East African Scholars Journal of Medicine and Surgery
Abbreviated Key Title: EAS J Med Surg
ISSN: 2663-1857 (Print) & ISSN: 2663-7332 (Online)
Published By East African Scholars Publisher, Kenya

OPEN ACCESS

Volume-8 | Issue-3 | Mar-2026 | DOI: https://doi.org/10.36349/easjms.2026.v08i03.008

Original Research Article

Intrauterine Fetal Death among Adolescents in Yaoundé, Cameroon: Associated Factors and Maternal Outcomes

Christiane Jivir Fomu Nsahlai[1,2]*, Inna Rakya[3,4], Mamadou Maransi Diaby[1], Anny Ngassam[1,6], Mol Henri Leonard Chatelin[1,5], Bertine Manuela Ndjeunga[1], Kodoumé Motolouze[1,7], Mve Koh Valere Salomon[1,8]

[1]Department of Obstetrics and Gynecology, Faculty of Medicine and Biomedical Sciences, The University of Yaoundé I
[2]Essos Hospital Center, Yaoundé
[3]Department de Obstetrics and Gynecology, Faculty of Medicine and Biomedical Sciences, The University of Garoua
[4]Garoua Regional Hospital Center
[5]Yaoundé Central Hospital
[6]Gynecological Endoscopic Surgery and Human Reproductive Teaching Hospital, Yaoundé
[7]Yaoundé Gynecology Obstetrics and Pediatrics Hospital
[8]University Teaching Hospital

Article History
Received: 28.01.2026
Accepted: 23.03.2026
Published: 27.03.2026

Journal homepage:
https://www.easpublisher.com

Quick Response Code

Abstract: Intrauterine fetal death (IUFD) remains a public health concern worldwide, particularly in low- and middle-income countries. Adolescents constitute a vulnerable population because pregnancy during this period is frequently associated with biological immaturity, limited reproductive health knowledge, and suboptimal use of antenatal care services. This study aimed to identify factors associated with IUFD and maternal outcomes among adolescents managed in referral hospitals in Yaoundé, Cameroon. A case–control study was conducted in three tertiary hospitals between January 2021 and December 2023. Cases were adolescents admitted with IUFD at ≥22 weeks of gestation or birth weight ≥500 g, while controls were adolescents who delivered live fetuses. Cases and controls were matched in a 1:2 ratio. Data were analyzed using SPSS version 23.0 with univariate analysis followed by multivariate logistic regression. A total of 180 adolescents were included (60 cases and 120 controls). Sociodemographic characteristics did not differ significantly between groups. IUFD cases occurred more at earlier gestational ages and were strongly associated with low birth weight (<2500 g) and placental anomalies. A history of induced abortion, maternal pathology during pregnancy and threatened preterm delivery were significantly associated with IUFD. Multivariate analysis identified maternal pathology, fetal anomaly, and low birth weight as independent factors associated with outcome. Vaginal delivery was predominant. Maternal complications included endometritis, postpartum hemorrhage, disseminated intravascular coagulation, acute psychosis, and maternal death. Strengthening antenatal surveillance and early management of maternal and fetal complications among adolescents may help reduce IUFD in this setting.

Keywords: Intrauterine Fetal Death, Stillbirth, Adolescent Pregnancy, Maternal Complications, Placental Anomalies, Low Birth Weight, Cameroon.

INTRODUCTION

Intrauterine fetal death (IUFD), commonly referred to as stillbirth, remains a major global public health concern. The World Health Organization (WHO) defines stillbirth as fetal death occurring before birth at ≥28 weeks of gestation or a birth weight ≥1000 g in low- and middle-income countries (LMICs), although high-income countries use a lower threshold of ≥22 weeks of gestation or ≥500 g [1]. The French National College of Gynecologists and Obstetricians (CNGOF) has proposed a broader definition including fetal deaths occurring after 14 weeks of gestation, allowing earlier pregnancy losses to be considered in epidemiological surveillance and research [2]. Adolescence, defined by the WHO as the period between 10 and 19 years of age, represents a critical stage of biological, psychological, and social development. In girls, this stage corresponds to the maturation of the reproductive system, making pregnancy biologically possible, although pregnancies occurring during adolescence are frequently associated with increased obstetric and perinatal risks [3].

***Corresponding Author:** Christiane Jivir Fomu Nsahlai
Department of Obstetrics and Gynecology, Faculty of Medicine and Biomedical Sciences, The University of Yaoundé I

Despite improvements in maternal and neonatal care globally, stillbirth remains highly prevalent in low-resource settings. Recent estimates suggest that approximately 2 million stillbirths occur annually worldwide, with nearly 98% occurring in LMICs, particularly in sub-Saharan Africa and South Asia [1]. While stillbirth rates in high-income countries range between 3 and 5 per 1000 births, rates in sub-Saharan Africa frequently exceed 20 per 1000 births [1-4]. Several studies conducted across Africa have identified multiple determinants of stillbirth, including maternal age, low educational level, hypertensive disorders of pregnancy, maternal anemia, antepartum hemorrhage, infections, fetal growth restriction, and inadequate antenatal care [5–7]. These factors are often compounded by delays in accessing quality obstetric care, weaknesses in referral systems, and shortages of essential resources in health facilities.

Adolescent mothers appear to be particularly vulnerable to adverse pregnancy outcomes, including intrauterine fetal death. In many African settings, adolescent pregnancy is associated with biological immaturity, nutritional deficiencies, limited reproductive health knowledge, and poor utilization of antenatal care services, all of which may contribute to unfavorable maternal and perinatal outcomes [8]. Studies conducted in West and Central Africa have demonstrated higher rates of obstetric complications and stillbirth among adolescents compared with adult women [8, 9].

In Cameroon, available evidence also indicates a substantial burden of stillbirth. Earlier studies conducted in tertiary facilities reported concerning prevalence rates. For example, Nkwabong *et al*., reported a stillbirth prevalence of 3.4% at the Yaoundé University Teaching Hospital [10]. In another study conducted in the Buea Regional Hospital, the stillbirth rate was estimated at 26 per 1000 births [11]. More recently, Egbe *et al*., reported stillbirth rates exceeding 30 per 1000 births in Buea and Limbe Regional Hospitals, with significant associated factors including late antenatal care booking, maternal anemia, hypertensive disorders of pregnancy, placental abruption, and preterm delivery [12]. In addition, national analyses based on demographic and health survey data have confirmed the persistence of stillbirths in Cameroon and highlighted the need for improved surveillance and identification of risk factors [13].

Although several studies have investigated determinants of stillbirth in Africa and Cameroon, findings remain heterogeneous and often focus on the general obstetric population rather than adolescents specifically. Moreover, most Cameroonian studies on stillbirth were conducted more than a decade ago and did not specifically examine the unique vulnerabilities of adolescent mothers. Given the high prevalence of adolescent pregnancy in sub-Saharan Africa and the associated maternal and perinatal risks, updated evidence is needed to better understand the determinants of intrauterine fetal death in this vulnerable population.

Therefore, this study aimed to identify factors associated with intrauterine fetal death and maternal outcomes among adolescents in three referral hospitals in Yaoundé, Cameroon.

METHODS

We conducted a case-control study in 3 tertiary care facilities in Yaoundé, Cameroon. These included the Yaoundé University Teaching Hospital, Yaoundé Central Hospital, and Yaoundé Gynecology Obstetrics and Pediatrics Hospital (YGOPH). The study period spanned three years, from January 1, 2021, to December 31, 2023. The target population comprised women of reproductive age. The source population included medical records of adolescent mothers managed in the study hospitals. Cases were defined as adolescents admitted with intrauterine fetal death at ≥22 weeks of gestation or birth weight ≥500 g, while controls were adolescents who delivered a live fetus at ≥22 weeks during the same period. We excluded records involving therapeutic termination of pregnancy, pregnancy termination following trauma, voluntary termination of pregnancy, or incomplete files. Cases and controls were matched in a 1:2 ratio by recruitment site. Consecutive sampling was used for participant selection.

The minimum sample size was calculated using Schlesselman's formula. Parameters were derived from a 2020 Cameroonian case–control study by Fouelifack *et al.*, on maternal and perinatal outcomes among adolescent and adult primiparas [14]. The minimum sample size was 38 cases. With a 1:2 case-control ratio, 76 controls were required, giving a total minimum sample of 114 study participants.

Data were entered and analyzed using SPSS (Statistical Package for the Social Sciences) version 23.0. Qualitative variables were described using frequencies and percentages, while quantitative variables were summarized using measures of central tendency (mean, median, mode) and dispersion (standard deviation, minimum, and maximum). Student's t-test was used to compare means. Factors associated with intrauterine fetal death were identified through univariate analysis followed by multivariate analysis using binary logistic regression. Statistical significance was set at $p \leq 0.05$ with a 95% confidence interval. Results were presented in tables and figures using Microsoft Word 2013.

RESULTS

Sociodemographic Factors Associated with Intrauterine Fetal Death (IUFD)

As shown on table I, most of our study participants were aged 17–19 years in both groups (93.3% of cases vs. 85.8% of controls). Adolescents aged

10–17 years represented a smaller proportion (6.7% of cases vs. 14.2% of controls). Concerning marital status, most adolescents were single (75% of cases vs. 79.2% of controls). Majority of participants lived in urban areas (86.7% in both groups). The table shows identical proportions in residence location between cases and controls. Most adolescents had a secondary education (70% of cases vs. 66.7% of controls). None of the sociodemographic variables showed statistical significance.

Table I: Sociodemographic factors associated with IUFD

Variables	Case N=60; n(%)	Control N=120; n(%)	OR [95% CI]	*p value*
Age (years)				
[10-17]	4 (6.7)	17 (14.2)	0.50 [0.15-1.46]	0.19
[17-19]	56 (93.3)	103 (85.8)	1.10 [0.69-1.7]	0.71
Marital status				
Married	15 (25)	25 (20.8)	1.2 [0.58-2.44]	0.615
Single	45 (75)	95 (79.2)	0.95 [0.59-1.52]	0.822
Residence				
Rural	8 (13.3)	16 (13.3)	1 [0.4-2.47]	1
Urban	52 (86.7)	104 (86.7)	1 [0.63-1.57]	1
Education				
No formal	1 (1.6)	6 (5)	0.3 [0.03-2.83]	0.314
Primary	10 (16.7)	14 (11.7)	1.4 [0.59-3.40]	0.421
Secondary	42 (70)	80 (66.7)	1.05 [0.64-1.70]	0.844
Tertiary	7 (11.7)	20 (16.6)	0.7 [0.28-1.75]	0.445

Clinical Factors Associated with IUFD

The clinical factors associated with IUFD were analyzed under four aspects: admission presentation, obstetrical history, fetal characteristics, and pathologies associated with the index pregnancy. Table II shows that absence of fetal movements was the most frequent presenting complaint among IUFD cases (86.7%) and was strongly associated with IUFD (OR = 209.1; p = 0.0002). In contrast, pelvic pain was significantly more common among controls (55.8%) than cases (p = 0.0001). Preeclampsia and malpresentation were observed only among controls and showed statistically significant differences (p = 0.03 and p = 0.04, respectively). Regarding gestational age, IUFD cases were significantly more frequent at earlier gestational ages (22–28 weeks and 28–34 weeks), while term pregnancies (≥37 weeks) were significantly more common among controls (p = 0.013). Milk letdown and vaginal bleeding were uncommon and showed no significant association with IUFD.

Table II: Admission characteristics

Variables	Case N=60; n (%)	Control N=120; n (%)	OR [95% CI]	*p value*
Chief complaint				
Absent fetal kicks	52 (86.7)	0 (0)	209.1 [12.69-3446.3]	0.0002
Milk letdown	2 (3.3)	1 (0.8)	4 [0.35-45]	0.262
Pelvic pain	3 (5)	67 (55.8)	0.1 [0.02-6.293]	0.0001
Bleeding	3 (5)	15 (12.5)	0.4 [0.111-1.435]	0.159
Preeclampsie	0 (0)	19 (15.8)	0.1 [0.003-0.86]	0.03
Mal présentation	0 (0)	18 (15)	0.1 [0.003-0.9]	0.04
Gestational age				
[22-28 weeks]	13 (21.7)	0 (0)	53.8 [3.14-920.03]	0.006
[28-34 weeks]	10 (16.7)	4 (3.3)	5 [1.51-16.6]	0.008
[34-37 weeks]	11 (18.3)	14 (11.7)	1.6 [0.67-3.67]	0.296
≥37 weeks	26 (43.3)	102 (85)	0.5 [0.299-0.866]	0.013

Obstetrical History

Table III below shows that parity was similar in both groups, with most participants being nulliparous (95.0% of cases vs. 98.3% of controls). A history of abortion was more frequent among cases (11.7%) than controls (4.2%) and there was a statistically significant association with IUFD (OR = 2.8; 95% CI: 1.2–9.19; p = 0.040). A history of IUFD was rare in both groups (1.7% of cases vs. 0.8% of controls).

Table III: Obstetrical history

Variables	Case N=60; n (%)	Control N=120; n (%)	OR [95% CI]	*p value*
Parity				
Nulliparous	57 (95.0)	118 (98.3)	1.0 [0.62-1.5]	0.879
Multiparous	3 (5.0)	2 (1.7)	3.0 [0.48-1843]	0.286
Abortion history				
Yes	7 (11.7)	5 (4.2)	2.8 [1.2-9.19]	0.040
No	53 (88.3)	115 (95.8)	0.9 [0.59-1.44]	0.722
IUFD history				
Yes	1 (1.7)	0 (0.8)	6 [0.23-148.9]	0.582
No	59 (98.3)	120 (100)	1 [0.63-1.53]	0.940

Fetal Characteristics

As shown on table IV, low birth weight (<2500 g) was more frequent among IUFD cases (53.3%) than controls (7.5%) and was significantly associated with IUFD ($p < 0.001$). In contrast, birth weight >3000 g was more common among controls and was significantly associated with lower odds of IUFD ($p = 0.020$), while weights 2500–3000 g showed no significant difference ($p = 0.086$). Fetal sex distribution was similar between cases and controls ($p > 0.05$). Gross fetal malformations and umbilical cord anomalies were uncommon and showed no significant association with IUFD. In contrast, placental anomalies were observed only among cases (26.7%) and were significantly associated with IUFD ($p = 0.003$).

Table IV: Fetal characteristics

Variables	Case N=60; n (%)	Control N=120; n (%)	OR [95% CI]	*p value*
Weight				
< 2 500g	32 (53.3)	9 (7.5)	7.1 [3.18-15.85]	<0.001
2 500 – 3 000g	15 (25.0)	53 (44.2)	0.6 [0.29-1.08]	0.086
> 3 000g	13 (21.7)	58 (48.3)	0.4 [0.22-0.88]	0.020
Sex				
Male	28 (46.7)	60 (50)	0.9 [0.54-1.61]	0.804
Female	32 (53.3)	60 (50)	1.1 [0.62-1.81]	0.811
Gross fetal malformation				
Yes	6 (10.0)	1 (0.8)	12.0 [1.41-101.9]	0,0.20
No	54 (90.0)	119 (99.2)	0.9 [0.58-1.41]	0.670
Umbilical cord anomaly				
Yes	2 (3.3)	1 (0.8)	4.0 [0.35-45]	0.261
No	58 (96.7)	119 (99.2)	1.0 [0.6-1.5]	0.909
Placental anomaly				
Yes	16 (26.7)	0 (0.0)	65.7 [3.87-1114.3]	0.003
No	44 (73.3)	120 (100.0)	0.7 [0.46-1.17]	0.190

Maternal Pathologies

Overall maternal pathology was significantly more frequent among cases than controls, 86.7% of cases compared with 48.3% of controls (OR = 1.8; 95% CI: 1.1–2.91; $p = 0.010$). Conversely, the absence of maternal pathology was significantly less frequent among cases (13.3%) than among controls (51.7%) (OR = 0.3; 95% CI: 0.11–0.57; $p < 0.001$) (Table V). Of note, as far as specific pathologies are concerned only threatened pre-term delivery was significantly associated with case status. It was reported in 13.5% of cases and was absent among controls, with an odds ratio of 16.7 (95% CI: 1.2–299.82; $p = 0.040$).

Table V: Pathologies during index pregnancy

Variables	Case N=60; n (%)	Control N=120; n (%)	OR [95% CI]	*p value*
Maternal pathology				
Yes	52 (86.7)	58 (48.3)	1.8 [1.1-2.91]	0.010
No	8 (13.3)	62 (51.7)	0.3 [0.11-0.57]	<0.001
Malaria				
Yes	43 (82.7)	46 (79.3)	1 [0.59-1.82]	0.883
No	9 (17.3)	12 (20.7)	0.8 [0.32-2.14]	0.71

Variables	Case N=60; n (%)	Control N=120; n (%)	OR [95% CI]	*p value*
UTI				
Yes	10 (19.2)	11 (19)	1 [0.39-2,58]	0.977
No	42 (80.8)	47 (81)	1 [0.57-1.74]	0.991
GTI				
Yes	1 (1.9)	2 (3.4)	0.6 [0.05-6.33]	0.637
No	51 (98.1)	56 (96.6)	1 [0.59-1.73]	0.954
HTN				
Yes	8 (15.4)	9 (15.5)	1 [0.35-2.8]	0.987
No	44 (84.6)	49 (84.5)	1 [0.6-1.74]	0.996
Placenta previa/abruptio				
Yes	1 (1.9)	2 (3.4)	0.6 [0.05-6.33]	0.637
No	51 (98.1)	56 (96.6)	1 [0.59-1.73]	0.954
Threatened PTD				
Yes	7 (13.5)	0 (0)	16.7 [1.2-299.82]	0.040
No	45 (86.5)	58 (100)	0.9 [0.5-1.49]	0.599
HIV				
Yes	1 (1.7)	3 (2.5)	0.67 [0.07-6.54]	0.728
No	59 (98.3)	117 (97.5)	1.01 [0.64-1.57]	0.96

UTI-urinary tract infection; GTI-genital tract infection; HTN-hypertension; Threatened PTD-threatened pre-term delivery.

Labor Characteristics and Mode of Delivery

Table VI presents the distribution of labor characteristics and mode of delivery among cases and controls. Spontaneous labor was the most frequent mode of labor onset in both groups, occurring in 83.3% of cases and 80% of controls. Induced labor accounted for 16.7% of cases and 20% of controls. The distribution of delivery modes was similar between cases and controls with vaginal delivery predominating (83.3% of cases and 80% of controls).

Table VI: Labor characteristics and mode of delivery

	Case		Control	
	Number	**%**	**Number**	**%**
Labor characteristics				
Spontaneous	50	83.3	96	80
Induced	10	16.7	24	20
Mode of delivery				
Vaginal	50	83.3	96	80
Cesarean	10	16.7	24	20

Maternal Complications

Table VII presents the distribution of maternal complications as occurred in 26 cases. Endometritis was the most frequent complication, occurring in 8 cases (30.1%). This was closely followed by postpartum hemorrhage, which was reported in 7 cases (29.9%). Disseminated intravascular coagulation (DIC) was observed in 6 cases, representing 23.1% of the complications. Acute psychosis was less frequent, affecting 3 patients (11.6%). Maternal death was the least frequent, occurring in 2 cases (7.7%).

Table VI:

Variables	Numbers N=26	Frequency (%)
Endometritis	8	30.1
Post-partum hemorrhage	7	29.9
DIC	6	23,1
Acute psychosis	3	11.6
Maternal death	2	7.7

Multivariate Binary Logistic Regression

The multivariate analysis identified three variables significantly associated with the outcome. Fetal pathology showed the strongest association, occurring in 86.7% of cases and 48.3% of controls (OR = 26.8; 95% CI: 4.3–157.1; $p < 0.001$). Secondly, maternal pathology was also significantly associated with case status, being present in 86.7% of cases compared with 48.3% of controls (OR = 7.83; 95% CI: 1.60–37.60; $p = 0.030$). Conversely, the absence of maternal pathology was

significantly more frequent among controls (OR = 0.10; 95% CI: 0.01–1.11; p = 0.040). Finally, low birth weight (<2,500 g) was significantly associated with case status, observed in 53.3% of cases compared with 7.5% of controls (OR = 4.82; 95% CI: 0.96–24.04; p = 0.030).

Table VII

	Case		Control		OR	CI	*p value*
	Number	%	Number	%			
Abortions							
Yes	7	11.7	5	4.2	0.16	[0.01-4.96]	0.297
Maternal pathology							
Yes	52	86.7	58	48.3	7.83	[1.60-37.60]	0.030
No	8	13.3	62	51.7	0.10	[0.01-1.11]	0.040
Fetal pathology							
Yes	34	86.7	58	48.3	26.8	[4.3-157.1]	<0.001
Congenital malformation							
Yes	5	8.3	1	0.8	2.27	[0.047-108.9]	0.678
Gestational age (weeks)							
≥ 22	13	21.7	0	0	4.37	[0.37-51.61]	0.241
28-34	10	16.7	4	3.3	3.66	[0.39-34.61]	0.257
≥ 37	26	43.3	102	85	0.32	[0.22-1.47]	0.082
Poids							
< 2 500g	32	53.3	9	7.5	4.82	[0.96-24.04]	0.030
> 3 000g	13	21.7	58	48.3	0.73	[0.23-2.37]	0.604

DISCUSSION

The distribution of sociodemographic variables among cases and controls did not show statistically significant differences, suggesting that these factors were not strongly associated with IUFDs among adolescents in our study population. Surprisingly, marital status did not influence the occurrence of IUFD among adolescents. This may reflect the culture in the setting in which the study was conducted where adolescents are mostly unmarried. However, other studies have suggested that marital status may indirectly affect pregnancy outcomes through social support, economic stability, and access to antenatal care [8-15]. Although factors such as education, marital status, and residence are often associated with reproductive outcomes, their effects may vary depending on contextual determinants such as access to antenatal care, socioeconomic status, and health system factors. Studies conducted in Sub-Saharan Africa have reported inconsistent associations between these variables and adverse pregnancy outcomes among adolescents [16, 17], suggesting that their impact may be mediated by broader structural and healthcare-related factors.

Clinical Factors Associated with IUFD

Absence of fetal movements was the main presenting complaint among IUFD cases, which is consistent with the fact that reduced or absent fetal activity is often the first sign perceived by the mother after fetal demise. This finding underscores the importance of maternal awareness of fetal movements and early consultation when they decrease. In contrast, pelvic pain was more frequent among controls, likely reflecting the onset of labor contractions in pregnancies with a viable fetus. IUFD cases were also more common at earlier gestational ages (22–34 weeks), whereas most controls delivered at term, a pattern consistent with reports that stillbirth occurs more frequently in preterm pregnancies. Several studies have reported that intrauterine fetal deaths occur more frequently at earlier gestational ages. For example, Derikvand *et al.,* reported that nearly half of stillbirths occur before 28 weeks of gestation, highlighting the vulnerability of early pregnancies to severe maternal, placental, and fetal complications [18]. Similarly, large multicountry analyses have shown that the risk of stillbirth is highest before 29 weeks and declines as gestational age approaches term [19]. The preterm nature of IUFD cases is proportional to low birth weight, which was significantly associated with IUFD in our study, with more than half of IUFD cases weighing less than 2500 g. This finding is consistent with previous studies showing that low birth weight and fetal growth restriction are major contributors to stillbirth, particularly in low-resource settings where maternal conditions such as anemia, hypertensive disorders, and placental insufficiency are common [16-20]. Conversely, birth weights above 3000 g were more frequent among controls, suggesting that adequate fetal growth may be associated with better perinatal outcomes.

Fetal sex was not associated with IUFD in this study, a finding consistent with many studies reporting no clear relationship between fetal sex and stillbirth risk [21, 22]. However, multiple studies have shown a male fetus predominance in cases of IUFD [23–25]. The reason for male predominance remains unclear. Although gross fetal malformations were more frequent among cases, the association was not statistically significant, possibly due to the small number of cases

observed. Several authors from developed countries have reported a 6 – 20% association of fetal malformations to IUFD [25–27]. It is not customary in our setting to perform autopsies on dead fetuses mostly due to financial constraints. However, new tools for LMICs to determine cause of death in IUFDs are currently being explored. An example is the minimally invasive tissue sampling (MITS) – a method using needle biopsies to obtain internal organ tissue from deceased fetuses for histology and pathogen identification in those tissues [26]. Umbilical cord anomalies were rare and did not appear to contribute significantly to IUFD in this population, although again our main constraint was the small sample size as many studies have implicated umbilical cord anomalies in IUFD [27, 28]. In contrast, our study showed placental anomalies being strongly associated with IUFD, occurring exclusively among cases. Placental abnormalities such as abruption, insufficiency, or infarction are well-recognized causes of fetal demise because they compromise fetal oxygenation and nutrient exchange. Several studies corroborate our findings with Bjarnadottir *et al*., in Iceland reporting as high as 72% causes of stillbirth due to placental anomalies [29–31].

Obstetrical History

Most participants in both groups were nulliparous, reflecting the adolescent population studied, and parity was not associated with IUFD. In contrast, a history of induced abortion was significantly more frequent among IUFD cases, suggesting that induced abortions may increase the risk of adverse pregnancy outcomes. Similar associations have been reported in several studies where prior induced abortions predisposed to IUFDs [32–34]. Previous IUFD was rare in both groups and was not significantly associated with IUFD in this study. This can be explained by the young age of the participants, who had limited obstetrical histories and therefore fewer prior pregnancies.

Maternal Pathology in Index Pregnancy

The presence of maternal pathology during pregnancy was significantly associated with IUFD in this study (OR = 1.8; 95% CI 1.1–2.91; p = 0.010), highlighting the important role of maternal medical and obstetric conditions in fetal demise. Similar findings have been reported in Sub-Saharan Africa, where maternal illnesses such as infections, hypertensive disorders, and anemia contribute substantially to stillbirth through mechanisms including placental insufficiency, fetal hypoxia, and preterm birth [32-35]. Among the specific conditions examined, threatened preterm delivery showed a significant association with IUFD (OR = 16.7; 95% CI 1.2–299.82; p = 0.040), which is consistent with studies indicating that complications leading to preterm labor are strongly linked to fetal death, particularly in low-resource settings where delays in diagnosis and management may occur [6]. Although malaria, urinary tract infection, genital tract infection, hypertension, placental abnormalities, and HIV infection were observed among participants, none showed a statistically significant association with IUFD in this study, possibly due to the limited sample size or improved antenatal screening and treatment programs. Nevertheless, these conditions remain well-established contributors to stillbirth in endemic regions of Africa [36, 37]. We did not include anemia in our study, however, the inclusion of maternal anemia as a variable is justified in the Sub-Saharan African context, where anemia is highly prevalent and has been consistently associated with adverse perinatal outcomes, including stillbirth, due to impaired maternal-fetal oxygen delivery and placental dysfunction [38, 39]. Overall, these findings underscore the importance of early detection and effective management of maternal pathologies during antenatal care to reduce the risk of IUFD.

Labor, Delivery Mode, and Maternal Outcomes

Most deliveries in both groups followed spontaneous labor, with similar proportions among cases (83.3%) and controls (80%). Induced labor was less frequent and occurred in comparable proportions in the two groups (16.7% vs 20%). Similarly, vaginal delivery was the predominant mode of delivery in both cases and controls, accounting for 83.3% and 80% respectively, while cesarean delivery represented a smaller proportion (16.7% vs 20%). These findings are consistent with those in the literature, which show that vaginal delivery is usually the preferred mode of delivery in IUFD, including in adolescents with cesarean section being reserved for specific maternal indications (e.g., obstructed labor, previous uterine scar, severe hemorrhage, or maternal instability). Adolescents generally have lower cesarean rates than adults [40, 41].

In terms of complications post IUFD delivery, adolescents may be particularly vulnerable due to biological immaturity, anemia, and limited access to timely obstetric care in many Sub-Saharan African settings. The maternal complications observed in our study were dominated by infectious and hemorrhagic conditions. Endometritis was the most frequent complication (30.1%), followed closely by postpartum hemorrhage (29.9%). This is reversed as reported in a study by Gold *et al*., which reported PPH as the most common complication [42]. Furthermore, in adolescents, the risk of obstructed or prolonged labor may be increased due to pelvic immaturity, which can further contribute to hemorrhage [43]. Disseminated intravascular coagulation was also relatively common, affecting 23.1% of cases, reflecting the severity of maternal clinical conditions in this population. Beyond physical complications, IUFD is also associated with significant psychological morbidity, including postpartum depression, anxiety, and complicated grief [44]. In our study, acute psychosis occurred less frequently in 11.6% of cases. Our study reported maternal death in 7.7% of cases, indicating that severe maternal morbidity was present in a proportion of patients. Direct case reports of maternal death specifically following IUFD in adolescents are rare in the

literature, but there are studies and reports documenting maternal deaths among adolescent pregnancies with stillbirth [38-45].

Finally, we did a multivariate analysis of our findings and identified maternal pathology, fetal pathology, and low birth weight as factors independently associated with the outcome. Maternal pathology remained significant after adjustment, suggesting that maternal medical conditions during pregnancy may compromise the intrauterine environment and contribute to adverse fetal outcomes. Fetal pathology showed the strongest association, reflecting the direct impact of fetal conditions on pregnancy outcomes. In addition, low birth weight was independently associated with the outcome, likely reflecting underlying pregnancy complications such as placental insufficiency or fetal growth restriction. This is corroborated by several studies, although the variables studied are not identical but overlap. Independent predictors of IUFD included different maternal pathologies such as, anemia, in addition low birth weight, prelabor rupture of membranes, or poor antenatal care follow-up [46,47].

CONCLUSION

In this study, maternal pathology, fetal pathology, and low birth weight were independently associated with intrauterine fetal death among adolescents. Placental abnormalities and threatened preterm delivery also showed strong associations with IUFD. Although vaginal delivery was the predominant mode of delivery, maternal complications such as endometritis, postpartum hemorrhage, and disseminated intravascular coagulation occurred in a proportion of cases, with maternal death reported in a few patients. These findings highlight the importance of early detection and management of maternal and fetal complications during pregnancy, particularly among adolescents. Strengthening antenatal care and improving monitoring of high-risk pregnancies may help reduce the burden of IUFD in this vulnerable population.

Conflict of Interest: The authors declare that they have no conflicts of interest regarding the publication of this paper.

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Cite This Article: Christiane Jivir Fomu Nsahlai, Inna Rakya, Mamadou Maransi Diaby, Anny Ngassam, Mol Henri Leonard Chatelin, Bertine Manuela Ndjeunga, Kodoumé Motolouze, Mve Koh Valere Salomon (2026). Intrauterine Fetal Death among Adolescents in Yaoundé, Cameroon: Associated Factors and Maternal Outcomes. *East African Scholars J Med Surg, 8*(3), 120-129.