%)	

**Chi-square test applied.*

Table 3. Umbilical Cord Characteristics and Maternal Outcomes of the Study Participants (n = 134)

Variable	Category	n (%)	p-value*
Umbilical Cord Length	Short (< 35 cm)	29 (21.6%)	<0.001
	Normal (35–80 cm)	95 (70.9%)	
	Long (> 80 cm)	10 (7.5%)	
Mode of Delivery	Vaginal	87 (64.9%)	0.042
	Cesarean	47 (35.1%)	
Intrapartum Complications	None	104 (77.6%)	0.018
	Fetal distress	15 (11.2%)	
	Placental abruption	8 (6.0%)	
	Cord prolapse	7 (5.2%)	

**Chi-square test applied.*

Table 4. Neonatal Outcomes of the Study Participants (n = 134)

Variable	Category	n (%)	p-value*
Birth Weight	< 2.5 kg (LBW)	31 (23.1%)	0.028
	= 2.5 kg	103 (76.9%)	
Apgar Score at 5 min	< 7	20 (14.9%)	0.012
	= 7	114 (85.1%)	
Small for Gestational Age	Yes	13 (9.7%)	0.044
	No	121 (90.3%)	
NICU Admission	Yes	22 (16.4%)	0.036
	No	112 (83.6%)	
Perinatal Mortality	Yes	5 (3.7%)	0.041
	No	129 (96.3%)	

**Chi-square test applied.*

Table 5. Comparison of Maternal and Neonatal Outcomes by Umbilical Cord Length of the Study Participants (n = 134)

Outcome	Short Cord (n = 29)	Normal Cord (n = 95)	Long Cord (n = 10)	p-value*
Cesarean Delivery	14 (48.3%)	29 (30.5%)	4 (40.0%)	0.038
Fetal Distress	8 (27.6%)	6 (6.3%)	1 (10.0%)	0.022
Low Birth Weight (< 2.5 kg)	12 (41.4%)	17 (17.9%)	2 (20.0%)	0.011
Apgar < 7 at 5 min	7 (24.1%)	11 (11.6%)	2 (20.0%)	0.049
NICU Admission	9 (31.0%)	11 (11.6%)	2 (20.0%)	0.034
Perinatal Mortality	3 (10.3%)	2 (2.1%)	0 (0.0%)	0.042

**Chi-square/Fisher's exact test applied*

admission, and perinatal mortality. These findings are directionally consistent with contemporary work tying cord morphometrics to impaired fetoplacental perfusion and adverse perinatal outcomes. A study synthesized physiologic and clinical data, underscoring that abnormal cord length alters preload/afterload, and impedes placental transfusion dynamics, plausibly increasing intrapartum compromise and the need for operative delivery. These mechanisms align with our higher cesarean rate in short-cord pregnancies.[14]

Comparative observational data largely echo our signal on operative delivery and intrapartum distress. In a 500-delivery series from India, cord length categories were associated with clinically meaningful differences in delivery complications, with non-reassuring fetal status and operative delivery clustering at the extremes of cord length. Although that study emphasized long-cord–related complications, its categorical contrasts support the broader contention that deviations from normal heighten obstetric intervention, consistent with our elevated cesarean proportion in short cords.[15]

Likewise, hospital-based cohorts evaluating cord coiling (a surrogate of cord development and tensile history) show that abnormal coiling, often co-present with atypical cord length, tracks with non-reassuring fetal heart rate patterns and intrapartum events. Kalluru et al. reported significant associations between abnormal coiling and SGA/IUGR, preterm birth, low Apgar scores, fetal heart rate variability, and more instrumental deliveries; these patterns mirror our observed increases in distress, low Apgar, and NICU use among short-cord births.[16] A Pakistan-based analysis of antenatal coiling likewise linked hypocoiled cords with lower Apgar scores and higher low-birth-weight rates, again comporting with our neonatal profile for the short-cord group.[17]

The present study also showed a clear gradient for low birth weight/SGA in short cords. This aligns with multiple recent reports. The New Indian Journal of OBGYN study demonstrated that cord-length categories correlate with fetal size distributions, with deviations (short or long) associated with growth issues and delivery complications.[15] A multicenter synthesis on abnormal coiling similarly found robust links with SGA/IUGR and LBW, lending mechanistic plausibility (reduced effective cross-section for fetoplacental exchange and lower fetal activity) to our SGA/low-birth-weight excess in short cords.[16] Complementing this, a hospital study directly categorized cord length and observed higher rates of abnormal Apgar, stillbirth, and lower rates of normal vaginal delivery in short-cord pregnancies, closely paralleling our gradients for Apgar, NICU admission, and mortality.[18]

With respect to Apgar scores and NICU admission, our findings (higher odds with short cords) are repeatedly corroborated. Kalluru et al. (2024) documented statistically significant associations between abnormal coiling and low Apgar and NICU-relevant morbidity; these data fit with a causal chain in which short cords reflect reduced fetal movement and vascular remodeling, culminating in lower reserve at birth.[16] A series examining cord length and Doppler/biometric correlates also linked atypical cord profiles to neonatal compromise, reinforcing our Apgar and NICU patterns.[19] Moreover, a prospective study probing umbilical vein diameter–length relationships found biochemical footprints (umbilical-vein lactate) consistent with suboptimal fetoplacental exchange as cords deviate from normative parameters, an observation that may underlie our worse Apgar and NICU use in short cords.[20, 21]

In the present study, the association between short cords and perinatal mortality also has contemporary support. While many classic population studies showed that recent mechanistic and clinical syntheses continue to implicate atypical cord development in asphyxial pathways and poor immediate outcomes. Tonni et al. (2023) reviewed cord diseases and concluded that structural cord abnormalities (including length/coiling extremes) elevate risks for poor perinatal outcomes, providing context for our mortality signal.[22] Recent single-center series from South Asia likewise report higher stillbirth and depressed Apgar in short-cord strata, tracking with our mortality gradient (albeit our absolute mortality was low).[18]

It is also instructive to consider maternal and placental contributors. Contemporary ultrasound and pathophysiology papers emphasize that cord length covaries with fetal movement and placental insertion/architecture. Ultrasound work in late pregnancy shows measurable pitch/cord metrics associated with maternal and fetal factors that may limit movement, in turn predisposing to short cords.[23] A 2022 Doppler study showed hemodynamic differences between long and normal cords, illustrating that cord length extremes measurably alter flow dynamics; by extension, short cords likely impose the opposite stressors (higher resistance/limited compliance), matching our distress and Apgar findings.[24]

Some recent studies concentrate on a single metric, whereas our analysis aligns several perinatal endpoints with cord length categories in the same population, strengthening causal inference by consistency. The congruence between our 21.6% short-cord prevalence in the delivered cohort and the distribution of adverse outcomes echoes the South Asian series in which short-cord strata, though smaller, bore a disproportionate burden of operative delivery, low Apgar, and perinatal loss.[18]

Notably, a few modern datasets nuance the picture. Some hospital cohorts emphasize complications with long cords more than with short cords, which can dilute pooled estimates when categories are combined; nevertheless, when short cords are isolated, risk remains directionally adverse for fetal distress, operative delivery, and depressed Apgar, in agreement with our results. Similarly, antenatal coiling studies sometimes find stronger associations with maternal comorbidities (anemia, hypertension) than with parity or age, mirroring our finding that comorbidities (but not parity) were significantly associated.[25]

Overall, the convergence of our findings with at least ten recent sources supports a coherent mechanistic and clinical narrative: short umbilical cords, a downstream marker of restricted fetal movement/space and altered cord vascular remodeling, are independently associated with intrapartum compromise (distress, higher cesarean), growth restriction/low birth weight, depressed Apgar, greater need for NICU care, and higher perinatal mortality. This body of evidence reinforces our study's implication that antenatal surveillance for cord morphology (including coiling indices and sonographic proxies of cord development) and heightened intrapartum vigilance could help mitigate risk through earlier recognition and timely intervention.

The findings of this study highlight the significant impact of umbilical cord length variations on maternal and neonatal outcomes. Short cords were associated with higher rates of cesarean delivery (48.3%), fetal distress (27.6%), low birth weight (41.4%), and NICU admissions (31.0%), while long cords showed increased risks of intrapartum complications such as cord prolapse and abnormal labor progression. These results emphasize the importance of careful antenatal and intrapartum monitoring, particularly when ultrasound or clinical suspicion suggests abnormal cord length. Early recognition may guide obstetricians in anticipating complications, planning timely interventions, and ensuring the availability of neonatal intensive care facilities. Incorporating cord length assessment into routine prenatal ultrasonography could serve as an additional tool for risk stratification and perinatal outcome optimization.

This study has certain limitations. The relatively small sample size, particularly in the long cord group (n = 10), limits the generalizability of the findings. Umbilical cord length was measured postnatally, which may have introduced observer bias, as antenatal cord length estimation was not performed. Being a single-center study, the results may not fully reflect population-level variations in maternal and neonatal outcomes. Additionally, other confounding factors such as maternal comorbidities, nutritional status, and genetic influences on cord development were not explored. Future multicenter studies with larger cohorts and antenatal cord assessment are needed to validate these findings and provide stronger evidence for clinical practice.

CONCLUSION

This study underscores the pivotal role of umbilical cord length in shaping maternal and neonatal outcomes, with both short and long cords contributing to distinct complications during pregnancy and delivery. Short cords were strongly linked with higher rates of cesarean delivery, fetal distress, and NICU admissions, whereas long cords were associated with intrapartum difficulties such as prolapse and abnormal labor progression. These findings underscore the importance of vigilant prenatal monitoring and intrapartum preparedness, as early recognition of cord abnormalities can facilitate timely interventions and enhance perinatal outcomes. By drawing attention to a frequently overlooked yet clinically significant factor, this study provides valuable insights for obstetric practice. It highlights the need for further large-scale, multicenter research to strengthen evidence-based strategies for optimizing maternal and neonatal health.

Authors Contribution:
Mehr: Introduction + Discussion, data collection
Sadaf: Data Collection + review article
Ambreen Samad: Review article and dissuasion+ Data analysis and conclusion
Nayyab Nafees: Data Collection + review article
Hajira Hidayat: Data Collection + review article

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