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# Low Birth Weight in Cameroon: Research and Analysis of Factors Associated with Their Occurrence in Douala Maternity Wards

**Henri Essome[1,2*], Merlin Boten Bounyom[3], Astrid Ndolo Kondo[1,2], Ingrid Doriane Ofakem Ilick[1,2], Charlotte Epossè Ekoube[2], Rita Bono Betoko[2], Hassanatou Iyawa[2], Fulbert Mangala Nkwele[1], Théophile Nana Njamen[4], Robert Tchounzou[4], Alphonse Ngalame Nyong[4], Charlotte Irène Cyrielle Edjoa Mboe[1], Moustapha Bilkissou[2], Junie Ngaha Yaneu[1], Marga Vanina Ngono Akam[1], Gervais Mounchikpou Ngouhouo[1], Grâce Tocki Toutou[2], Michel Roger Ekono[1], Nelly Noubi[5], Pascal Foumane[6]**

[1]Training, Teaching and Research Unit in Gynecology Obstetrics and Reproduction, Faculty of Medicine and Pharmaceutical Sciences, University of Douala, Douala, Cameroon
[2]Laquintinie Hospital, Douala, Cameroon
[3]Faculty of Health Sciences, University of Bamenda, Bamenda, Cameroon
[4]Faculty of Health Sciences, University of Buea, Buea, Cameroon
[5]Faculty of Medicine and Biomedical Sciences, University of Yaoundé 1, Yaoundé, Cameroon
[6]Faculty of Medicine and Pharmaceutical Sciences, University of Ebolowa, Ebolowa, Cameroon
Email: *essometocky@yahoo.com

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## Abstract

**Introduction:** Low birth weight (LBW) is defined by the World Health Organization (WHO) as a birth weight strictly below 2500 g, whatever the term of pregnancy. It constitutes a major public health problem, both in developed and developing countries, due to its magnitude and its strong association with infant morbidity and mortality. Main objective was to study the factors associated with the occurrence of small-for-gestational-age newborns in Douala. **Methodology:** We carried out a cross-sectional analytical study with prospective data collection using a technical pretested sheet in the maternity wards of the Douala General Hospital, the Laquintinie Hospital, and the District hospitals of Deido, Nylon and Bonassama over a period of 4 months (January to April 2020). We were interested in any newborn, born alive, vaginally or by cesarean section, of low weight, seen in the first 24 hours from a full-term single-fetal pregnancy whose mother had given her consent. Our sampling was consecutive and non-exhaustive. We excluded newborns whose term was unclear and those with congenital malformations or signs of embryo-foetopathy. Data collection was done using survey sheets. Statistical analyzes were carried out with CS Pro 7.3 and SPSS version 25.0 software. The

Student, Chi-square and Fischer tests were used to compare the means of the variables, the percentages with a significance threshold P value < 0.05. Logistic regression allowed us to determine maternal factors associated with newborns born small for gestational age. **Results:** During the study period, 305 full-term newborns were included, divided into 172 boys and 133 girls. The percentage of small-for-gestational-age newborns was 9.8%; after multivariate analysis by logistic regression to eliminate confounding factors, we found maternal factors associated with small for gestational age newborns; maternal age less than 20 years, primiparity, gestational age (37 - 38), a delay in prenatal visits greater than 14 weeks, anemia in pregnancy, positive toxoplasmosis serology in pregnancy, a body mass index of <18.5 kg/m$^2$ at the start of pregnancy. **Conclusion:** Our study revealed the potential determinants of low birth weight at term in the Cameroonian urban context and specifically in Douala.

## Keywords

Newborn, Low Birth Weight, Gestational Age, Douala

## 1. Introduction

Low birth weight (LBW) is defined by the World Health Organization (WHO) as a birth weight strictly below 2500 g, whatever the term of pregnancy [1]. It constitutes a major public health problem, both in developed and developing countries, due to its magnitude and its strong association with infant morbidity and mortality. Most of these low birth weight births (96%) take place in developing countries. In these countries, the proportion of LBW (16%) is twice that of developed countries [2].

The latter affects 30 million births per year in these countries, 24% of all births. Birth weight is an important indicator of the health and nutritional status of the mother before and during pregnancy. It is also an important predictor of child survival and subsequent development [3]. There is indeed a close short-term association between the level of LBW, fetal and neonatal mortality, and infant morbidity [4] [5]. Among the 11.6 million deaths of children under 5 years old that occurred in 1995 in developing countries, 6.3 million (or 53%) were associated with low birth weight [6]. In the medium term, LBW is associated with a deficit in cognitive and physical development with a reduction in the child's intellectual abilities [7] [8]. These children are also predisposed to diet-related chronic and cardiovascular pathologies in adulthood [9]. Furthermore, the treatment by the health system of developing countries of children born with growth deficits is generally insufficient or inadequate, due to its high cost. This then results in significant consequences for societies, in terms of losses in human capital and economic productivity.

The main etiologies of low birth weight are dominated by prematurity (birth before 37 weeks of gestation) in developed countries and intrauterine growth re-

striction (IUGR) in developing countries [10] [11] [12] [13] where it is estimated that 2/3 of low birth weight births are due to IUGR [14]. Prevalences are generally above the 20% limit set by the WHO for public health interventions to be necessary [15] [16] [17] [18].

Ultimately, born small for gestational age (SGA), a birth weight below the 10th percentile of a reference curve adjusted for gestational age and sex [19].

In view of the variability of inter-racial and even geographical parameters in the occurrence of a newborn of small weight for gestational age, we proposed to study the factors which would be associated with it in Douala (Cameroon).

## 2. Materials and Methods

### 2.1. Type, Location and Period of Study

We carried out a cross-sectional analytical study with prospective data collection in the maternity wards of the General Hospital of Douala, the Laquintinie Hospital, the District hospitals of Deido, Nylon, Bonassama over a period of 4 months (January to April 2020).

The sample of maternity hospitals selected for the recruitment of newborns was reasoned, because it is fairly representative given its cosmopolitan patient base covering all socio-economic and community categories in Cameroon.

### 2.2. Study Population

The target population consisted of all newborns from the hospitals in our study, born alive, at term during the recruitment period (January 2020-April 2020), with a single-fetal pregnancy.

#### 2.2.1. Inclusion Criteria

We were interested in any newborn born alive during the recruitment period in the above-mentioned hospitals, vaginally or by cesarean section, seen in the first 24 hours of life from a single-fetal pregnancy of gestational age between 37 completed weeks and 41 weeks of amenorrhea + 6 days for which the mother had given her consent.

#### 2.2.2. Non-Inclusion Criteria

Not included in the study:

- Newborns whose term was unclear.
- Newborns with congenital malformations or signs of embryo-foetopathy.

### 2.3. Sampling

We carried out a consecutive and non-exhaustive sampling, as such to avoid bias, every examined new born was registered and his sheet kept while waiting for data entry, and we moved on to the next new born.

#### 2.3.1. Documentation Materials

- Laptop

- Articles, books, journals, lectures
- High speed internet modem
- Ream of formats
- Ballpoint pen
- USB key

#### 2.3.2 Technical equipment

- A white blouse
- An outfit for night shift
- A baby scale
- A tape measure
- A scale
- Care gloves
- Inclusion sheet
- Technical sheet

## 3. Procedure

### 3.1. Administrative Process

We began our work by writing the research protocol. Authorization was then requested from the institutional ethics committee of the University of Douala in order to obtain ethical clearance (Clearance No. 2144) and we then requested research authorization in the various hospitals.

### 3.2. Data Collection Procedure

In order to determine the factors associated with the occurrence of a small-for-gestational-age newborn, a questionnaire was developed for this purpose. This questionnaire was on a technical sheet designed and pretested by 3 investigators all professors of university among which 2 gynecologists and a pediatrician. The newborns were examined and weighed at deliver by 4 pediatricians.

It included the following variables.

#### Socio-Demographic and Socio-Economic Characteristics of Full-Term Births in the City of Douala

1) Socio-demographic data
- Maternal age
- Ethnicity
- Religion
- Marital status
- Place of residence.

2) Household socio-economic data
- Level of education of the father and/or head of household
- Mother's educational level
- Fathers profession
- Mother's profession.

### 3.3. Obstetrical and Clinical Profile of Full-Term Deliveries in the City of Douala

#### 3.3.1. Obstetric Profile

- Obstetric history
- Gravidity
- Parity
- History of spontaneous or induced miscarriages
- Weight and sex of other children
- History of uterine malformations
- History of intrauterine growth retardation [20]
- History of fetal macrosomia
- History of fetal death in utero
- Obstetric monitoring
- The date of the last period
- The term of the pregnancy which was calculated in weeks of amenorrhea from the date of the last period (by questioning the mother/pregnancy monitoring diary) with the Naegle formula (gestational age = date of the last period + 7 days - 3 months) or from the ultrasound in the first trimester (before the $14^{th}$ week). In the event of discrepancy between the two estimates, the gestational age calculated from the date of the ultrasound was used.
- The inter-reproductive space
- The start date of prenatal consultations
- The place for prenatal consultations
- The number of prenatal consultations
- The assessments carried out (biological and morphological)
- Anti-malaria and anti-anemia prophylaxis during pregnancy.
- Pathologies during pregnancy
- Diet during pregnancy: number of meals before pregnancy, number of meals during pregnancy, number of added meals
- Toxic habits during pregnancy
- Alcohol consumption
- Tobacco
- Exposure to organophosphates
- Taking traditional potions.

#### 3.3.2. Clinical Profile

- Anthropometric data of the mother
- Weight at the beginning and end of pregnancy (on personal scale or examination of the monitoring log)
- Weight gain
- Maternal size (national identity card as reference)
- Body mass index (BMI) at the beginning and end of pregnancy calculated and expressed in kilogram (Kg)/square meter ($m^2$).
- Medical history

- High blood pressure
- Chronic kidney disease
- Respiratory disorders
- Thrombophilia
- Autoimmune diseases
- Hepatitis B
- Hepatitis C
- Human Immunodeficiency Virus (HIV) Infection
- Surgical history
- Pelvic surgery, cesarean section and indications
- Vital parameters on admission
- Blood pressure measured in mm Hg using an electronic blood pressure monitor
- Heart rate measured using the same electronic blood pressure monitor
- Respiratory frequency in cycles/minutes
- Axillary temperature in degrees/Celsius (°C)
- Obstetric examination
- Fundal height
- Abdominal circumference in centimeters using an inextensible tape measure
- Presentation
- Progress of childbirth
- Delivery routes
- Indications if cesarean section

### 3.4. Anthropometric Profile of the Newborn

- Sex
- Apgar
- Cephalohematoma
- Anthropometric parameters: the parameters studied were: weight in grams, height in centimeters, upper arm, thoracic and cranial perimeters in centimeters [21].

Anthropometric measurements of the newborn and weighing were taken at birth in the delivery room.

- Weight was measured in grams using baby scales from different hospitals. Newborns were weighed naked directly at birth. We delicately placed the newborn in supine position on the scale covered with a fine wipe and tared. The value obtained once the newborn was stable on the scale was noted.

### 3.5. Definitions of Operational Terms

Newborn: child who is less than or equal to 28 days old.

Term: gestational age between 37 completed weeks of amenorrhea and 41 completed weeks of amenorrhea + 6 completed days.

Gravidity: number of confirmed pregnancies.

Primigravida: any woman who has already had only one confirmed pregnancy.

Paucigravida: any woman who has had between 2 and 3 confirmed pregnancies.

Multigravida: any woman who has had between 4 and 5 confirmed pregnancies.

Parity: Number of full-term deliveries (from 37 weeks of amenorrhea).

Primiparous: any woman who has had only one full-term birth.

Pauciparous: any woman who has had 2 to 3 full-term deliveries.

Multiparous: any woman who has had 4 to 5 full-term deliveries.

Grande multipara: any woman who has had 6 full-term deliveries or more.

Anemia in pregnancy: defined based on a hemoglobin level ≤ 10 grams/deciliters.

3rd percentile: Value of a parameter in relation to which 3% of measurements are lower and 97% are higher.

10th percentile: Value of a parameter relative to which 10% of measurements are lower and 90% are higher.

90th percentile: Value of a parameter relative to which 90% of measurements are lower and 10% are higher.

97th percentile: Value of a parameter relative to which 97% of measurements are lower and 3% are higher.

Small for gestational age newborn: A newborn whose birth weight is less than the 10th percentile for gestational age.

Macrosome: Newborn whose birth weight is greater than or equal to the 90th percentile for gestational age.

### 3.6. Statistical Analysis

The data collected were recorded and analyzed by the Census Survey Processing System CS Pro version 7.3 and Statistical Package for Social Science SPSS 25 software.

The results were expressed in terms of average (average weight, average height, average head circumference, average arm circumference, average chest circumference) in the form of tables and graphs using Microsoft Office Excel 2016 and Word 2013 software. To study trophicity, we also brought out the distribution of anthropometric measurements in percentiles using SPSS software.

The Student t test was used to compare the mean of the parameters according to sex. Analysis of variance (ANOVA) made it possible to compare the parameters of the newborns according to the gestational age groups and for each parameter.

Chi-square and Fischer tests were used to compare percentages or proportions. Logistic regression allowed us to determine the maternal factors associated with the newborn's anthropometric measurements. The odds ratio was calculated with a significance threshold of $p < 0.05$.

### 3.7. Ethical Considerations

Our study was previously submitted for approval to the institutional ethics

committee of the University of Douala, with a view to obtaining ethical clearance allowing us to conduct our study. Study authorization was also requested from the administrative services of the hospitals in our study.

Parents of eligible newborns were clearly informed by the information sheet.

We carried out our study in strict compliance with the fundamental principles of medical research: the principle of the interest and benefit of research, the principle of the safety of research, confidentiality, and justice.

## 4. Results

The definition of a newborn born small for gestational age includes an essential constraint which is knowledge of the term of pregnancy.

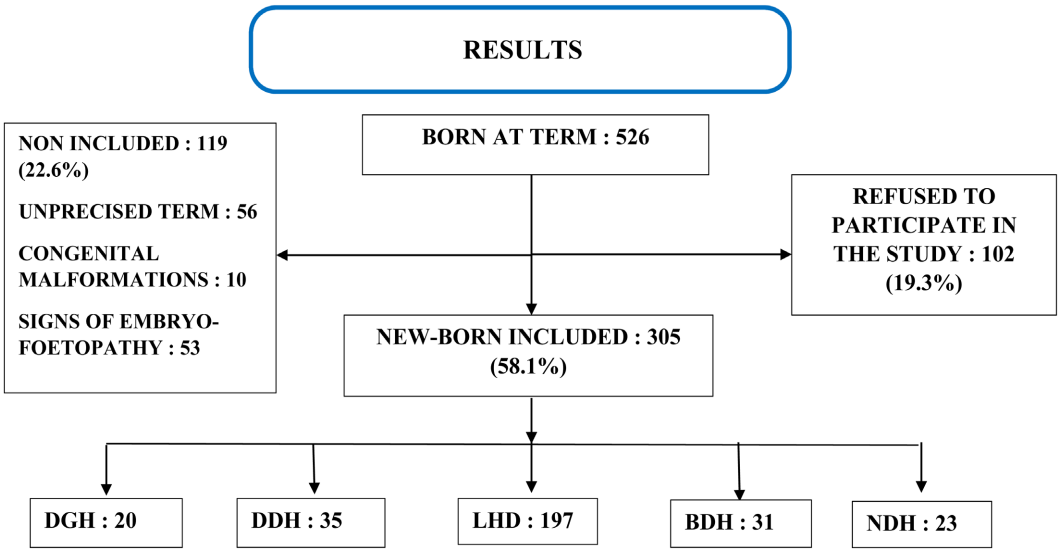
In total, 526 births were observed in maternity hospitals during the study period, among which we retained 305 newborns for this study (Figure 1).

The proportion of low birth weight for gestational age in our study was 9.8% (30 cases). Referring to the WHO threshold value of 2500 g, this percentage was 5.2%. According to gender, the majority of LBW were female (Table 1).

In univariate analysis, maternal age was significantly associated with small-for-gestational-age newborns and the risk was significant for those giving birth under 20 years of age. (p value = 0.018) (Table 2).

Obstetrically, a significant association between primiparity and LBW was found (p value = 0.001). The same was true for primigravidae (p = 0.009). It was also established that a history of spontaneous miscarriage was significantly associated with LBW (p = 0.009). At birth, a gestational age between 37 and 38 weeks of amenorrhea would be significantly associated with LBW (p < 0.001) (Table 3).

For obstetric follow-up, a time to start of ANC > 14 weeks was significantly associated with LBW (p < 0.001). A significant association was also demonstrated




DGH: Douala General Hospital; DDH: Deido District Hospital; LHD: Laquitinie Hospital Douala; BDH: Bonassama District Hospital; NDH: Nylon District Hospital.

**Figure 1.** Full-term newborn inclusion flowchart.

**Table 1.** Distribution of newborns by gestational age by sex.

| Weight (in g) | Male (%) | Female (%) | Total (%) | P-value |
|---|---|---|---|---|
| <2656 | | | | |
| Yes | 13 (43.3) | 17 (56.6) | 30 (9.8) | 0.063 |
| No | 160 (58.1) | 115 (41.8) | 275 (90.1) | |
| <2500 | | | | |
| Yes | 6 (37.5) | 10 (62.5) | 16 (5.2) | 0.061 |
| No | 167 (57.7) | 122 (42.2) | 289 (94.7) | |

**Table 2.** Demographic factors associated with LBW.

| Variables | LBW | | OR (IC 95%) | P-value |
|---|---|---|---|---|
| | Yes n (%) N = 30 | No N (%) N = 275 | | |
| Age of mother (in years) | | | | |
| <20 | 4 (20,0) | 16 (80.0) | 3.21 (1.25 - 8.27) | 0.018 |
| [20 - 25] | 6 (9.5) | 57 (90.5) | 1.03 (0.51 - 2.09) | 0.530 |
| [25 - 30] | 11 (13.4) | 71 (86.6) | 1.79 (0.97 - 3.29) | 0.055 |
| [30 - 35] | 7 (8.1) | 79 (92.9) | 0.63 (0.31 - 1.25) | 0.120 |
| [35 - 40] | 2 (4.5) | 42 (95.5) | 0.39 (0.13 - 1.15) | 0.05 |
| [40 - 45] | 0 (0.00) | 8 (100.0) | *** | *** |
| ≥45 | 0 (0.00) | 2 (100.0) | *** | *** |
| Marital status | | | | |
| Single | 21 (10.9) | 170 (89.1) | 1.51 (0.81 - 2.82) | 0.123 |
| Married | 9 (8.0) | 104 (92.0) | 0.67 (0.36 - 1.25) | 0.135 |
| Divorced | 0 (0.00) | 1 (100.00) | *** | *** |
| Professional status of the mother | | | | |
| None | 9 (13.4) | 58 (86.6) | 1.68 (0.88 - 3.21) | 0.081 |
| Pupil | 4 (16.0) | 21 (84.0) | 1.80 (0.71 - 4.51) | 0.162 |
| Student | 6 (9.8) | 55 (90.2) | 1.08 (0.53 - 2.20) | 0.476 |
| Worker | 11 (7.2) | 141 (92.8) | 0.06 (0.03 - 0.09) | 0.000 |

if follow-up was done in a 5$^{th}$ category hospital (p = 0.002). The association between LBW and pathologies interfering during pregnancy was significant in those giving birth with positive toxoplasmic serology (p = 0.019) (Table 4).

A significant association with LBW was also found in those giving birth who had anemia (p = 0.010), pre-eclampsia (p = 0.022) during pregnancy (Table 5).

Clinically, a maternal body mass index at the start of pregnancy < 18.5 kilograms/meter-squared was significantly associated with LBW (p = 0.044) (Table 6).

**Table 3.** Obstetric history associated with LBW.

| Variables | LBW | | OR (IC 95%) | P-value |
|---|---|---|---|---|
| | Yes n (%) N = 30 | No N (%) N = 275 | | |
| Gravidity | | | | |
| [1] | 21 (13.1) | 139 (86.9) | 1.74 (1.09 - 2.77) | 0.009 |
| [2; 3] | 4 (4.7) | 82 (95.3) | Ref. | |
| ≥ 4 | 5 (8.5) | 54 (91.5) | 0.86 (0.41 - 1.83) | 0.431 |
| Parité | | | | |
| 1 | 21 (15.7) | 113 (84.3) | 2.03 (1.27 - 3.28) | 0.001 |
| [2 - 5] | 8 (5.1) | 150 (94.9) | Ref. | |
| >5 | 1 (7.7) | 12 (92.3) | 0.35 (0.04 - 2.76) | 0.264 |
| Miscarriages Spontaneous | | | | |
| Yes | 5 (7.0) | 66 (93.0) | 1.97 (1.10 - 3.51) | 0.009 |
| No | 25 (10.7) | 209 (89.3) | Ref. | |
| Provoked | | | | |
| Yes | 3 (12.5) | 21 (87.5) | 1.50 (0.57 - 3.97) | 0.2788 |
| No | 27 (9.6) | 254 (90.4) | Ref. | |
| Gestational age | | | | |
| [37 - 38] | 11 (20.4) | 43 (79.6) | 4.36 (1.38 - 13.76) | 0.000 |
| [38 - 39] | 14 (17.3) | 67 (82.7) | 1.66 (0.90 - 3.07) | 0.075 |
| [39 - 40] | 5 (6.4) | 73 (93.6) | 0.56 (0.27 - 1.18) | 0.082 |

**Table 4.** Obstetric follow-up factors associated with LBW.

| Variables | LBW | | OR (IC 95%) | P-value |
|---|---|---|---|---|
| | Yes n (%) N = 30 | No N (%) N = 275 | | |
| Start time for prenatal visits (in WA) | | | | |
| ≤14 | 16 (6.1) | 246 (93.9) | 0.09 (0.04 -0.18) | |
| >14 | 14 (32.6) | 29 (67.4) | 11.89 (6.33 - 22.35) | 0.000 |
| Place of visits | | | | |
| 1st category | 1 (6.3) | 15 (93.7) | 0.28 (0.04 - 2.14) | 0.163 |
| 2ndcategory | 17 (16.8) | 84 (83.2) | 1.02 (0.55 - 1.86) | 0.542 |
| 3rdcategory | 0 (0.00) | 0 (0.00) | *** | *** |
| 4thcategory | 8 (11.9) | 59 (88.1) | 1.43 (0.73 - 2.81) | 0.191 |
| 5thcategory | 4 (28.6) | 10 (71.4) | 10.83 (1.96 - 59.84) | 0.002 |
| Positive serology | | | | |
| Toxoplasmosis | | | | |
| Yes | 3 (20.0) | 12 (80.0) | 3.10 (1.05 - 9.54) | 0.019 |

**Continued**

| | | | | |
|---|---|---|---|---|
| No | 27 (9.3) | 263 (90.7) | 0.44 (0.14 - 1.33) | |
| Aghbs | | | | |
| Yes | 1 (9.1) | 10 (90.9) | 0.43 (0.05 - 3.39) | 0.357 |
| No | 29 (9.9) | 265 (90.1) | 2.35 (0.30 - 18.76) | |
| HIV | | | | |
| Positive | 2 (13.3) | 13 (86.7) | 1.63 (0.50 - 5.31) | 0.300 |
| Negative | 28 (9.7) | 262 (90.3) | 0.62 (0.19 - 2.01) | |

**Table 5.** Pathologies in pregnancy associated with LBW.

| Variables | LBW | | OR (IC 95%) | P-value |
|---|---|---|---|---|
| | Yes n (%) N = 30 | No N (%) N = 275 | | |
| Pathologies associated with pregnancy | | | | |
| Malaria | | | | |
| Yes | 9 (11.5) | 69 (88.5) | 1.45 (0.77 - 2.71) | 0.1629 |
| No | 21 (9.2) | 206 (90.8) | 0.69 (0.37 - 1.30) | |
| Hyperemesis gravidarum | | | | |
| Yes | 1 (50.0) | 1 (50.0) | 4.41 (0.27 - 71.59) | 0.3393 |
| No | 29 (9.6) | 274 (90.4) | 0.23 (0.01 - 3.68) | |
| Pre eclampsia | | | | |
| Yes | 3 (30.0) | 7 (70.0) | 4.67 (1.31 - 16.73) | 0.0228 |
| No | 27 (9.2) | 268 (90.8) | 0.21 (0.06 - 0.77) | |
| Anemia | | | | |
| Yes | 3 (6.8) | 41 (93.2) | 2.29 (1.16 - 4.56) | 0.010 |
| No | 27 (10.3) | 234 (89.7) | 1.94 (0.73 - 5.17) | |

**Table 6.** Maternal clinical factors associated with LBW.

| Variables | LBW | | OR (IC 95%) | P-value |
|---|---|---|---|---|
| | Yes n (%) N = 30 | No N (%) N = 275 | | |
| BMI at start of pregnancy ($Kg/m^2$) | | | | |
| <18.5 | 2 (33.3) | 4 (66.7) | 6.18 (1.16 - 55.42) | 0.044 |
| [18.5 - 25] | 8 (10.5) | 68 (98.5) | Ref. | |
| [25 - 30] | 12 (8.6) | 128 (91.4) | 0.73 (0.41 - 1.29) | 0.140 |
| [30 - 35] | 5 (9.4) | 48 (90.6) | 0.75 (0.37 - 1.53) | 0.217 |
| [35 - 40] | 2 (9.1) | 20 (90.9) | 1.30 (0.45 - 3.73) | 0.322 |
| >40 | 1 (12.5) | 7 (87.5) | 2.14 (0.41 -11.17) | 0.200 |

**Continued**

| | | | | |
|---|---|---|---|---|
| Weight gain (Kg) | | | | |
| ≤9 | 20 (9.1) | 199 (90.9) | 0.74 (0.40 - 1.37) | 0.212 |
| [9 - 12] | 4 (10.8) | 33 (89.2) | 1.23 (0.53 - 2.86) | 0.383 |
| >12 | 6 (12.2) | 43 (87.8) | 1.32 (0.63 - 2.78) | 0.288 |
| BMI before delivery | | | | |
| <18.5 | 0 (0.0) | 0 (0.0) | NC | |
| [18.5 - 25] | 5 (13.9) | 31 (86.1) | 1.36 (0.62 - 2.98) | 0.226 |
| [25 - 30] | 9 (11.00) | 73 (89.0) | Ref. | |

**Table 7.** Factors associated with LBW newborns.

| Potential associated factors | OR (IC 95%) | P-value |
|---|---|---|
| Age of mother (<20 years) | 3.21 (1.25 - 8.27) | 0.018 |
| Gravidity (1) | 0.98 (0.65 - 1.49) | 0.959 |
| Parity (1) | 1.65 (1.03 - 5.92) | 0.008 |
| Spontaneous miscarriage (Yes) | 0.28 (0.05 - 5.71) | 0.178 |
| Gestational age ([37] [38]) | 1.59 (1.27 - 2.01) | 0.000 |
| Delay in start of ANC (>14) | 10.35 (4.48 - 20.16) | 0.000 |
| Place of ANC (5$^{th}$ category) | 0.98 (0.88 - 1.11) | 0.834 |
| Anemia (Yes) | 2.94 (1.45 - 11.95) | 0.000 |
| Toxoplasmosis (Yes) | 3.31 (1.98 - 11.178) | 0.005 |
| Preeclampsia | 4.99 (0.52 - 27.75) | 0.067 |
| BMI at the start of pregnancy (<18.5 Kg/m$^2$) | 7.59 (2.88 - 23.89) | 0.000 |

In multivariate analysis by logistic regression to eliminate among the above factors those which could give rise to confusion, the factors significantly exposing for LBW were: maternal age less than 20 years (odds 3.21 (1.25 - 8.27) p:0.018), primiparity (odds 1.65 (1.03 - 5.92) p:0.008), gestational age (37 - 38) (odds 1.59 (1.27 - 2.01) p:0.000), a delay in prenatal visits greater than 14 weeks (odds 10.35 (4.48 - 20.16) p:0.000), anemia in pregnancy (odds 2.94 (1.45 - 11.95) p: 0.000), positive toxoplasmosis serology in pregnancy (odds3.31 (1.98 - 11.178) p: 0.005), a body mass index < 18.5 kg/m$^2$ at the start of pregnancy (odds 7.59 (2.88 - 23.89) p:0.000) (**Table 7**).

## 5. Discussion

Small for gestational age (SGA) newborns

The criterion used to define small-for-gestational-age newborns is that recommended by the WHO expert committee [19], namely a child with a birth weight below the 10$^{th}$ percentile of a weight reference curve for sex-specific ges-

tational age. However, as in all studies on the LBW, the difficulty often encountered is the choice of the reference curve. Several references exist and, from one reference to another, the values at the 10$^{th}$ percentile vary, with differences that can occasionally even reach 500 g. Each of these curves has limits which are linked to the difficulty of controlling all the factors, both genetic and environmental, linked to IUGR. Also, most of these references were made from hospital studies [22].

According to the WHO in 2007, the percentage of newborns with low birth weight in Cameroon was 11% [23]. It is defined for any newborn whose birth weight is less than 2500 grams whatever the term. In our study this percentage was 5.2%. This low rate takes into account the fact that we only worked on full-term newborns. But by defining our 10$^{th}$ percentile weight of 2656 g as a threshold value, this percentage increased to 9.8%. This difference would suggest that a new threshold should be defined for full-term newborns in our context.

Concerning the associated maternal factors, our investigation revealed that the main demographic factor likely to influence anthropometric measurements was the age of the mother. Indeed, mothers aged less than 20 years had a significant association with LBW (OR = 3.21). Nikiema *et al.* in 2005 in Ouagadougou obtained the same association with low birth weight (OR = 1.93) in his case control study on the etiological factors associated with IUGR [24]. These results could be attributable to the less than optimal development of the reproductive system, poor eating habits and poor obstetric monitoring which most often characterize young girls; and even when nutrition during pregnancy is adequate, nutrients will be diverted for the growth of the young mother.

For the obstetric component, our analysis results revealed that the factors associated with LBW were:

1) Primiparity (OR = 2.03); this association was also established by Ngassa et al. in 2004 in their study on the factors influencing birth weight in Cameroon which also included parity as risk factors for low birth weight [25]. This association would be closely related to the young age of the mother at the time of the first pregnancy. But this association is not always significant with increasing age at first pregnancy.

2) Prenatal monitoring started after 14 weeks (OR = 11.89): Soriano *et al.* in 2004 during his study on the risk factors for low birth weight reported that prenatal monitoring started late was associated with low birth weight[26]. This would be due to late detection of fetal growth disorders [27] [28].

3) Anemia is an important component of nutritional deficit in pregnant women, both in developed and developing countries [29]. In our study this factor, noted just before delivery, was associated with LBW. It should be noted, however, that information on the hemoglobin level was only available by transcription of the data collected in the prenatal monitoring records of those giving birth, which inevitably constitutes a considerable source of bias. In addition, it is possible that the hemoglobin level, which tends to rise just before childbirth, did not reflect, as measured in the study, the reality of anemia at the end of preg-

nancy. This therefore explains the very low prevalence of anemia found (6.8%), far below the prevalence given by the WHO for pregnant women in Africa (40% - 80%).

In stable malaria endemic areas, malaria during pregnancy results in anemia in the mother and low birth weight in the newborn [30]. Several studies have shown a significant association between placental infestation and IUGR in stable endemic areas [11] [31] [32] [33]. However, this association is more important in periods of high transmission [32] and, in our study, very few placental infestations were found 25.5% including 11.5% associated with low birth weight for gestational age. While our study took place partly during the short rainy season from March to April; we can assume that the infestation was rather ongoing and the consequences distant to our study.

4) Positive toxoplasmosis serology:

Fetal infections alter the development of the neurological, digestive and hematopoietic systems, causing fetal growth disorders. Unlike Freeman et al who found no association between low birth weight and toxoplasmosis, in our study this association was significant with an odds ratio of 3.1 [34].

5) Nutritional status (BMI)

It is considered a condition resulting from the balance between the ingestion of food and its use by the body. The nutritional status of the mother before pregnancy is an important determinant for both the mother and the fetus. The indicator often used to measure this condition is BMI and it is widely recognized that low BMI before pregnancy is an important risk factor for IUGR [35] [36] [37]. However, there is no consensus on the BMI threshold associated with IUGR risk. It is also true that this indicator is influenced by ethnicity and genetic factors, but it nevertheless makes it possible to measure the result of the energy balance.

In our study, very few women were able to reliably declare their weight before pregnancy, so we used the BMI after delivery as close to the BMI at the start of pregnancy, even though we know that weight maternal after birth is in principle superior to it

We found, as in most African series [38], a significant association with the nutritional indicators available to us, namely BMI. In our series, women giving birth with a BMI less than 18.5 kg/m$^2$ at the start of pregnancy or after delivery had a significant association with LBW (OR = 6.1).

## 6. Conclusions

Our study revealed the potential determinants of low birth weight in the Cameroonian urban context and specifically in Douala.

Some of these determinants can be modified by operational strategies aimed at combating early motherhood, cleaning up the living environment against the anopheline population, improving the completeness of prenatal visits as well as the nutritional state of pregnant women.

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## Contribution of Study to Science

Our study highlights the levers on which operational strategies should support to promote fetal well-being and therefore that of the Cameroonian newborn.

## Contribution of Authors

Essome: coordinated the study and wrote the manuscript; Edjoa: collected the data; Tocki: provided the English translation and formatting of the manuscript; Boten, Ndolo, Ofakem, Eposse, Bono, Hassanatou, Bilkissou, Ngaha, Mounchikpou, Ngono, Mangala, Ngalame, Tchounzou; Ekono, Nana read and corrected the manuscript; Noubi and Foumane supervised the study and corrected the manuscript; All authors read and validated the final manuscript.

## Conflicts of Interest

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

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## Survey Sheet for Low Birth Weight

| ANTHROPOMETRY AND LOW BIRTH WEIGHT SURVEY SHEET | | |
|---|---|---|
| **S1Q01** | Interviewee number | \|__\|\|__\|\|__\| |
| **S1Q02** | Date (JJ/MM/AAAA) | \|__\|\|__\|/\|__\|\|__\|/\|__\|\|__\|\|__\|\|__\| |
| **S1Q03** | Maternal (in years) | \|__\|\|__\| |
| **S1Q04** | Region of origin | \|__\| (1 = Adamawa, 2 = Centre, 3 = East, 4 = Far north, 5 = Littoral, 6 = North, 7 = North-west, 8 = West, 9 = South, 10 = South-west) |
| **S1Q05** | Religion | \|__\| (1 = Christian, 2 = Islam, 3 = Others ) |
| **S1Q06** | Place of residence | \|_____\| |
| **S1Q07** | Marital status | \|__\| (1 = Single, 2 = Married, 3 = Divorced, 4 = Widow) |
| **SECTION 2: SOCIO-ECONOMIC DATA** | | |
| **S2Q01** | Level of study of father | \|__\| (1 = None, 2 = Primary, 3 = Secondary, 4 = Superior) |
| **S2Q02** | Level of study of mother | \|__\| (1 = None, 2 = Primary, 3 = Secondary, 4 = Superior) |
| **S2Q03** | Profession of father | \|__\| (1 = None, 2 = pupil, 3 = student, 4 = worker) |
| **S2Q04** | Profession of mother | \|__\| (1 = None, 2 = pupil, 3 = student, 4 = worker) |
| **SECTION 3: PAST HISTORY** | | |
| **S3Q01** | Gravidity | \|_____\| |
| **S3Q02** | Parity | \|_____\| |
| **S3Q03** | Term pregnancy | \|_____\| |
| **S3Q04** | Miscarriage | \|__\| (1 = Spontaneous, 2 = Provocked) |
| **S3Q05** | Intra-uterine death (If no go to **S3Q06**) | \|__\| (1 = yes, 2 = No) |
| **S3Q05A** | Nomber | |
| **S3Q06** | Live children | \|__\|\|__\| |
| **S3Q07** | **Birth weight of children** (in kg) | |
| **S3Q07A** | Weight of first child | \|__\|\|__\|,\|__\|\|__\|\|__\| |
| **S3Q07B** | Weight of second child | \|__\|\|__\|,\|__\|\|__\|\|__\| |
| **S3Q07C** | Weight of third child | \|__\|\|__\|,\|__\|\|__\|\|__\| |
| **S3Q07D** | Weight of fourth child | \|__\|\|__\|,\|__\|\|__\|\|__\| |
| **S3Q07E** | Weight of fifth child | \|__\|\|__\|,\|__\|\|__\|\|__\| |
| **S3Q07F** | Weight of sixth child | \|__\|\|__\|,\|__\|\|__\|\|__\| |
| **S3Q08** | **Sex of children (Only for the sexes, 1 = *Male*, 2 = *Female)*** | |
| **S3Q08A** | Sex of first child | \|__\| |
| **S3Q08B** | Sex of second child | \|__\| |
| **S3Q08C** | Sex of third child | \|__\| |
| **S3Q08D** | Sex of fourth child | \|__\| |

**Continued**

| | | |
|---|---|---|
| **S3Q08E** | Sex of fifth child | \|__\| |
| **S3Q08F** | Sex of sixth child | \|__\| |
| **S3Q09** | Number of new-born whose weigth was less than 2500 g | \|__\|\|__\| |
| **S3Q10** | Number of new-born whose weigth was greater than 4000 g | \|__\|\|__\| |
| **Monitoring of the current pregnancy (from which the newborn included)** | | |
| **S3Q11** | LMP (last menstrual period) | \|__\|\|__\|/\|__\|\|__\|/\|__\|\|__\|\|__\|\|__\| |
| **S3Q12** | Ga (gestational age) (in WA) | \|__\|\|__\| |
| **S3Q13** | Interbirth space | |
| **S3Q14** | Date of start of ANC | \|__\|\|__\|/\|__\|\|__\|/\|__\|\|__\|\|__\|\|__\| |
| **S3Q15** | Term | |
| **S3Q16** | Number of ANC | \|__\|\|__\| |
| **S3Q17** | Place of ANC | \|_____\| |
| **S3Q18** | Check-ups during pregnancy | |
| **S3Q18A** | FBC (level of hemoglobin) | |
| **S3Q18B** | Positive serologies | \|__\| (1 = TPHA/VDRL, 2 = Toxoplasmosis, 3 = Rubella, 4 = AgHbs, 5 = Others (to precise)) |
| **S3Q18BA** | Details on other positive serologies | |
| **S3Q18C** | Fasting capillary blood glucose | |
| **S3Q20** | First trimester echographie | \|__\| **(1 = *yes*, 2 = *No*)** |
| **S3Q20A** | Term | |
| **S3Q21** | second trimester echographie | \|__\| **(1 = *yes*, 2 = *No*)** |
| **S3Q21A** | Estimated fetal weight (EFW) | \|__\|\|__\|,\|__\|\|__\|\|__\| |
| **S3Q22** | Pathologies in pregnancy (If None go to **S3Q23**) | \|__\| (1 = Malaria, 2 = Hemorrhagic, 3 = Urinary infections, 4 = Genital infection; 5 = hyperemesis gravidarum, 6 = preeclampsia, 7 = Gestational diabetes, 8 = None) |
| **S3Q22A** | Other pathologies in pregnancy | |
| **S3Q23** | **Prophylaxy (1 = *yes*, 2 = *No*)** | |
| **S3Q23A** | Intermittent preventive treatment | \|__\| |
| **S3Q23B** | Antianaemic | \|__\| |
| **S3Q24** | Nutrition during pregnancy | |
| **S3Q24A** | Number of meals before pregnancy | \|__\|\|__\| |
| **S3Q24B** | Number of meals during pregnancy | \|__\|\|__\| |
| **S3Q24C** | Number of meals added | \|__\|\|__\| |
| **Medical (*Except* S3Q31,1 = *yes*, 2 = *No*)** | | |
| **S3Q25** | HTN | \|__\| |

**Continued**

| | | |
|---|---|---|
| **S3Q26** | Gestational diabetes | \|__\| |
| **S3Q27** | Chronic nephropathies | \|__\| |
| **S3Q28** | HIV infection | \|__\| |
| **S3Q29** | Hepatitis B | \|__\| |
| **S3Q30** | Hepatitis C | \|__\| |
| **S3Q31** | Other medical history(s) | |
| **Surgical (*Except* S3Q33A, 1 = *Yes*, 2 = *No*)** | | |
| **S3Q32** | Pelvic surgery | \|__\| |
| **S3Q33** | Cesarean (if no go to **S3Q34**) | \|__\| |
| **S3Q33A** | Indication of cesarean | \|__\|(1 = Mechanical dystocia, 2 = Shoulder dystocia, 3 = Cervical dystocia, 4 = AFD) |
| **Toxicologic (1 = *yes*, 2 = *No*)** | | |
| **S3Q34** | Alcohol consumption | \|__\| |
| **S3Q35** | Tobacco | \|__\| |
| **S3Q36** | Traditional potions | \|__\| |
| **SECTION 4: CLINICAL EXAM** | | |
| **Anthropometric data of the mother** | | |
| **S4Q01** | Weight at the start of pregnancy (in kg) | \|__\|\|__\|,\|__\|\|__\|\|__\| |
| **S4Q02** | Weight at the end of pregnancy (in Kg) | \|__\|\|__\|,\|__\|\|__\|\|__\| |
| **S4Q03** | Weight gain | \|__\|\|__\|,\|__\|\|__\|\|__\| |
| **S4Q04** | Maternal height (in metres) | |
| **S4Q05** | BMI (in $Kg/m^2$) | |
| **Vital parameters on admission** | | |
| **S4Q06** | Blood pressure (in mm Hg) | |
| **S4Q06A** | Right arm | |
| **S4Q06B** | Left arm | |
| **S4Q07** | Pulse (in bpm) | |
| **S4Q08** | Respiratory frequency (in cycles/min) | |
| **S4Q09** | Axillary temperature (in ˚C) | |
| **Obstetrical exam** | | |
| **S4Q10** | Uterine height (in cm) | |
| **S4Q11** | Abdominal circumference (in cm) | |
| **S4Q12** | EFW (according Johnson) | |
| **S4Q13** | Presentation | \|__\| (1 = Cephalic, 2 = breech; 3 = Transverse) |

**Continued**

| | | |
|---|---|---|
| **Progress of delivery** | | |
| **S4Q14** | Delivery methods (If 1, 2, 3 or 4 go to **S5Q01**) | \|__\| (1 = Spontaneous, 2 = Suction cup, 3 = Forceps, 4 = With episiotomy, 5 = Caesarean section) |
| **S4Q14A** | Indication of cesarean | \|__\| (1 = Mechanical dystocia, 2 = Shoulder dystocia, 3 = Cervical dystocia, 4 = AFD) |
| **S4Q15** | Other indications | |
| **SECTION 5: Characteristics of the newborn** | | |
| **S5Q01** | Sex | \|__\| (1 = Male, 2 = Female) |
| **S5Q02** | **Apgar** | |
| **S5Q02A** | 1st minute | \|_____\| |
| **S5Q02B** | 5th minute | \|_____\| |
| **S5Q02C** | 10th minute | \|_____\| |
| **S5Q03** | Serosanguineous bump | \|__\| **(1 = *yes*, 2 = *No*)** |
| **S5Q04** | **Noted parameter** | |
| **S5Q04A** | Weight | \|_____\| |
| **S5Q04B** | Height | \|_____\| |
| **S5Q04C** | Head circumference | \|_____\| |
| **S5Q04D** | Arm circumference | \|_____\| |
| **S5Q04E** | Chest circumference | \|_____\| |