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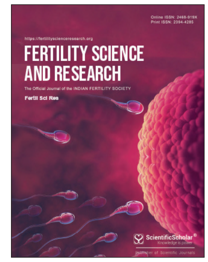

Original Article

Gross Placental Morphometry and Morphological Features in Pregnancies Among Women Living with HIV: A Case–Control Study

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ABSTRACT

Objectives: Pregnancies among women living with human immunodeficiency virus (HIV) remain associated with adverse perinatal outcomes in sub-Saharan Africa despite widespread antiretroviral therapy. The placenta plays a central role in foetal growth and maternal-foetal exchange, and gross placental examination offers a low-cost approach for identifying clinically relevant abnormalities in resource-limited settings. However, data from Southern Nigeria are limited. Thus, we aimed to compare gross placental morphometry and morphological features between HIV-positive pregnant women and HIV-negative controls in Uyo, Southern Nigeria.

Material and Methods: This hospital-based case-control study examined placentas from 48 HIV-positive and 96 HIV-negative mothers. Placental weights were measured before and after formalin fixation and categorised using gestational age-adjusted standards. Gross features of the foetal membranes, umbilical cord, and placental disk were systematically assessed. Between-group comparisons employed non-parametric and categorical tests, with significance set at $p<0.05$.

Results: Placentas from women living with HIV had significantly lower weights before and after fixation compared with HIV-negative controls ($p= 0.001$ and $p<0.001$, respectively). Gestational age-adjusted placental weight categories also differed significantly between groups. Umbilical cord length was shorter in HIV-positive pregnancies ($p= 0.026$), and cord discolouration was more frequent ($p= 0.010$). Most foetal membrane and placental disk features showed no significant differences.

Conclusion: Pregnancies among women living with HIV are associated with reduced placental weight, shorter umbilical cords, and increased cord discolouration, reflecting subtle but clinically relevant placental compromise. Routine gross placental examination may help identify at-risk pregnancies in resource-constrained settings.

Keywords: Foetal membrane, Gross placental morphometry, HIV-positive pregnancy, Placental disk, Umbilical cord

INTRODUCTION

Human immunodeficiency virus (HIV) infection remains an important contributor to maternal and perinatal morbidity in sub-Saharan Africa, where a substantial proportion of women of reproductive age live with the infection.[1-8] Although the widespread use of highly active antiretroviral therapy (HAART) has significantly reduced maternal mortality and motherto-child transmission, adverse pregnancy outcomes such as low birth weight, preterm delivery, and foetal growth restriction continue to be reported among pregnancies among women living with HIV.[1,9–15] These outcomes suggest that HIV infection may exert persistent effects on pregnancy physiology beyond viral suppression alone.

The placenta plays a central role in maintaining maternal-foetal homeostasis, serving as the interface for nutrient exchange, oxygen transfer, waste elimination, and immunological regulation.[1–4,9,11–14,16–23] Disruption of placental structure or function can therefore have direct consequences for foetal growth and neonatal outcome. Previous studies have demonstrated that HIV infection is associated with placental abnormalities, including reduced placental weight, vascular malperfusion, inflammatory lesions, and altered villous architecture.[1–4,9,11–14,16–24] Proposed mechanisms include chronic maternal inflammation, endothelial dysfunction, immune activation at the maternal-foetal interface, and placental vascular compromise, which may persist even in the HAART era.[1–9,11–25]

While histopathological studies have provided valuable insights into HIV-associated placental lesions, gross placental examination remains an underutilised yet clinically practical tool, particularly in resource-limited settings.[1–4,9,16–21,26] Simple measurements such as placental weight, umbilical cord length, and gross morphological features of the foetal membranes and placental disk can serve as accessible markers of placental health and foetal well-being.[1–3,9–11,13,17–20,22,23,26–30] However, data on gross placental morphometry and morphology in pregnancies among women living with HIV are limited, especially in West Africa and Southern Nigeria.

This study, therefore, aimed to compare gross placental morphometry and morphological features between pregnancies among women living with HIV and HIV-negative controls in Uyo, Southern Nigeria. By focusing on gross placental characteristics, this work seeks to highlight pragmatic, low-cost markers of placental compromise that may support risk stratification and improve perinatal care in resource-constrained settings.

MATERIAL AND METHODS

Study design and setting

This was a hospital-based case-control study conducted at the Departments of Histopathology and Obstetrics and Gynaecology of the University of Uyo Teaching Hospital (UUTH), Uyo, Akwa Ibom State, Southern Nigeria. The study formed part of a broader investigation into placental pathology in pregnancies among women living with HIV.

Study population

The study population consisted of consecutive placentas obtained at delivery from consenting mothers with known HIV status. Cases comprised placentas from women living with HIV, while controls were placentas from HIV-negative women delivering during the same study period. HIV status was determined using routine antenatal screening records based on nationally approved serial rapid testing algorithms.[31]

Inclusion and exclusion criteria

Included were pregnancies delivered at ≥28 weeks' gestation with complete clinical records and intact placentas suitable for gross examination. Exclusion criteria included grossly macerated placentas and placentas with extensive mechanical disruption that precluded accurate assessment.

Clinical data collection

Maternal demographic and obstetric data, including age, gestational age at delivery, and HIV status, were extracted from antenatal and delivery records. Gestational age was determined based on the last menstrual period, corroborated by early obstetric ultrasound, where available.

Placental collection and gross examination

A total of 144 Placentas were collected immediately following delivery and examined according to standard placental gross examination protocols. In multiple gestations, each placenta was examined and analysed separately using the same gross examination protocol. After trimming of membranes and umbilical cord, placental weight was measured using a calibrated digital scale within hours of delivery (pre-fixation weight). Placentas were subsequently fixed in 10% neutral buffered formalin for 48 h and re-weighed (post-fixation weight). Placental weights were categorised using gestational age-adjusted reference standards for placental weight.[32] Gross morphological assessment was performed using a structured data collection form and included evaluation of:

- **Foetal membranes:** Completeness, opacity, nodules, hematoma, bands or adhesions, insertion type, and extrachorial components.
- **Umbilical cord:** Length, diameter, insertion site, distance from placental margin, number of vessels, knots, torsion, discolouration, oedema, and hematoma.
- **Placental disk:** Shape, dimensions, thickness, surface characteristics, subchorionic fibrin, hematoma, and chorionic plate vessel appearance.

Statistical analysis

Data were entered into Microsoft Excel (Microsoft Corp., USA) and analysed using Python (version 3.13). Continuous variables were summarised using means with standard deviations or medians with interquartile ranges, as appropriate. Categorical variables were expressed as frequencies and percentages. Between-group comparisons (HIV-positive vs. HIV-negative) were performed using the Mann-Whitney U test for continuous variables and the Chi-square or Fisher's exact test for categorical variables. All tests were two-tailed, and statistical significance was defined as $p < 0.05$. No stratified analysis was performed based on plurality due to the limited number of multiple gestations.

Ethical considerations

Ethical approval was obtained from the Health Research Ethics Committee of the University of Uyo Teaching Hospital (Reference: UUTH/AD/S/96/VOL.XII/115) as a subset of a larger placental study project. Written informed consent was obtained from all participants prior to inclusion, and all data were anonymised to ensure confidentiality.

RESULTS

Study population characteristics

A total of 144 placentas were examined, comprising 48 from pregnancies among women living with HIV and 96 from HIV-negative controls. Maternal age and gestational age at delivery were comparable between groups. The median maternal age was 30 years in the HIV-positive group and 29 years in the HIV-negative group, while the median gestational age at delivery was 39 weeks in both groups. There were no statistically significant differences in maternal age or gestational age between groups ($p>0.05$) [Table 1].

Placental weights before and after fixation

Placentas from women living with HIV demonstrated significantly lower weights compared with HIV-negative controls, both before and after formalin fixation. Pre-fixation placental weight was significantly lower in the HIV-positive group ($p= 0.001$), and this difference persisted after 48 hours of fixation ($p<0.001$) [Table 1]. A proportional reduction in placental weight following fixation was observed in both groups. When placental weights were categorised using gestational age-adjusted essential pathology reference standards, significant differences in weight category distribution were identified between HIV-positive and HIV-negative pregnancies. A greater proportion of placentas from HIV-negative controls fell within the higher weight category, whereas placentas from HIV-positive pregnancies were more frequently represented in the lower weight categories ($p<0.05$) [Table 1].

Umbilical cord and foetal membrane morphometry/features

Umbilical cord length was significantly shorter in pregnancies among women living with HIV compared with HIV-negative controls ($p= 0.026$), while cord diameter did not differ significantly between groups [Table 1].

Gross examination of the foetal membranes revealed that incomplete membranes were more frequently observed in placentas from HIV-positive pregnancies compared with HIV-negative controls ($p= 0.014$). No significant differences were identified between groups with respect to membrane opacity, nodules, bands or adhesions, hematoma, insertion type, or extrachorial components [Table 2].

Notably, although marginal cord insertion was more frequent in the HIV-positive group, this difference did not reach statistical significance [Table 3]. Qualitative assessment of umbilical cord features showed that cord discolouration occurred more frequently in HIV-positive pregnancies than in controls ($p = 0.010$). Other umbilical cord characteristics, including the number of vessels, knots, torsion, oedema, and hematoma, were comparable between groups [Table 3].

Representative umbilical cord and foetal membrane findings are depicted in [Figures 1 to 3].

Placental disk morphology

Quantitative placental disk dimensions, including length, width, and thickness, were similar between HIV-positive and HIV-negative groups [Table 1]. Qualitative assessment demonstrated statistically significant differences in placental disk shape, connecting blood vessels, selected chorionic plate vessel abnormalities, and cut-surface features ($p< 0.05$) [Table 4].

However, most placental disk surface characteristics did not differ significantly between groups. Representative placental disk features are shown in [Figures 1 to 3].

Exploratory analyses among HIV-positive pregnancies

Within the HIV-positive group, exploratory analyses based on HIV clinical stage demonstrated significant associations with selected gross placental features, including foetal membrane completeness, foetal membrane hematoma, placental disk hematoma, and maternal surface colour [Figure 4]. No consistent differences were observed in major placental morphometric parameters across HIV stages.

Similarly, exploratory comparison based on HAART exposure showed a significant difference in the distance of umbilical cord insertion from the placental margin, while other gross placental parameters did not differ significantly between treated and untreated women [Figure 5]. Given the small number of untreated cases, these findings were interpreted descriptively.

Table 1: Maternal, gestational, and placental morphometric characteristics in HIV-positive vs. HIV-negative pregnancies.

Mothers' age (Years)											
Mothers' age (years)	HIV-positive mothers (n = 48)					HIV-negative mothers (n = 96)					
	Mean	Median	Std	Min	Max	Mean	Median	Std	Min	Max	p value
	30.20	30	4.28	21	38	29	29	4.31	19	41	0.079
Gestational age (GA) in weeks											
Gestational age (GA) in weeks	HIV-positive mothers (n = 48)					HIV-negative mothers (n = 96)					
	Mean	Median	Std	Min	Max	Mean	Median	Std	Min	Max	p value
	38.22	39	2.69	30	43	38.27	39	2.48	28	42	0.918
Placental weight categories (g) [based on weights before fixation]											
Variables	Placental weights at GA 38-40 weeks (n = 103)					Placental weights at all GA (in weeks) (n = 145)					
	<340 g		340-540 g	>540 g		<340 g		340-540 g	>540 g		
HIV-positive	1 (0.97%)		10 (9.71%)	24 (23.30%)		3 (2.07%)		14 (9.66%)	32 (22.07%)		
HIV-negative	0 (0.00%)		7 (6.80%)	61 (59.22%)		0 (0.00%)		12 (8.28%)	84 (57.93%)		
p value	0.020					0.002					
Placental weight before fixation (g)											
Placental weight before fixation (g)	HIV-positive mothers (n = 48)					HIV-negative mothers (n = 96)					
	Mean	Median	Std	Min	Max	Mean	Median	Std	Min	Max	p value
	588.78	600	170.86	300	1200	678.23	650	136.19	450	1200	0.001
Placental weight after 48 hours of fixation (g)											
Placental weight after 48 hours fixation (g)	HIV-positive mothers (n = 48)					HIV-negative mothers (n = 96)					
	Mean	Median	Std	Min	Max	Mean	Median	Std	Min	Max	p value
	435.71	450	106.83	200	750	519.48	500	104.65	300	800	<0.001
Umbilical cord length (cm)											
Umbilical cord length (cm)	HIV-positive mothers (n = 48)					HIV-negative mothers (n = 96)					
	Mean	Median	Std	Min	Max	Mean	Median	Std	Min	Max	p value
	26.28	26	10.04	9	46.5	30.32	30	10.69	4.5	58.2	0.026
Umbilical cord diameter (cm)											
Umbilical cord diameter (cm)	HIV-positive mothers (n = 48)					HIV-negative mothers (n = 96)					
	Mean	Median	Std	Min	Max	Mean	Median	Std	Min	Max	p value
	1.58	1.6	0.35	0.9	2.4	1.64	1.7	0.34	0.5	2.7	0.151
Placental disk dimension 1 (cm)											
Placental disk dimension 1 (cm)	HIV-positive mothers (n = 48)					HIV-negative mothers (n = 96)					
	Mean	Median	Std	Min	Max	Mean	Median	Std	Min	Max	p value
	19.53	19	4.41	12.2	32	19.27	19	3.03	13	28.2	0.872
Placental disk dimension 2 (cm)											
Placental disk dimension 2 (cm)	HIV-positive mothers (n = 48)					HIV-negative mothers (n = 96)					
	Mean	Median	Std	Min	Max	Mean	Median	Std	Min	Max	p value
	16.44	16	2.97	10.5	23.8	16.82	16.55	2.99	8	24.2	0.401
Placental disk dimension 3 (cm)											
Placental disk dimension 3 (cm)	HIV-positive mothers (n = 48)					HIV-negative mothers (n = 96)					
	Mean	Median	Std	Min	Max	Mean	Median	Std	Min	Max	p value
	2.50	2.6	0.64	1	3.4	2.49	2.5	0.76	1	5	0.564

Statistically significant p-value: p-value <0.05

Table 2: Comparative analysis of foetal membrane morphological features between HIV-positive and HIV-negative mothers.

Completeness of the foetal membrane					
Completeness of the foetal membrane	HIV-positive mothers (n = 48)		HIV-negative mothers (n = 95)		
	Frequency	Percentage (%)	Frequency	Percentage (%)	p value
Complete	37	77.08	88	92.63	0.014
Incomplete	11	22.92	7	7.37	
Opacity of the foetal membrane					
Opacity of the foetal membrane	HIV-positive mothers (n = 48)		HIV-negative mothers (n = 95)		
	Frequency	Percentage (%)	Frequency	Percentage (%)	p value
Opaque	27	56.25	37	38.95	0.053
Transparent	21	43.75	58	61.05	
Foetal membrane nodules					
Foetal membrane nodules	HIV-positive mothers (n = 48)		HIV-negative mothers (n = 95)		
	Frequency	Percentage (%)	Frequency	Percentage (%)	p value
No	47	97.92	90	94.74	0.664
Yes	1	2.08	5	5.26	
Foetal membrane bands and adhesions					
Foetal membrane bands and adhesions	HIV-positive mothers (n = 48)		HIV-negative mothers (n = 95)		
	Frequency	Percentage (%)	Frequency	Percentage (%)	p value
No	45	93.75	90	94.74	1
Yes	3	6.25	5	5.26	
Foetal membrane hematoma					
Foetal membrane hematoma	HIV-positive mothers (n = 48)		HIV-negative mothers (n = 95)		
	Frequency	Percentage (%)	Frequency	Percentage (%)	p value
No	39	81.25	80	84.21	0.644
Yes	9	18.75	15	15,79	
Foetal membrane insertion type					
Foetal membrane insertion type	HIV-positive mothers (n = 48)		HIV-negative mothers (n = 95)		
	Frequency	Percentage (%)	Frequency	Percentage (%)	p value
Circummarginate	3	6.25	10	10.53	0.645
Circumvallate	1	2.08	3	3.16	
Margin	44	91.67	82	86.32	
Foetal membrane extrachorial component					
Foetal membrane extrachorial component	HIV-positive mothers (n = 48)		HIV-negative mothers (n = 95)		
	Frequency	Percentage (%)	Frequency	Percentage (%)	p value
No	47	97.92	94	98.95	0.288
Yes (3%)	1	2.08	0	0.00	
Yes (5%)	0	0.00	1	1.05	

Statistically significant p-value: p value <0.05

Table 3: Comparison of umbilical cord morphological and structural features between HIV-positive and HIV-negative mothers.

Umbilical cord site of insertion					
Umbilical cord site of insertion	HIV-positive mothers (n = 48)		HIV-negative mothers (n = 95)		
	Frequency	Percentage (%)	Frequency	Percentage (%)	p value
Central	7	14.58	22	23.16	0.422
Eccentric	37	77.08	67	70.53	
Marginal	3	6.25	5	5.26	
Membranous	0	0.00	1	1.05	
Velamentous	1	2.08	0	0.00	
Distance of the umbilical cord from the nearest disk margin (cm)					
Distance of the umbilical cord	HIV-positive mothers (n = 48)		HIV-negative mothers (n = 95)		
	Frequency	Percentage (%)	Frequency	Percentage (%)	p value
<2.5 cm (marginal)	14	29.2	19	20.0	0.120
2.5–6.0 cm (eccentric)	25	52.1	52	54.7	
>6.0 cm (central)	9	18.8	24	25.3	
Number of blood vessels in the umbilical cord					
Number of blood vessels	HIV-positive mothers (n = 49)		HIV-negative mothers (n = 96)		
	Frequency	Percentage (%)	Frequency	Percentage (%)	p value
2	1	2.04	3	3.13	0.718
3	48	97.96	92	95.83	
4	0	0.00	1	1.04	
Umbilical cord true knots					
Umbilical cord true knots	HIV-positive mothers (n = 48)		HIV-negative mothers (n = 95)		
	Frequency	Percentage (%)	Frequency	Percentage (%)	p value
False knots	14	29.17	15	15.79	0.078
No	34	70.83	80	84.21	
Excess torsion of the umbilical cord					
Excess torsion of the umbilical cord	HIV-positive mothers (n = 48)		HIV-negative mothers (n = 95)		
	Frequency	Percentage (%)	Frequency	Percentage (%)	p value
No	42	87.50	79	83.16	0.626
Yes	6	12.50	16	16.84	
Discolouration of the umbilical cord					
Discolouration of the umbilical cord	HIV-positive mothers (n = 48)		HIV-negative mothers (n = 95)		
	Frequency	Percentage (%)	Frequency	Percentage (%)	p value
Brownish	0	0.00	2	2.11	0.010
Creamy	0	0.00	1	1.05	
Greenish	22	45.83	33	34.74	
No	21	43.75	57	60.00	
Yellowish	5	10.42	2	2.11	
Umbilical cord hematoma					
Umbilical cord hematoma	HIV-positive mothers (n = 48)		HIV-negative mothers (n = 95)		
	Frequency	Percentage (%)	Frequency	Percentage (%)	p value
No	18	37.50	29	30.53	0.453
Yes	30	62.50	66	69.47	

Statistically significant p value: p value <0.05

Figure 1 (A – F): Comparative distribution of selected qualitative gross placental features among HIV-positive and HIV-negative mothers. Panels show: (A) umbilical cord edema, (B) umbilical cord web, (C) subchorionic fibrin of placental disk, (D) amnion nodosum of placental disk, (E) placental disk hematoma, and (F) assessment of placental disk cut surfaces. Bars represent category frequencies and percentages within each group, with p-values indicating statistical significance of group differences. Statistically significant p value: p value <0.05.

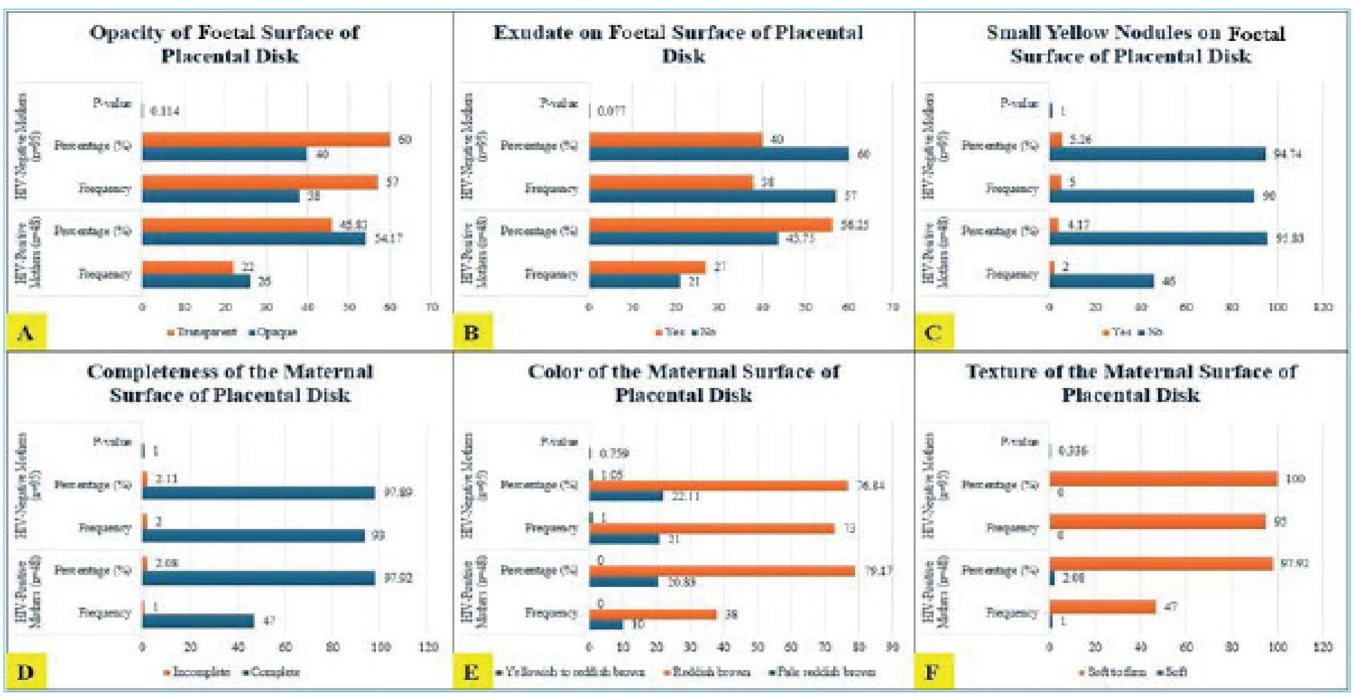

Figure 2 (A – F): Comparative distribution of qualitative gross placental disk surface features between HIV-positive and HIV-negative mothers. Panels show: (A) Opacity and (B) Exudate of the fetal surface, (C) Small yellow nodules on the fetal surface, (D) Completeness, (E) Color, and (F) Texture of the maternal surface of the placental disk. Bars represent frequencies and percentages, with p-values indicating statistical significance of differences between groups. Statistically significant p value: p value <0.05.

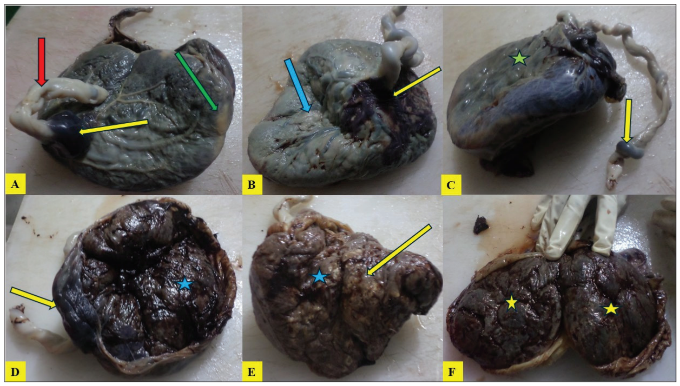

Figure 3 (A – F): Representative Gross Placental Features Observed in HIV-Positive and HIV-Negative Pregnancies. Panels A–F show representative gross placental findings. (A) Short umbilical cord with marginal insertion (red arrow), subchorionic fibrin deposition (green arrow), and marginal hematoma (yellow arrow) at the point of insertion of the umbilical cord to the fetal surface of placental disk. (B) Extensive opacity (blue arrow) of the fetal surface of the placental disk with eccentric umbilical cord insertion and hematoma (yellow arrow). (C) Umbilical cord edema and hematoma (yellow arrow) and opacity with greenish discoloration of the fetal surface (green star) of the placental disk. (D) Hematoma of the fetal membrane (yellow arrow) and irregular maternal surface (blue star) of the placental disk. (E) Diffuse maternal surface fibrosis with calcification (blue star) and prominent lobulation (yellow arrow). (F) Maternal surface of a bilobed placental disk from a twin gestation showing nodular consistency and diffuse lobulation (yellow stars).

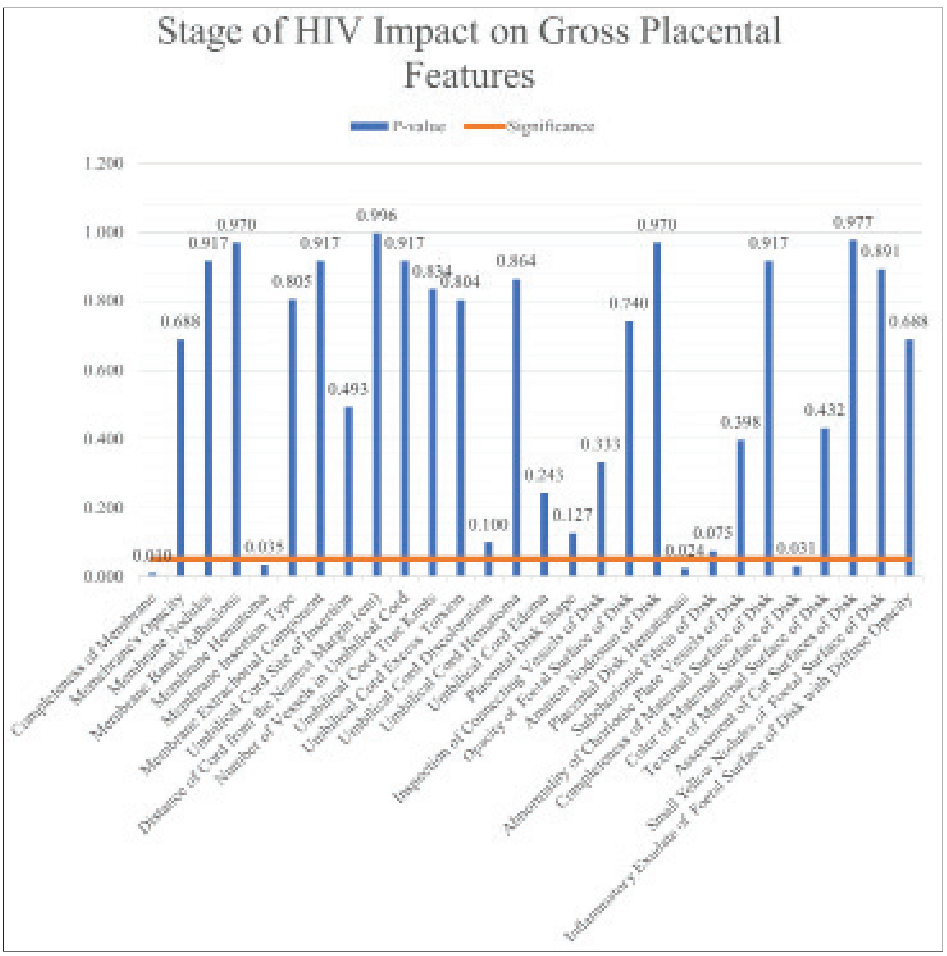

Figure 4: Impact of HIV disease stage on gross placental morphometric and morphological features. This bar chart summarises the influence of HIV clinical stage on multiple gross placental features, including foetal membrane, umbilical cord, and placental disk characteristics. Blue bars represent p value for stage comparisons, while the horizontal orange bar indicates features reaching statistical significance. Values above each blue bar denote the exact p value for that parameter. Statistically significant p value: p value <0.05

Table 4: Comparison of placental disk morphology and chorionic plate blood vessel characteristics between HIV-positive and HIV-negative mothers

Placental disk shape					
Placental disk shape	HIV-positive mothers (n = 48)		HIV-negative mothers (n = 95)		
	Frequency	Percentage (%)	Frequency	Percentage (%)	p value
Bilobed	1	2.08	0	0.00	<0.001
Bilobed and discoid	0	0.00	2	2.11	
Bulbous and discoid	0	0.00	1	1.05	
Discoid	31	64.58	78	82.11	
Irregular	14	29.17	0	0.00	
Irregular to discoid	2	4.17	13	13.68	
Polypoid to discoid	0	0.00	1	1.05	
Inspection of the connecting blood vessels of the placental disk					
Inspection of the connecting blood vessels	HIV-positive mothers (n = 48)		HIV-negative mothers (n = 95)		
	Frequency	Percentage (%)	Frequency	Percentage (%)	p value
Occluded partially	1	2.08	0	0.00	0.020
Partially patent	1	2.08	1	1.05	
Patent	36	75.00	89	93.68	
Reduced in number but patent	9	18.75	4	4.21	
Surrounded by a hematoma but patent	1	2.08	0	0.00	
Thrombosed	0	0.00	1	1.05	
Abnormality of chorionic plate blood vessels of the placental disk					
Abnormality of chorionic plate blood vessels	HIV-positive mothers (n = 49)		HIV-negative mothers (n = 96)		
	Frequency	Percentage (%)	Frequency	Percentage (%)	p value
No	42	87.50	85	89.47	0.031
Yes (reduced number)	1	2.08	1	1.05	
Yes (patchy whitish discolouration)	5	10.42	5	5.26	
Yes (patchy whitish discolouration and reduced number)	0	0.00	1	1.05	
Yes (congestion and dilatation)	0	0.00	1	1.05	
Yes (focal oedema and patchy whitish discolouration)	0	0.00	1	1.05	
Yes (haematoma)	0	0.00	1	1.05	

Statistically significant p value: p value <0.05

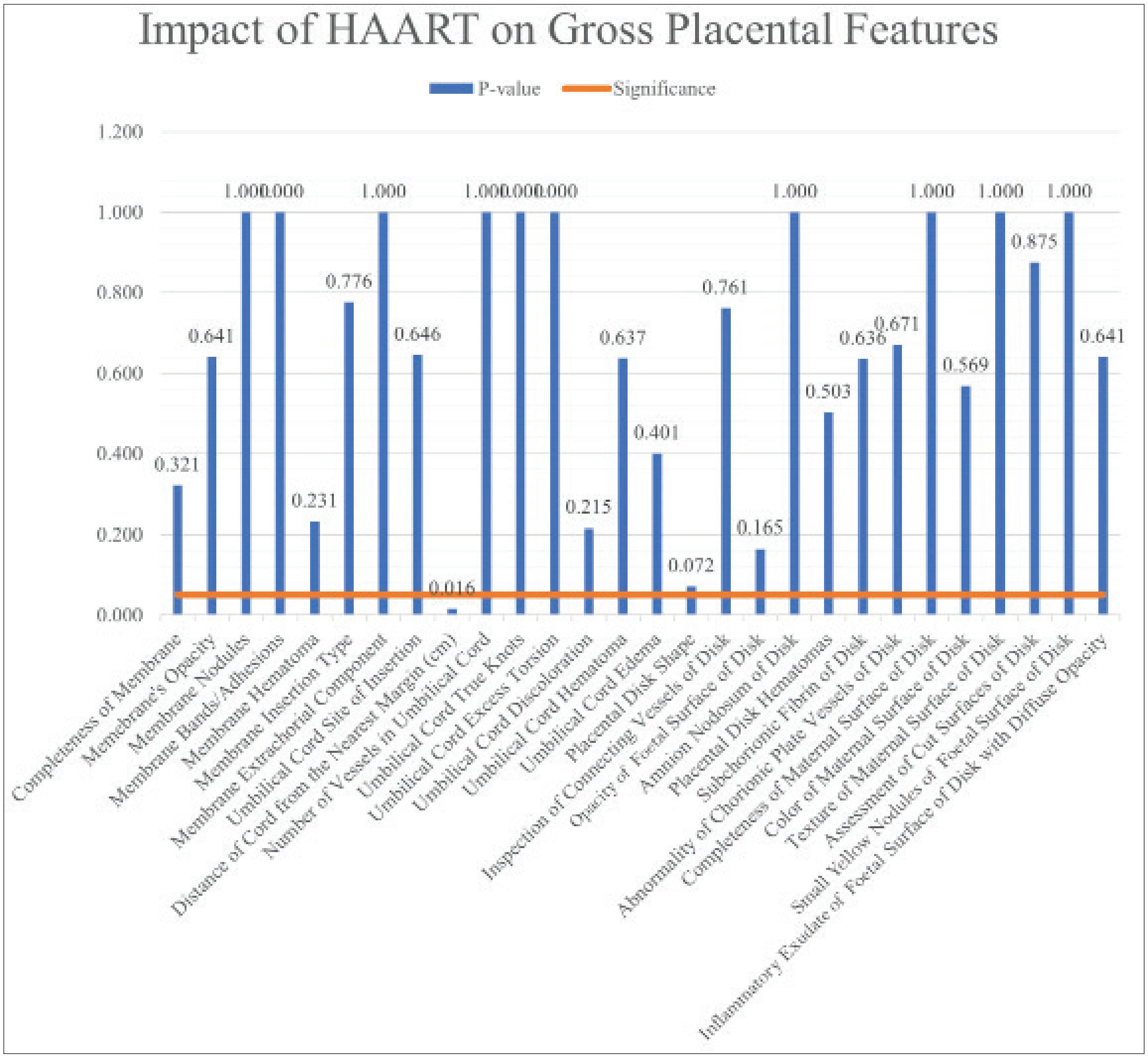

Figure 5: Impact of highly active antiretroviral therapy (HAART) treatment on gross placental morphometric and morphological features. This bar chart illustrates the influence of HAART treatment status on gross placental features, including foetal membrane, umbilical cord, and placental disk characteristics. Blue bars represent p value for comparisons between HAART-treated and untreated HIV-positive mothers, while the horizontal orange bar indicates features reaching statistical significance. Exact p value are displayed above each bar. Statistically significant p value: p value <0.05

DISCUSSION

This study provides a systematic comparison of gross placental morphometry and morphological features between pregnancies among women living with HIV and HIV-negative controls in Southern Nigeria. The principal findings were significantly reduced placental weight before and after fixation, shorter umbilical cord length, and a higher frequency of umbilical cord discolouration among HIV-positive pregnancies. In contrast, most gross features of the foetal membranes and placental disk did not differ significantly between groups. Collectively, these findings suggest the presence of subtle but clinically relevant placental compromise in pregnancies among women living with HIV that is detectable through routine gross examination.

Reduced placental weight emerged as the most consistent morphometric abnormality in HIV-positive pregnancies. Placental weight is widely recognised as a proxy for placental functional capacity and foetal growth potential.[9,13,20,22,33] Studies by Hutcheon *et al.,* and Kumar and Agarwal have demonstrated strong associations between low placental weight for gestational age and adverse perinatal outcomes, including stillbirth, low birth weight, and neonatal intensive care unit admission.[9,20] In the context of HIV infection, earlier work, by Gichangi *et al*., Dos Reis *et al*., and Obimbo *et al*., similarly reported reduced placental weight and surface area among HIV-positive mothers, supporting the biological plausibility of our findings.[13,22,33] The persistence of lower placental weight after fixation in the present study further underscores that this observation reflects true placental growth impairment rather than a post-delivery artefact.

Several mechanisms may underlie reduced placental growth in HIV-positive pregnancies. Chronic maternal immune activation, endothelial dysfunction, and placental vascular malperfusion have been proposed as key contributors.[3,4,10,14,28,30] Bruce-Brand *et al*. and Ikumi *et al*. have highlighted the role of inflammatory and vascular lesions in HIV-associated placental pathology, even in the ART era.[3,4,21] Additionally, mitochondrial dysfunction and oxidative stress related to HIV infection and antiretroviral exposure, as described by Hernández *et al*., may impair placental cellular proliferation and nutrient transport, thereby limiting placental growth.[14]

Umbilical cord length was significantly shorter in pregnancies among women living with HIV. Short umbilical cords have been associated with restricted foetal movement, placental insufficiency, and foetal growth restriction.[10,28,30] Large obstetric studies, by Sharma and Soliriya, Yamamoto *et al*., have shown that abnormal cord length correlates with adverse perinatal outcomes, including low Appearance, pulse, grimace, activity, and respiration (APGAR) scores and increased operative delivery.[10,28,30] In HIV-positive pregnancies, reduced cord length may reflect chronic intrauterine stress or altered placental-foetal hemodynamics, reinforcing its potential value as a simple gross marker of placental compromise.

Umbilical cord discolouration was also more frequently observed among HIV-positive pregnancies. Although this finding has received limited attention in the HIV literature, cord discolouration may reflect underlying vascular congestion, haemorrhage, inflammation, or meconium exposure.[26] Studies on umbilical cord pathology, by Dondiuc *et al*., Yamamoto *et al*., Nandini *et al*., Dias and Kore, Naniche *et al*., and Sharma and Soliriya, suggest that such gross changes may have clinical implications, particularly in settings where histopathological evaluation is not routinely available.[10,26–30] The increased frequency of cord discolouration observed in this study further supports the utility of careful gross examination in identifying pregnancies at increased risk of adverse outcomes.

In contrast to placental weight and umbilical cord features, most gross morphological characteristics of the foetal membranes and placental disk did not differ significantly between HIV-positive and HIV-negative groups. This finding aligns with previous reports indicating that many HIV-associated placental abnormalities are microscopic rather than grossly apparent.[19,34] Histopathological studies, by Schuetz *et al*., Vermaak *et al*., and Jauniaux *et al*., have documented increased rates of villitis, deciduitis, and vascular lesions in HIV-positive placentas despite minimal gross abnormalities.[16,17,35] The relative preservation of gross placental architecture in the present study highlights an important limitation of gross examination alone while reinforcing its role as a pragmatic first-line assessment tool.

Exploratory analyses within the HIV-positive cohort suggested limited associations between gross placental features and HIV clinical stage or antiretroviral therapy exposure. These findings should be interpreted cautiously due to the small number of women with advanced disease and those not receiving HAART. Previous studies, by Ikumi *et al*., and Yampolsky *et al*., have demonstrated that HAART initiation timing and regimen composition may influence placental pathology, particularly at the microscopic and molecular levels.[18,21] The absence of consistent gross differences in the present study does not preclude subtler effects that would require histological or molecular evaluation to detect.

The strengths of this study include the use of standardised gross examination protocols, gestational age-adjusted placental weight categorisation based on essential pathology standards, and inclusion of an HIV-negative control group from the same clinical setting. Importantly, the study addresses a critical evidence gap from Southern Nigeria, where access to advanced placental diagnostics may be limited.

Overall, pregnancies among women living with HIV in Southern Nigeria are characterised by reduced placental weight, shorter umbilical cords, and increased umbilical cord discolouration, despite largely preserved gross placental morphology. These findings underscore the value of routine gross placental examination as a low-cost, clinically informative adjunct in the care of HIV-positive pregnancies, particularly in resource-limited settings.

Limitations of this study

This case-control study was conducted at a single tertiary centre, which may limit generalisability and preclude causal inference. Although both singleton and multiple gestations were included, plurality and unmeasured maternal factors such as viral load, comorbidities, and antiretroviral regimen composition may have influenced placental findings. In addition, the absence of histopathological and molecular analyses restricted the mechanistic interpretation of the observed gross placental changes. Future studies should incorporate systematic histopathological examination of placental tissue to correlate gross findings with microscopic lesions and better clarify mechanisms of placental compromise in HIV.

CONCLUSION

Pregnancies among women living with HIV in Southern Nigeria were associated with reduced placental weight, shorter umbilical cords, and increased umbilical cord discolouration, despite largely preserved gross placental morphology. These findings indicate subtle but clinically relevant placental compromise that can be detected through routine gross examination. In resource-limited settings, systematic gross placental assessment represents a pragmatic, low-cost adjunct for identifying pregnancies at increased risk of adverse perinatal outcomes. While gross examination cannot replace histopathological or molecular evaluation, it provides valuable first-line information to support clinical decision-making. Future multicenter studies integrating gross, histological, and molecular approaches are needed to further elucidate HIV-associated placental pathology and improve maternal and neonatal outcomes.

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