

# Towards a Simple Prediction Tool for Acute Fetal Asphyxia in Cameroon: Results from a Longitudinal Study of 498 Parturients

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## Abstract

**Introduction:** Monitoring labor and delivery is central to preventing maternal and neonatal morbidity and mortality. The available methods are cardiotocography (CTG) and intermittent auscultation, but their predictive value and clinical impact remain debated in resource-limited countries. **Objective:** To compare maternal and fetal outcomes based on the mode of intrapartum monitoring and propose a simple prediction tool for acute fetal asphyxia (AFA) in Cameroon. **Methods:** A longitudinal observational study with an analytical component was conducted in four hospitals in Douala. A total of 498 deliveries were included: 195 monitored by CTG and 303 by intermittent auscultation. The variables studied included maternal, obstetric, and neonatal characteristics. The main outcomes were the mode of delivery, neonatal asphyxia (Apgar score < 7 at 5 minutes), transfer to intensive care, and neonatal mortality. Statistical analyses used the Chi-square and Student's t-test, with a significance level set at  $p < 0.05$ . **Results:** The cesarean section rate was higher with CTG than with auscultation (21.5% vs. 6.3%;  $p = 0.07$ ), without a significant benefit on neonatal outcomes. The overall incidence of neonatal asphyxia was 8.2%. The appearance of clear amniotic fluid was protective against cesarean sections ( $p = 0.001$ ) and neonatal asphyxia ( $p = 0.020$ ). Based on intrapartum determinants (parity, maternal age, gestational age, amniotic fluid appearance, CTG tracing), we developed the DASH Score (Douala Asphyxia Scoring in Hospitals), which allows for rapid stratification of the risk of neonatal asphyxia. **Conclusion:** CTG increases the rate of cesarean sections without significantly improving neonatal prognosis. Simple parameters such as the appearance of amniotic fluid are reliable indicators of asphyxia. The DASH Score

offers a practical prediction tool in resource-limited settings and warrants prospective validation.

## Keywords

Fetal Asphyxia, Prediction Tool, Risk Factors, Intrapartum Care, Low-Resource Settings, Cameroon

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## 1. Introduction

Monitoring labor is a crucial pillar in preventing maternal and neonatal morbidity and mortality [1]. The fetal aspect primarily relies on monitoring the fetal heart rate, which allows for the early detection of anomalies that may indicate acute fetal asphyxia (AFA), a major complication during labor and a frequent cause of perinatal death [2]. There are two main monitoring methods available. Cardiotocography (CTG), a continuous electronic method, simultaneously records the fetal heart rate and uterine activity [3]. It is recommended by several scientific societies, including FIGO, CNGOF, and ACOG, for high-risk pregnancies or when clinical anomalies are present [4]-[6]. However, its systematic use in the delivery room remains controversial, with some authors pointing out an excess of cesarean sections without a significant reduction in severe neonatal outcomes [7]. Conversely, intermittent auscultation (using a Doppler or Pinard fetal stethoscope) remains the reference method in low-risk pregnancies, particularly in resource-limited countries [8]. In Cameroon, both methods coexist in maternity settings, but their availability and interpretation vary according to the level of the hospitals [9]. Douala city, which hosts hospitals of different levels (tertiary and secondary), provides a favorable environment for the comparative evaluation of their impact on maternal and fetal outcomes. Therefore, we undertook this study to compare maternal and fetal outcomes based on the type of intrapartum monitoring in four hospitals in Douala.

## 2. Methodology

### 2.1. Type and Setting of the Study

We conducted an observational longitudinal study with an analytical component in four hospitals in the city of Douala: Douala General Hospital, Laquintinie Hospital in Douala, Cité des Palmiers District Hospital, and Logbaba District Hospital. These institutions include facilities from the 1st, 2nd, and 3rd categories, thus providing a representative sample of the local healthcare context.

### 2.2. Period and Duration

Data collection was carried out over a five-month period, from January to May 2025.

### 2.3. Study Population

Included were all pregnant women admitted in labor to the maternity wards of the four aforementioned hospitals, as well as their newborns. Excluded were multiple pregnancies, cases of known fetal malformations, and patients who refused to consent.

### 2.4. Sample Size and Sampling

A total of 498 deliveries were recorded: 195 under cardiotocographic (CTG) monitoring and 303 under intermittent auscultation (Doppler or Pinard fetal stethoscope). The sampling was consecutive and exhaustive over the study period. The allocation to the monitoring method (CTG or intermittent auscultation) depended on the technical availability in each maternity unit and on the initial clinical assessment of the parturient. In the two district hospitals, monitoring was exclusively electronic. At the General Hospital of Douala, it was exclusively electronic. At Laquintinie Hospital, we had both types of monitoring.

### 2.5. Variables Studied

- **Independent:** Sociodemographic characteristics (age, marital status, level of education), obstetric characteristics (parity, number of prenatal consultations, gestational age, appearance of amniotic fluid, type of intrapartum monitoring).
- **Dependent:** Maternal outcomes (mode of delivery, obstetric complications) and neonatal outcomes (Apgar score at 1 and 5 minutes, neonatal asphyxia, intensive care transfer, neonatal death).

### 2.6. Data Collection

Information was collected using a standardized questionnaire that included sociodemographic, clinical, and obstetric data, as well as immediate neonatal outcomes. Informed consent was obtained from patients before inclusion.

### 2.7. Statistical Analysis

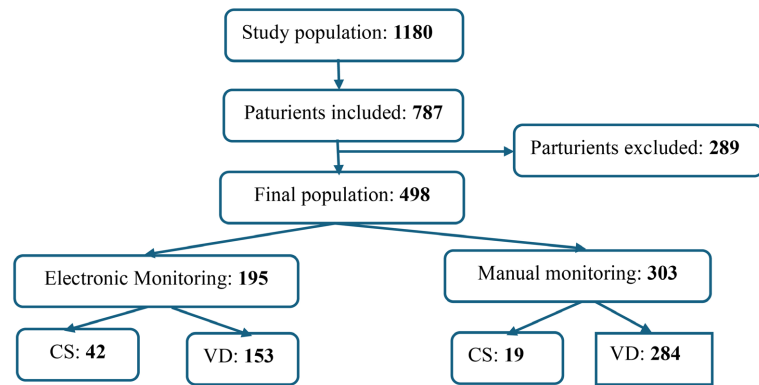
Data were entered and analyzed using SPSS version 28.0. Quantitative variables were presented as means  $\pm$  standard deviation, and qualitative variables as counts and percentages. Comparisons between groups were made using the Chi-square test for categorical variables and the Student's t-test for quantitative variables. Statistical significance was set at  $p < 0.05$ .

### 2.8. Ethical Considerations

The study received approval from the institutional ethics committee and authorizations from the different healthcare facilities involved. The confidentiality and anonymity of the participants were ensured throughout the research.

## 3. Results

The flow chart below illustrates the details of our sample selection (**Figure 1**).



**Figure 1.** Flow Chart. CS: cesarean section; VD: vaginal delivery.

### 3.1. Population Distribution Based on Hospitals and Type of Monitoring

The distribution of monitoring methods varied considerably across the hospitals involved in the study. At the District Hospital of the City of Palms and the District Hospital of Logbaba, all women (100.0%) were monitored using intermittent auscultation, with no cases of electronic monitoring. Conversely, at the Douala General Hospital, all deliveries (100.0%) were monitored exclusively with CTG. At Laquintinie Hospital, CTG was used in the vast majority of cases (94.2%), with only 5.8% monitored manually. Overall, 195 women (39.2%) were monitored with CTG and 303 (60.8%) with intermittent auscultation. This distribution highlights the influence of hospital technical capacity and resources on the choice of intrapartum monitoring method (**Table 1**).

**Table 1.** Distribution according to hospitals and types of monitoring.

Hospitals	Electronic N (%)	Manual N (%)
District Hospital of the City of Palms	0 0.0	180 100.0
District Hospital of Logbaba	0 0.0	116 100.0
General Hospital of Douala	82 100.0	0 0.0
Laquintinie Hospital of Douala	113 94.2	7 5.8
<b>Total</b>	<b>195 39.2</b>	<b>303 60.8</b>

### 3.2. Sociodemographic and Obstetric Characteristics

The study population consisted of 498 women, with the majority aged between 25 and 34 years (51.6%), while younger women aged 15 - 24 years represented 24.3%, and those aged 35 years and above accounted for 24.1%. Most of the participants were single (68.3%), whereas only about one-third were married (31.7%). In terms of education, more than half of the women had attained higher education (53.4%), followed by secondary education (35.2%) and a minority with only primary education (11.4%). Regarding parity, nearly half of the women (47.0%) were of low parity (1 - 2 deliveries), while 29.3% were nulliparous and 23.7% were multiparous

( $\geq 3$  deliveries). With respect to antenatal consultations, most women had between 4 and 8 visits (52.0%), whereas 27.3% had more than 8, and 20.7% had fewer than 4 visits. Concerning gestational age at delivery, the majority of pregnancies (75.5%) reached term (37 - 40 weeks), while 14.0% were post-term and 10.5% ended before 37 weeks of gestation (**Table 2**).

**Table 2.** Sociodemographic and obstetric characteristics of parturients (N = 498).

Variables	Number (n = 498)	Percentage %
<b>Age (years)</b>		
15 - 24	121	24.3
25 - 34	257	51.6
$\geq 35$	120	24.1
<b>Marital Status</b>		
Married	158	31.7
Single	340	68.3
<b>Level of Education</b>		
Primary	57	11.4
Secondary	175	35.2
Higher	266	53.4
<b>Parity</b>		
Nulliparous	146	29.3
Low Parity (1 - 2)	234	47.0
Multiparous ( $\geq 3$ )	118	23.7
<b>Prenatal Consultations</b>		
<4	103	20.7
4 - 8	259	52.0
>8	136	27.3
<b>Gestational Age (weeks)</b>		
<37	52	10.5
37 - 40	376	75.5
>40	70	14.0

### 3.3. Modes of Delivery

Among the 498 women included in the study, 437 (87.8%) had a vaginal delivery while 61 (12.2%) delivered by cesarean section. Vaginal delivery was more frequent in the group monitored with intermittent auscultation (IA) (93.7%) compared to the CTG group (78.5%). Conversely, cesarean section was more common among women monitored with CTG (21.5%) compared to those under IA (6.3%). Although there was a tendency toward higher cesarean section rates in the CTG group, this difference did not reach statistical significance ( $p = 0.07$ ) (**Table 3**).

**Table 3.** Modes of delivery according to the type of monitoring.

Mode of Delivery	CTG (n = 195)	AI (n = 303)	Total (N = 498)	%	p-value
Vaginal Delivery	153 (78.5)	284 (93.7)	437	87.8	
Cesarean Section	42 (21.5)	19 (6.3)	61	12.2	<b>0.07</b>
<b>Total</b>	195	303	498	100	

### 3.4. Neonatal Asphyxia and Outcomes

Regarding neonatal outcomes, 41 newborns (8.2%) presented with asphyxia defined as Apgar <7 at 5 minutes. The prevalence was slightly higher in the CTG group (10.3%) compared to the intermittent auscultation (IA) group (6.9%), although this difference was not statistically significant ( $p = 0.555$ ). A total of 33 neonates (6.6%) required transfer to intensive care, more frequently in the CTG group (9.2%) than in the IA group (5.0%), with a difference close to the threshold of significance ( $p = 0.08$ ). Neonatal death due to asphyxia occurred in 4 cases (0.8%), with one case in the CTG group (0.5%) and three in the IA group (1.0%), with no statistically significant difference between groups ( $p = 0.62$ ) (**Table 4**).

**Table 4.** Neonatal outcomes according to the type of monitoring.

Neonatal Outcomes	CTG (n = 195)	AI (n = 303)	Total (N = 498)	%	p-value
Neonatal Asphyxia (Apgar <7)	20 (10.3)	21 (6.9)	41	8.2	0.555
Transfer to Intensive Care	18 (9.2)	15 (5.0)	33	6.6	0.08
Neonatal Death due to Asphyxia	1 (0.5)	3 (1.0)	4	0.8	0.62

### 3.5. Association with the Appearance of Amniotic Fluid

Analysis of amniotic fluid appearance revealed significant associations with both mode of delivery and neonatal outcomes. Among women with clear amniotic fluid, vaginal delivery was predominant (92.0%), while cesarean section was relatively rare (8.0%). Neonatal asphyxia occurred in 5.5% of these cases. In contrast, the presence of meconial fluid was associated with a higher cesarean rate (29.2%) and a higher proportion of neonatal asphyxia (16.7%). Troubled amniotic fluid showed a similar pattern, with 34.3% delivered by cesarean section and 20.0% of neonates experiencing asphyxia. Statistical analysis demonstrated that the mode of delivery was significantly associated with amniotic fluid appearance ( $p = 0.001$ ). Neonatal asphyxia was also significantly more frequent when the fluid was meconial or troubled compared with clear fluid ( $p = 0.020$ ). Multivariate analysis indicated that the presence of clear amniotic fluid was protective against asphyxia, with an odds ratio of 0.25 (95% CI: 0.02 - 0.90) (**Table 5**).

Given the absence of a simple and validated tool to anticipate the risk of neonatal asphyxia in our maternity wards, we have developed the DASH Score (Dou-

ala Asphyxia Scoring in Hospitals). This score is based on easily accessible obstetric and intrapartum parameters (parity, gestational age, appearance of amniotic fluid, electronic monitoring) and allows for real-time estimation of the probability of neonatal asphyxia occurrence.

**Table 5.** Association between the appearance of amniotic fluid and obstetric and neonatal outcomes.

Appearance of Amniotic Fluid	Vaginal Delivery n (%)	Cesarean Section n (%)	Asphyxia n (%)	p-Value (Delivery Mode)	p-Value (Asphyxia)	OR (Vaginal Delivery) [IC95%]
Clear	380 (92.0)	33 (8.0)	18 (5.5)	<b>0.001</b>	<b>0.020</b>	0.25 [0.02 - 0.90]
Meconial	34 (70.8)	14 (29.2)	8 (16.7)		0.058	—
Troubled	23 (65.7)	12 (34.3)	7 (20.0)		0.869	—

#### DASH Score—Douala Asphyxia Scoring in Hospitals (Table 6)

**Table 6.** Score matrix.

Variable	Options	Points
<b>Parity</b>	Nulliparous	1
	Pauciparous (1–2)	1
	Multiparous ( $\geq 3$ )	0
<b>Maternal age</b>	< 20 years	2
	20–34 years	0
	$\geq 35$ years	1
<b>Gestational age</b>	< 37 weeks of gestation (preterm)	2
	37–40 weeks of gestation (term)	0
	> 40 weeks of gestation (post-term)	1
<b>Appearance of amniotic fluid</b>	Clear	0
	Meconial	3
	Troubled	3
<b>Electronic monitoring (CTG)</b>	Normal trace	0
	TSuspicious trace	2
	Pathological trace	3

**Total minimum-maximum score : 0 → 11 points (Table 7)**

**Table 7.** Risk classes.

Total Score	Risk Class	Clinical Interpretation
0 - 3	Low	Standard monitoring.
4 - 7	Moderate	Close monitoring, logistical preparation (team/neonatal resuscitation).
8 - 11	High	Anticipate obstetric decision, alert neonatal resuscitation.

**Practical notes**

- Pathological CTG carries more weight (3 points); a suspicious trace adds 2 points.
- Meconial/troubled amniotic fluid remains a major determinant (3 points).
- Background factors (maternal age, parity, gestational age) would modulate the baseline risk.

**Example of use (quick calculation)**

- Nulliparous (1) + 20–34 years old (0) + 41 weeks of gestation (1) + Meconial amniotic fluid (3) + Suspicious CTG (2) = **7 points** → **Moderate risk**.
- Multiparous (0) + ≥35 years old (1) + 39 weeks of gestation (0) + Clear amniotic fluid (0) + Pathological CTG (3) = **4 points** → **Moderate risk**.
- Nulliparous (1) + <20 years old (2) + 35 weeks of gestation (2) + Troubled amniotic fluid (3) + Pathological CTG (3) = **11 points** → **High risk**.

**4. Discussion****4.1. Main Results**

This multicenter study conducted in four hospitals in Douala shows that the frequency of neonatal asphyxia is 8.2%. The cesarean section rate was higher among women monitored by cardiotocography (CTG) compared to those monitored by intermittent auscultation, without a significant reduction in neonatal morbidity and mortality. The appearance of amniotic fluid emerged as the prognostic factor most strongly associated with neonatal asphyxia, with clear fluid being protective, while meconial or troubled fluids increased the risk. These results confirm that certain simple intrapartum parameters allow for the anticipation of asphyxia risk and justify the development of a clinical prediction tool such as the DASH Score.

**4.2. Comparison with the Literature**

The incidence of neonatal asphyxia reported in this study (8.2%) is comparable to that described in other sub-Saharan African countries (610%) [10] [11], but remains higher than in high-income countries (<2%) [12]. Regarding monitoring methods, several randomized trials and meta-analyses, especially the Cochrane Review of 2017, have shown that continuous CTG is associated with an increased rate of cesarean sections and instrumental interventions, without a significant reduction in neonatal mortality or the incidence of severe asphyxia [7]. Our results

align with this trend, suggesting a risk of over-intervention linked to CTG. The prognostic importance of amniotic fluid is well documented: the presence of thick meconium or “pea soup” increases the risk of asphyxia and meconium aspiration syndrome by 2 to 4 times [13] [14]. In our study, meconial fluid was associated with an asphyxia frequency of 16,7 %, confirming these observations. Finally, while previous work has identified other factors associated with the risk of asphyxia (prematurity, extreme maternal age, low number of prenatal visits), few studies have attempted to integrate these elements into a simple clinical score applicable in the delivery room [12] [14].

### 4.3. Strengths and Limitations of the Study

This study presents several strengths : a relatively large sample size (n = 498), a multicenter methodology, and the direct comparison of two intrapartum monitoring strategies in an African context. In Cameroon, antibiotics are systematically administered to pregnant women in cases of premature rupture of membranes to prevent maternal or fetal infections (postpartum endometritis, neonatal infection). However, certain limitations must be noted. The definition of neonatal asphyxia was primarily based on the Apgar score, without systematic use of arterial pH or umbilical blood gases, which could lead to imperfect classification. Finally, some potentially confounding clinical variables (intrapartum fever, prolonged rupture of membranes) were not included in the analysis.

### 4.4. Clinical Implications and Perspectives

The construction of the DASH Score, based on parity, maternal age, gestational age, appearance of amniotic fluid, and CTG tracing, addresses a need for simplification and anticipation in our maternity wards. Its use could help clinicians quickly stratify patients according to their risk of neonatal asphyxia, in order to adapt monitoring and anticipate resource mobilization. Prospective external validation studies are necessary to confirm the predictive performance of the score and its impact on clinical management.

## 5. Conclusion

Ultimately, our study confirms that the appearance of amniotic fluid and certain simple obstetric parameters are strongly associated with the risk of neonatal asphyxia. Implementing a predictive score such as the DASH Score could help improve intrapartum monitoring and reduce the burden of neonatal asphyxia in our hospitals.

### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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