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Study Of Postnatal Umbilical Cord Coiling Index and Its Association with Perinatal Outcome in a Tertiary Care Hospital.

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ABSTRACT

Background: The umbilical cord is often seen as just a connecting structure, but its unique pattern of coiling might hold valuable clues about a baby's health. Studies suggest that the number and tightness of coils—known as the Umbilical Coiling Index (UCI)—can affect how well the fetus tolerates labor and overall pregnancy outcomes.

Objective: This study set out to examine how different patterns of umbilical cord coiling, measured after birth, relate to the baby's health and the events around delivery.

Methods: We conducted a three-month prospective observational study involving 92 women with single pregnancies between 37–40 weeks of gestation. After delivery, we measured the number of complete vascular coils in the cord and calculated the UCI. Based on this, cords were classified as hypocoiled, normocoiled, or hypercoiled. We then compared these groups against delivery mode, birth weight, Apgar scores, NICU admission, and other outcomes.

Results: Most cords fell into the normocoiled category (54.35%), while 20.65% were hypocoiled and 25% hypercoiled. Babies with abnormal cord coiling were more likely to face complications like low Apgar scores, fetal distress, and NICU admission. Hypocoiling was especially linked to poor fetal growth and difficult labor, whereas hypercoiling had stronger ties with gestational diabetes and cesarean delivery.

Conclusion: The pattern of umbilical cord coiling, often overlooked, may provide important insights into the baby's well-being. Routinely evaluating UCI could help clinicians identify at-risk pregnancies and intervene early.

1. INTRODUCTION

The umbilical cord plays a quiet but crucial role in pregnancy—delivering oxygen and nutrients while also protecting the fetus from compressive forces. One of its lesser-known features is its spiral or helical shape, which varies from person to person. This coiling, while often dismissed as incidental, may actually reflect deeper physiological processes.

To quantify this, researchers use something called the **Umbilical Coiling Index (UCI)**—a simple measure of how many times the vessels coil per centimeter of cord. Cords that coil too little (hypocoiling) or too much (hypercoiling) have been associated with different pregnancy risks, from poor fetal growth to delivery complications [1].

While some believe the coiling pattern forms as a result of fetal movement and blood flow dynamics, it's still not fully understood [2]. What is becoming clear, though, is that abnormal coiling could act as a warning sign. A few studies have reported higher rates of fetal distress, meconium-stained liquor, and cesarean sections in pregnancies with coiling abnormalities [3,4].

Most existing research has focused on measuring UCI antenatally using ultrasound. However, postnatal examination of the cord offers more precision, as the entire cord is available for direct measurement. In this context, our study aimed to explore the relationship between postnatal UCI and various perinatal outcomes in women delivering at term. Understanding these associations better could help healthcare professionals flag potential complications early and tailor care accordingly.

2. MATERIAL AND METHOD:

The prospective observational study was carried out in 92 antenatal women aged above 18 years of age within 37- 40 weeks of gestation with singleton pregnancy irrespective of parity and mode of delivery for a period of 3 months who are delivering in the department of obstetrics and Gynecology, at a tertiary care hospital in Chennai. Antenatal women with multifetal pregnancy and history of fetus with congenital malformation where excluded.

Upon admission, a detailed medical history, physical examination, and relevant investigations will be conducted. Informed consent will be obtained from all participants. Demographic information and the patient's medical history will be

documented. Women who meet the inclusion criteria will be evaluated in the Obstetrics and Gynaecology Outpatient

Department (OBG OPD) by professors and assistant professors who are not involved in the study.

Data collected will include age, current and past medical history, and obstetric history. Serial ultrasonography reports performed by professionals not associated with the study, along with routine antenatal blood investigations conducted during the pregnancy, will also be reviewed. Both vaginal deliveries and cases of elective or emergency caesarean sections will be included in the study.

Immediately after the delivery of the baby, the umbilical cord will be clamped, leaving approximately 5 cm on the fetal side. After the placenta is completely separated, the remaining cord length from the cut end to the placental insertion will be measured. This measurement will then be added to the 5 cm left with the baby to determine the total cord length. The number of coils—defined as complete 360-degree spirals of umbilical vessels around Wharton's jelly—will be counted. The coiling index will be calculated by dividing the total number of coils by the total length of the umbilical cord in centimeters.

Obstetric and neonatal outcomes such as mode of delivery (vaginal, instrumental, or caesarean section), abnormal fetal heart rate, abnormal amniotic fluid volume, associated medical conditions (e.g., hypertensive disorders of pregnancy, gestational diabetes mellitus, placental abruption), low birth weight, low Apgar scores, and perinatal mortality will be evaluated in relation to the coiling index. Cases will be categorized into three groups—hypocoiled, normocoiled, and hypercoiled —based on the coiling index and assessed according to the parameters mentioned above. Data collected analysed by using SPSS Version 26 and Epi-info statistical package, version 7. P<0.05 will be considered as statistically significant.

3. RESULTS:

Table 1: Mean Umbilical Cord Index

	Value
Mean UCI	0.257
10th Percentile	0.157
90th Percentile	0.367

Table 2: Coil Characteristics

Coil Characteristics	Number (%)	P-Value
Normocoiling	50 (54.35%)	0.01
Hypercoiling	23 (25%)	0.03
Hypocoiling	19 (20.65%)	0.01

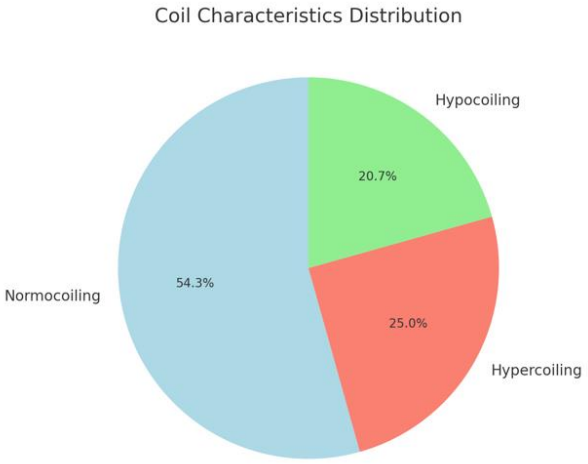

Table 3: Antenatal Complications

Complication	Total n(%)	Hypocoiled n (%)	Normocoiled n (%)	Hypercoiled n (%)	P-Value n (%)
Gestational Hypertension	12 (13%)	4(33.3%)	3 (25%)	5 (41.7)	0.045
Gestational Diabetes	9 (9%)	1 (11.1%)	3 (33.3%)	5 (55.6%)	0.021
Oligohydramnios	8 (8.6%)	4 (50%)	3 (37.5%)	1 (12.5%)	0.038
Polyhydramnios	5 (5.4%)	1 (20%)	1 (20%)	3 (60%)	0.062
Fetal Growth Restriction	10 (10.8%)	5 (50%)	3 (30%)	2 (20%)	0.017

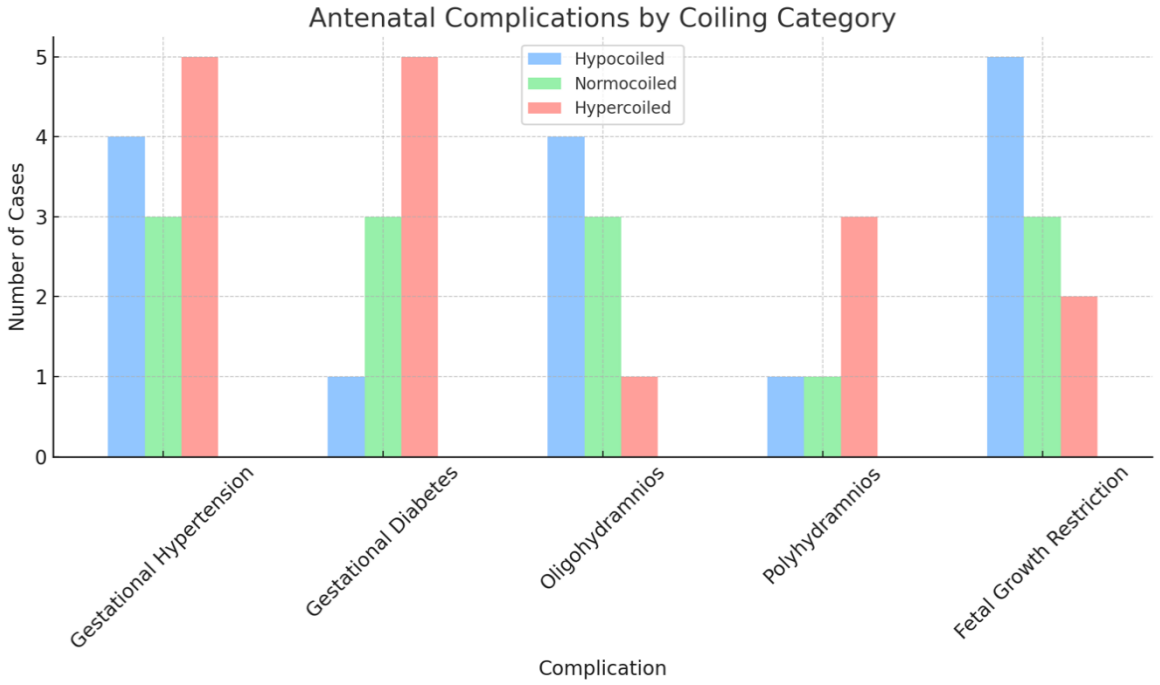

Table 4A: Intrapartum – Fetal Heart Rate

Fetal Heart Rate	Total n (%)	Hypocoiled n (%)	Normocoiled n (%)	Hypercoiled n (%)	P-Value
Normal (110–180 bpm)	72(78.3%)	12 (16.7%)	43 (59.7%)	17 (23.6%)	0.028
Abnormal	20 (21.7%)	7 (35%)	7 (35%)	6 (30%)	

Table 4B: Intrapartum – Liquor

Liquor Condition	Total	Hypocoiled	Normocoiled	Hypercoiled	P-Value
Normal Colour	71 (77.2%)	10 (14.1%)	42 (59.1%)	19 (26.8%)	0.041
Meconium-Stained	21 (22.8%)	9 (42.8%)	8 (38.1%)	4 (19.1%)	

Table 5: Mode of Delivery

Mode of Delivery	Total	Hypocoiled	Normocoiled	Hypercoiled	P-Value
Vaginal Delivery	46 (50%)	7 (15.2%)	30 (65.2%)	9 (19.6%)	0.049
Assisted Vaginal	8 (8.7%)	4 (50%)	3 (37.5%)	1 (12.5%)	
Caesarean Section	38 (41.3%)	8 (21.1%)	17 (44.7%)	13 (34.2%)	0.032

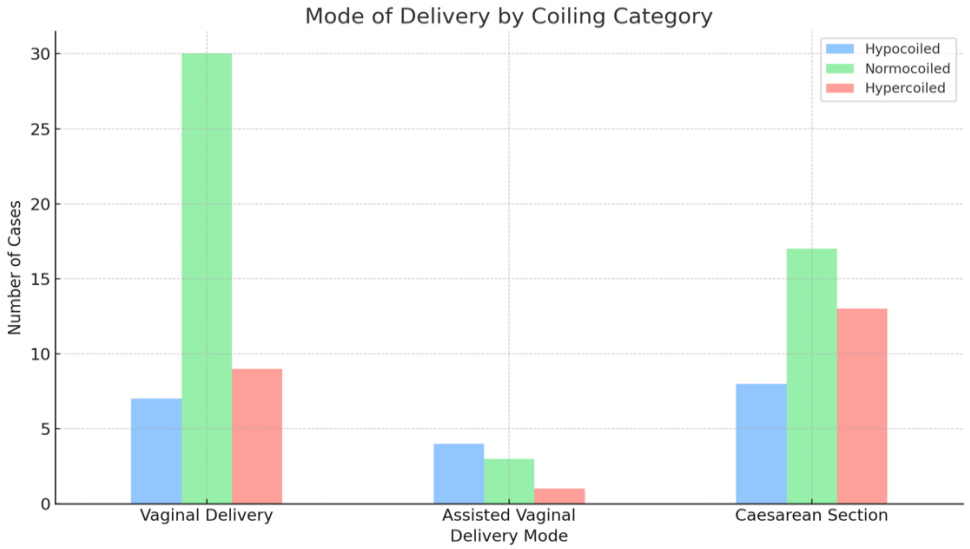

Table 6A: Apgar Score at 1 Minute

Apgar Score Category	Total	Hypocoiled	Normocoiled	Hypercoiled	P-Value
Normal (≥ 7)	76 (82.6%)	12 (15.8%)	45 (59.2%)	19 (25%)	0.044
Low (< 7)	16 (17.4%)	7 (43.75%)	5 (31.28%)	4 (25%)	

Table 6B: Apgar Score at 5 Minutes

Apgar Score Category	Total	Hypocoiled	Normocoiled	Hypercoiled	P-Value
Normal (≥ 7)	84 (91.3%)	14 (16.7%)	49 (58.3%)	21 (25%)	0.031
Low (< 7)	8 (8.7%)	5 (62.5%)	1 (12.5%)	2 (25%)	

Table 6C: Low Birth Weight (< 2.5 kg)

Category	Total	Hypocoiled	Normocoiled	Hypercoiled	P-Value
LBW Cases	18 (19.6%)	7 (38.9%)	6 (33.3%)	5 (27.8%)	0.027

Table 6D: NICU Stay

Category	Total	Hypocoiled	Normocoiled	Hypercoiled	P-Value
NICU Admission	20 (21.7%)	8 (40%)	5 (25%)	7 (35%)	0.016

Table 7: Gestational Age Distribution vs. UCI Category

Gestational Age (weeks)	Hypocoiled	Normocoiled	Hypercoiled	Total
37–38	8 (21%)	21 (55.3%)	9 (23.7%)	38 (41.3%)
38–39	6 (19.4%)	17 (54.8%)	8 (25.8%)	31 (33.7%)
39–40	5 (21.7%)	12 (52.2%)	6 (26.1%)	23 (25%)
Total	19 (16.7%)	50 (54.3%)	23 (25%)	92

Table 8: Parity vs. UCI Category

Parity	Hypocoiled	Normocoiled	Hypercoiled	Total
Primigravida	10 (22.7%)	22 (50%)	12 (27.3%)	44 (47.8%)
Multigravida	9 (18.7%)	28 (58.3%)	11 (23%)	48 (52.2%)
Total	19 (16.7%)	50 (54.3%)	23 (25%)	92

Table 9: Neonatal Sex Distribution vs. UCI

Sex	Hypocoiled	Normocoiled	Hypercoiled	Total
Male	11 (20.4%)	28 (51.8%)	15 (27.8%)	54 (58.7%)
Female	8 (21.05%)	22 (57.9%)	8 (21.05%)	38 (41.3%)
Total	19 (16.7%)	50 (54.3%)	23 (25%)	92

Table 10: UCI Category vs. Composite Adverse Outcome

Composite Outcome (NICU/Low Apgar/LSCS/FGR)	Hypocoiled	Normocoiled	Hypercoiled	P-Value
Present	14 (29.8%)	17 (36.2%)	16 (34%)	0.015
Absent	5 (11.1%)	33 (73.3%)	7 (15.6%)	

4. DISCUSSION:

The present prospective observational study aimed to evaluate the association between postnatal umbilical cord coiling index (UCI) and perinatal outcomes in term pregnancies. Among the 92 antenatal women enrolled, normocoiling was the most prevalent pattern (54.35%), followed by hypercoiling (25%) and hypocoiling (20.65%). These proportions are comparable to previous studies by Strong et al. and Degani et al., where normocoiling was the predominant pattern, supporting the reproducibility of UCI categorization in different populations [6,7].

A key finding was the significant association between abnormal coiling (both hypo- and hypercoiling) and adverse perinatal outcomes. Hypocoiled cords were more frequently associated with fetal growth restriction (FGR), low Apgar scores, abnormal fetal heart rate tracings, and increased NICU admissions. These observations echo the findings of Gupta et al., who reported that hypocoiling is linked with chronic placental insufficiency and restricted fetal growth [8]. Similarly, Nasin et al.

noted that a lower UCI correlates with an increased risk of operative delivery and meconium-stained liquor [9].

Hypercoiling in our cohort also demonstrated significant associations with gestational diabetes, meconium-stained liquor, and increased incidence of cesarean section, which may be attributed to vascular hyperactivity or turbulence in coiled vessels, as suggested by Predanic et al. [10]. However, unlike hypocoiling, hypercoiling showed less association with FGR, aligning with studies by Chitra et al. [11], who proposed that hypercoiling may represent a compensatory adaptation rather than a pathological state in some cases.

Interestingly, parity and fetal sex did not show statistically significant associations with UCI categories in our data, which contrasts with the findings of Rana et al., who observed higher incidence of hypercoiling in male fetuses and primigravidas [12]. This could reflect demographic or genetic variability in umbilical coiling patterns.

The umbilical cord length analysis revealed a trend toward hypercoiling in cords >60 cm and hypocoiling in shorter cords, a finding also documented in the work of Ercal et al., where longer cords were more likely to show exaggerated coiling [13].

The composite outcome analysis underscored the clinical utility of UCI as a predictor of adverse neonatal events. Abnormal UCI was significantly associated with composite outcomes such as NICU admission, low birth weight, low Apgar scores, and need for operative delivery ($P < 0.05$), affirming that UCI may serve as a non-invasive surrogate marker of fetal well-being.

Despite these valuable insights, the study is limited by its relatively small sample size and single-center design. Furthermore, postnatal measurement of UCI might be influenced by cord manipulation or dehydration, although efforts were taken to standardize measurement techniques.

5. CONCLUSION

In summary, this study supports existing evidence that abnormal umbilical coiling—whether excessive or reduced—is associated with adverse maternal and neonatal outcomes. Incorporating UCI measurement into routine ultrasound evaluation, particularly in the third trimester, could improve risk stratification and management of at-risk pregnancies.

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Conflict of Interest

No conflict of interest was noted.

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