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Decreased Fetal Movements and the Role of Ultrasound Assessment in Predicting the Risk of Stillbirth

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Abstract: Decreased Fetal Movements (DFM) is a clinical warning sign that is correlated with placental dysfunction and poor perinatal outcomes. The predictiveness of the traditional ultrasound evaluation of the risk of fetuses, however, is still rather limited. Objective to evaluate the association between decreased fetal movements, ultrasound findings, and the antenatal umbilical cord coiling index (aUCI), and to assess their predictive value for adverse perinatal outcomes, including stillbirth. The present study was a prospective cohort study of 100 pregnant women who were > 28 weeks of gestation at Bent Al-Huda Teaching Hospital. Fifty women with a decrease in fetal movement were compared with 50 gestational age–matched women. Standardized ultrasound assessment was performed in all participants, including fetal biometry, measurement of the amniotic fluid volume, Doppler studies and the antenatal umbilical coiling index. The pregnancy and neonatal outcomes were analyzed. Abnormal ultrasound findings associated with decreased fetal movements are significantly higher for high umbilical artery pulsatility index ($p = 0.026$), fetal growth restriction (estimated fetal weight below the 10th percentile; $p = 0.003$), oligohydramnios ($p < 0.001$), and abnormal aUCI ($p = 0.027$). These pregnancies were associated with smaller gestational age at delivery ($p < 0.001$), higher rates of small-for-gestational age neonates ($p = 0.004$), preterm birth ($p < 0.001$), and admission to NICU for >24 hours ($p = 0.008$) and stillbirth ($p = 0.041$). There was no significant difference in cerebral Doppler indices between the groups ($p>0.05$). Reduced fetal movements are associated with major ultrasound abnormalities of the placenta (and other abnormalities) and adverse perinatal outcomes such as the stillbirth. Including an antenatal umbilical cord coiling index assessment could improve the risk stratification in pregnancies with reduced fetal movements beyond using traditional ultrasound.

Keywords: Decreased Fetal Movements, Ultrasound, Umbilical Cord Coiling Index, Placental Insufficiency, Stillbirth

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1. Introduction

Fetal movement decrease (DFM) is a usual worry during pregnancy, and a clinical marker for fetal compromise, especially in the case of stillbirth. Most pregnancies which present with DFM have good

outcomes, however, decreased fetal movement has been linked to fetal growth restriction, oligohydramnios, preterm birth, and higher perinatal death rates. The observation of fetal movements by the mother is a useful tool for evaluating fetal health, and changes in rhythm, intensity, or frequency may indicate fetal oxygenation problems and/or placental insufficiency [1].

Stillbirth is a significant obstetric problem globally and is caused by various factors such as maternal medical disorders, fetal abnormalities, placental insufficiency and umbilical cord complications [2]. There is evidence that about 55% of women who have a stillbirth have noticed a decrease in fetal movements prior to diagnosis, highlighting the need to assess the situation in the clinic in a timely fashion [3]. In addition, there is a greater risk of poor pregnancy outcomes if there is recurrent episodes of DFM [4].

US is a key role in the evaluation of pregnancies with DFM with evaluation of fetal biometry, estimated fetal weight, amniotic fluid volume and Doppler blood flow indices [5]. The value of traditional ultrasound markers of stillbirth, however, is limited, suggesting that other markers of fetoplacental compromise are needed [6].

The antenatal umbilical coiling index (aUCI) is a sonographic parameter related to the structural features of the umbilical cord that could be a useful index. The dyscoiling present in fetus, like hypocoiling or hypercoiling, is linked to impaired fetoplacental circulation, fetal growth restriction and adverse perinatal outcomes [7,8]. However, its clinical significance in pregnancies complicated by DFM is still poorly understood.

So, the purpose of this research is to assess the relationship between reduced fetal movement, conventional ultrasound measurements, and the antenatal umbilical coiling index and to see how well they predict poor perinatal outcomes, including stillbirth.

2. Method

The study was a prospective cohort study that took place at the Department of Obstetrics and Gynecology, Bint Al-Huda Teaching Hospital from February 9, 2024 to February 9, 2025. This study comprised 100 women with singleton pregnancies at more than 28 weeks' gestation, divided into 2 groups: the first had decreased fetal movements (DFM), while the second had normal fetal movements (NFM), but were matched for gestational age. Women who presented with multiple pregnancies, major fetal dysmorphology, significant maternal medical complications, obesity (BMI ≥30 kg/m²) or known intrauterine fetal death were excluded.

Comprehensive obstetric assessment, cardiotocography and standardized ultrasonography were performed in all participants. Estimated fetal weight (EFW), deepest vertical pocket (DVP), umbilical artery pulsatility index (UA-PI), middle cerebral artery pulsatility index (MCA-PI), cerebroplacental ratio (CPR), antenatal umbilical coiling index (aUCI) were calculated. Abnormal was classified as EFW < 10th percentile, DVP < 2 cm, UA-PI > 95th percentile, MCA-PI < 5th percentile and CPR < 10th percentile or < 1.0, and aUCI < 10th percentile or > 90th percentile. The aUCI was measured as a secondary research tool and did not affect clinical care.

The infants were followed until delivery for the occurrence of stillbirth, small for gestational age infants, preterm delivery, NICU admission, and mode of delivery. A statistical software package SPSS version 18.0 was used to analyze the data. The appropriate statistical tests were Student’s t-test, Mann–Whitney U test, Kruskal–Wallis test and chi-square test. Odds ratios with 95% confidence intervals were used to evaluate associations, with $p<0.05$ considered statistically significant.

3. Results

The women in our study who met the inclusion criteria at the start of the study period (9th February 2024) are included until 9th February 2025. Pregnancy outcomes were evaluated in all the participating women who were singleton pregnancies followed till delivery. No difference was found among the studied groups with respect to age ($p > 0.05$), place of residence (urban vs. rural) ($p > 0.05$) and occupation ($p > 0.05$). Table 1 indicates that BMI was found to be significantly different between groups with the DFM group having a higher mean BMI compared to the control group (25.94 and 24.49 respectively, $p = 0.001$).

Table 1. Demographic data in the studied groups

Variables	DFM group N= 50	Control group N= 50	Test	P value
Age (year) Mean ±SD	30.7 ±6.04	31.56 ±4.04	T=0.83	0.404
BMI (kg/m^2) Mean ±SD	25.94 ±2.14	24.49 ±2.35	T= 3.22	0.001
		Residence		
Urban	28 (56%)	21 (42%)	X^2=1.96	0.161
Rural	22 (44%)	29 (58%)		
		Occupation		
Housewife	23 (46%)	22 (44%)	X^2=0.04	0.841
Employed	27 (54%)	28 (56%)		

There was no statistically significant difference between the DFM and control groups regarding gravidity ($p = 1.000$) and previous cesarean section ($p = 0.160$). However, there were statistically significant differences in parity ($p = 0.005$), number of abortions ($p = 0.003$), and previous stillbirth ($p = 0.041$). Specifically, the control group had a higher proportion of primiparous women (38% vs. 14%) and women with one abortion (54% vs. 36%). In contrast, the DFM group had a higher proportion of multiparous women (64% vs. 34%) and experienced previous stillbirths (8% vs. 0%), as shown in Table 2.

Table 2. Obstetric history in the studied groups

Variables	DFM group N= 50	Control group N= 50	Test	P value
		Gravidity		
Primigravida	6 (12%)	6 (12%)	X^2=0.000	1.000
Multigravida	44 (88%)	44 (88%)		
		Parity		
Nulliparous	11 (22%)	14 (28%)		
Primiparous	7 (14%)	19 (38%)	X^2=10.49	*0.005*
Multiparous	32 (64%)	17 (34%)		
		NO of abortion		
0	14 (28%)	20 (40%)		
1	18 (36%)	27 (54%)		
2	15 (30%)	3 (6%)	X^2=13.859	*0.003*
3	3 (6%)	0.0 (0.0%)		
Previous CS	15 (30%)	9 (18%)	X^2=1.97	0.160
Previous stillbirth	4 (8%)	0 (0%)	X^2=4.16	*0.041*

The DFM group had significantly higher rates of abnormal UAPI (>95th percentile), EFW <10th percentile, and abnormal DVP (<2 cm), abnormal aUCI compared to the control group (p = 0.026, 0.003, <0.001 and 0.027, respectively), in contrast, there was no statistically significant difference between the two groups regarding CPR <10th percentile or MCAPI <5th percentile (p > 0.05), as shown in table 3.

Table 3. Ultrasound parameters in the studied groups

Variables	DFM group N= 50	Control group N= 50	Test	P value
UAPI >95th percentile	7 (14%)	1 (2%)	X^2= 4.891	0.026
CPR <10th percentile	6 (12%)	4 (8%)	X^2=0.444	0.505
MCAPI <5th percentile	5 (10%)	1 (2%)	X^2= 2.837	0.092
EFW <10th percentile	14 (28%)	3 (6%)	X^2= 8.575	0.003
DVP <2 cm	15 (30%)	2 (4%)	X^2=11.977	<0.001
Abnormal aUCI	10 (20%)	2 (4%)	X^2=4.91	0.027

There was significant difference between the DFM and control groups in terms of gestational age at delivery (37.56 ± 1.80 vs. 39.34 ± 1.08, p < 0.001). Although the rates of normal vaginal delivery and cesarean section were higher in the control and DFM groups, respectively, these differences were not statistically significant (p = 0.157). There were differences in several poor outcomes. The DFM group had a higher incidence of Small for Gestational Age (SGA) (34% vs. 10%, p = 0.004), preterm birth (28% vs. 0%, p < 0.001), NICU admission >24 hours (18% vs. 2%, p = 0.008), and stillbirth (8% vs. 0%, p = 0.041). Table 4 shows that there was no significant difference (p = 0.081) between the DFM and other groups in the number of emergency cesarean sections performed for foetal distress. There was no significant difference (p = 0.081) between the DFM and other groups regarding the number of patients who had emergency cesarean section for foetal distress as shown in Table 4.

Table 4. Pregnancy outcomes in the studied groups

Variables	DFM group N= 50	Control group N= 50	Test	P value
GA at delivery (weeks) Mean ±SD	37.56 ±1.80	39.34 ±1.08	t = 5.996	*<0.001*
NVD	25 (50%)	32 (64%)	X^2= 1.999	0.157
C/S	25 (50%)	18 (36%)	X^2= 1.999	0.157
SGA	17 (34%)	5 (10%)	X^2= 8.392	*0.004*
Preterm birth	14 (28%)	0 (0.0%)	X^2= 16.279	*<0.001*
NICU admission >24 h	9 (18%)	1 (2%)	X^2= 7.111	*0.008*
Stillbirth	4 (8%)	0 (0.0%)	X^2= 4.167	*0.041*
Emergency CS for fetal distress	7 (14%)	2 (4%)	X^2= 3.053	0.081

As shown in table 5, the mean gestational age at delivery was not significantly different between the 7 groups (p = 0.72) ranging from 36.9 ± 2.5 to 38.3 ± 1.3 weeks. In the same way, the mode of delivery was similar in both groups as shown that there was no statistically significant difference between the rates of normal vaginal delivery (p = 0.61) or cesarean section (p = 0.58). No significant difference was found among groups in terms of pre-term birth rate (p = 0.83).

However, in contrast, the incidence of SGA babies was found to be significantly different across the various categories of antenatal abnormalities (p = 0.043). There was a significant association between impaired placental or cord function and SGA, as the highest rates of SGA were observed in pregnancies with high UAPI (87.5%), hypercoiled umbilical cords (83.3%) and hypocoiled umbilical cords (66.7%).

Results for neonatal outcomes were also significantly different between groups.

Abnormal umbilical cord coiling significantly affected admission to NICU more than 24 hours with a higher rate for hypocoiled cords (50%) and hypercoiled cords (33.3%) than Doppler based abnormalities ($p = 0.048$). In addition, stillbirth was only seen in pregnancies where there was EFW <10th percentile, abnormal DVP and abnormal umbilical coiling, with highest prevalence seen in pregnancies with hypercoiled aUCI (33.3%). This difference was statistically significant ($p = 0.011$). Emergency cesarean section (ECS) due to fetal distress was found to be between 11.8% and 33.3% across groups and no statistically significant association was found between the type of abnormality in the fetus and the ECS ($p = 0.67$).

Table 5. Comparison of Delivery Outcomes Across Abnormal Doppler and Ultrasound Parameters

Variables	UAPI >95th percentile N= 8	CPR <10th percentile N=10	MCAPI <5th percentile N= 6	EFW <10th percentile N= 17	DVP <2 cm N= 17	Hypocoiled aUCI <10th percentile N=6	Hypercoiled aUCI >90th percentile N=6	p-value
GA at delivery (weeks) Mean ±SD	37.0 ±3.4	38.3 ± 1.3	38 ±1.9	37.2 ±2.4	37.1±2.4	36.9±2.5	37.3±2.1	0.72
NVD	5 (62.5%)	4 (40%)	4 (66.7%)	7 (41.2%)	6 (35.3%)	2 (33.3%)	3 (50%)	0.61
C/S	3 (37.5%)	6 (60%)	2 (33.3%)	10 (58.8%)	11 (64.7%)	4(66.7%)	3(50%)	0.58
SGA	7 (87.5%)	6 (60%)	2 (33.3%)	9 (52.9%)	7 (41.2%)	4(66.7%)	5(83.3%)	0.043
Preterm birth	3 (37.5%)	0 (0.0%)	2 (33.3%)	5 (29.4%)	6 (35.3%)	3(50%)	2(33.3%)	0.83
NICU admission >24 h	2 (25%)	0 (0.0%)	0 (0.0%)	2 (11.8%)	3 (17.6%)	3(50%)	2(33.3%)	0.048
Stillbirth	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (17.6%)	4 (23.5%)	1(16.7%)	2(33.3%)	0.011
Emergency CS for fetal distress	1 (12.5%)	3 (30%)	1 (16.7%)	2 (11.8%)	5 (29.4%)	1(16.7%)	2(33.3%)	0.67

4. Discussion

The present study shows that the reduced fetal movements (RFM) is very strongly linked to poor antenatal findings and poor perinatal outcomes, which indicates that while some fetuses with RFM may develop normally, some show increased risks of poor outcomes such as fetal growth restriction, oligohydramnios and stillbirth [9,10]. The results of this study broadly support the previous one and further strengthen the increasing body of evidence that indicates that DFM can be a prognostic factor.

In the current cohort, for analyses of the effects of DFM, socio-demographic factors were comparable between the DFM and control groups, and therefore unlikely to introduce confounding. However, maternal BMI was significantly higher in the DFM group (25.94 ± 2.14 kg/m²) compared with controls (24.49 ± 2.35 kg/m²). These findings are confirmed by prior studies that indicated increased BMI in maternal weight could be linked to impaired perception of fetal movements and a higher likelihood of placental dysfunction and poor pregnancy outcomes.

The two groups had vastly different obstetric histories. Women with DFM were more likely to be multiparity (64% versus 34%) and previous stillbirth was only reported in the DFM group (8% versus 0%). Gordon Smith and Alexander Heazell [11,12] made similar observations and reported that women with a history of adverse obstetric outcomes are at risk of placental insufficiency and fetal compromise in subsequent pregnancies.

The pregnancy rate for DFM was significantly higher for pregnancies with abnormal umbilical artery Doppler (UAPI>95th percentile: 14% vs. 2%), fetal growth restriction (EFW<10th percentile: 28% vs. 6%), oligohydramnios (DVP<2 cm: 30% vs. 4%) and abnormal antenatal umbilical cord coiling index (aUCI: 20% vs. 4%). The results corroborate those of Alexander Heazell and Vicki Flenady [13] who showed that decreased fetal movements are often linked to objective signs of placental dysfunction and fetal--placental circulation abnormalities.

However, there were no significant differences in cerebral Doppler parameters between the DFM and control groups, such as CPR <10th percentile and MCAPI <5th percentile. This pattern is similar to what was pointed out by Baschat Ahmed [14] who noted that normal Doppler indices do not rule out fetal compromise, especially in the late onset of placental insufficiency. Such results indicate that use of cerebral Doppler parameters may be inadequate for assessing fetal risk in women with DFM.

The pregnancy outcomes were significantly poor among women with DFM. The gestational age was significantly lower in DFM group (37.56 ± 1.80 weeks) than in controls (39.34 ± 1.08 weeks). In DFM pregnancies, 34% of infants were SGA while in controls 10% were SGA, and 28% of DFM infants were preterm, while none of the controls were. Tessy Stacey [15] and Julia Unterscheider [16] reported similar findings of association between DFM, FGR, and early delivery, and proposed that the early delivery is much more likely to result from fetal than from spontaneous preterm delivery.

Pregnancy complicated by DFM also had a significantly higher rate of neonatal morbidity. 18% of the neonates in the DFM group needed to be admitted to the NICU for over 24 hours, while only 2% of neonates in the control group required admission to the NICU. Similar results have been published by Emily O'Sullivan [17] who showed that reduced fetal movements during pregnancy resulted in increased neonatal morbidity.

Stillbirth was only observed in the DFM group (8% vs 0%) and this is consistent with the known relationship between DFM and perinatal mortality. Many stillbirths occur when the mother notifies the physician of decreased fetal movements. The results confirm current clinical guidance from the Royal College of Obstetricians and Gynaecologists [18] which indicates that DFM is a significant antenatal risk factor and highlights the need for early assessment and management.

One of the most significant results of the present study is the high association between abnormal antenatal umbilical cord coiling and bad pregnancy outcomes. The highest rates of small for gestational age babies, NICU admission>24 hr and stillbirth were all associated with abnormal aUCI. The results of this study are similar to those of Ercal Turgut and Degani Shlomo [19] who showed that hypo-coiled and hyper-coiled cords are linked to blood flow impairment in the fetoplacental unit and a higher risk of fetal hypoxia.

In conclusion, the results of the present study are in general accordance with the other studies and support the need to evaluate fetuses more thoroughly rather than being reassured when fetal movements decrease. Incorporation of fetal growth assessment, the volume of amniotic fluid, Doppler studies, and the assessment of coiling of the umbilical cord could improve the identification of fetuses most at risk for adverse outcomes and thus more effective perinatal care.

5. Conclusions

This study shows that reduced fetal movements (RFM) are significantly related with poor perinatal outcome such as fetal growth restriction, preterm delivery, admission to the neonatal intensive care unit (NICU) and still birth. The prevalence of abnormal ultrasound measurements was greater in pregnancies complicated by DFM, such as decreased estimated fetal weight, oligohydramnios, abnormal umbilical artery Doppler indices and abnormal antenatal umbilical cord coiling patterns. In addition, the use of cerebral Doppler indices alone was not adequate to effectively rule out fetal compromise. The abnormal coiling of the umbilical cord was found to be a potential predictor of poor fetal and neonatal outcomes, and could be used as a further parameter in fetal risk stratification. These results underscore the need to undertake a thorough evaluation with ultrasound in pregnancies complicated by DFM to enable early detection of fetal compromise, expedient management decisions, and minimize perinatal morbidity and mortality.

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