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Determinants and Adverse Outcomes of Short Inter-Pregnancy Intervals and Maternal Knowledge of Optimal Birth Spacing: A Cross-Sectional Study in Douala, Cameroon

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Abstract

Background: Short inter-pregnancy interval (IPI), defined as less than 24 months between a live birth and subsequent conception, is a critical modifiable risk factor for maternal and neonatal morbidity. In Cameroon, high fertility rates and unmet needs for birth spacing persist, contributing to high maternal and neonatal mortality. **Objective:** This study aimed to identify the prevalence, determinants, and outcomes of short IPI, and evaluate maternal knowledge regarding optimal birth spacing among women delivering at two public hospitals in Douala, Cameroon. **Methodology:** A hospital-based cross-sectional analytic study was conducted from February to May 2022 at Douala Laquintinie and Nylon District Hospitals. Overall, 408 pregnant women with at least one previous live birth (vaginal and caesarean) within five years were recruited using purposive sampling after screening 450 women. Data collected via structured Likert scale questionnaires and clinical record reviews were analyzed using bivariate and multivariable logistic regression. **Results:** The prevalence of short IPI was 42.9%. Independent predictors included maternal age ≤ 20 years, primary education, parity ≥ 4, breastfeeding < 6 months, and non-use of contraceptives. Short IPI was associated with anemia ($p < 0.001$), postpartum hemorrhage ($p < 0.001$), and preterm birth ($p < 0.001$). While 62%

had sufficient general knowledge, only 30.6% knew the 5-year maximum interval. **Conclusion:** Short IPI is common among women delivering at these facilities and linked to adverse maternal and perinatal outcomes. Despite fair general awareness, specific knowledge gaps regarding optimal intervals persist. Integrate birth spacing counseling and modern contraception in postpartum, prioritizing the risk-mitigating 24 - 59-month window.

Keywords

IPI, Determinants, Maternal Outcomes, Perinatal Outcomes, Birth Spacing

1. Introduction

Short inter-pregnancy interval (IPI), classically defined as less than 24 months between a live birth and conception of the subsequent pregnancy, is a key modifiable risk factor for adverse maternal and perinatal outcomes [1]. Inadequate recovery time between pregnancies has been associated with anemia, hypertensive disorders, postpartum hemorrhage (PPH), preterm birth, low birth weight, small-for-gestational-age neonates and increased perinatal mortality [2]. The World Health Organization (WHO) recommends waiting at least 24 months after a live birth before conceiving again, corresponding to a birth-to-birth interval of about 33 months [3]; USAID and other agencies further suggest that 3 - 5 years may provide optimal health benefits [4].

Globally, about one quarter of births occur after short IPIs, with the burden disproportionately borne by low- and middle-income countries [5]. In Sub Saharan Africa, estimates suggest that 20% - 59% of women experience short intervals between pregnancies, reflecting high fertility, limited access to contraception and social norms favoring closely spaced births [6]. In Ethiopia, recent hospital-based studies report short IPI prevalences around 40% - 45% and demonstrate strong links to low maternal education, high parity, suboptimal breastfeeding duration and non-use of modern contraception [7]. Similar patterns have been described in Tanzania and other African settings [8].

Cameroon faces persistently high maternal and neonatal mortality, estimated at 467 maternal deaths per 100,000 live births and 28 neonatal deaths per 1000 live births [9]. The 2018 Demographic and Health Survey reported a high total fertility rate of 4.8 children per woman and an unmet need for birth spacing of around 15% among married women aged 15 - 49 years, conditions that favor short IPIs [10]. The median birth interval in Cameroon is approximately 31.2 months, masking substantial heterogeneity between regions, urban and rural areas, and socioeconomic strata [10].

Understanding determinants of short IPI and its consequences in urban referral settings can guide targeted interventions to improve maternal and perinatal outcomes. Several biological mechanisms have been proposed to explain the associa-

tion between short IPIs and poor outcomes. The maternal depletion syndrome posits that closely spaced pregnancies do not allow sufficient time for restoration of maternal nutrient stores and physiological reserves, resulting in increased risks of anemia, hypertensive disorders and obstetric complications [11] [12]. The folate depletion hypothesis suggests that inadequate replenishment of folate between pregnancies contributes to fetal growth restriction and preterm birth [13].

In addition to biological pathways, social and behavioral factors such as contraceptive non-use, unintended pregnancy, low decision making power, and limited knowledge of optimal birth spacing strongly influence the occurrence of short IPI [14]. Despite the public health relevance of birth spacing, there are limited contemporary data on short IPI, its determinants and outcomes among pregnant women in Cameroon, particularly in high volume urban facilities such as Douala Laquintinie Hospital (DLH) and Nylon District Hospital (NDH). Existing DHS data provide aggregate information on birth intervals but do not link them to detailed obstetric outcomes or women's knowledge and practices around optimal spacing [10].

2. Rationale and Justification

Given Cameroon's high fertility and mortality indicators, and the documented benefits of optimal birth spacing, there is a pressing need for context-specific evidence to support postpartum family planning and counseling strategies [10] [15]. Urban public hospitals in Douala serve large, socio-economically diverse populations and are critical platforms for interventions targeting women at high risk of closely spaced pregnancies [16]. Identifying modifiable determinants of short IPI and quantifying its contribution to adverse maternal and perinatal outcomes will help clinicians and policymakers design more effective birth spacing and contraceptive programs [17]. Assessing women's knowledge of optimal IPI is equally important to tailor counseling messages and address misconceptions [18].

3. Objectives

General objective

To determine the prevalence, determinants and outcomes of short inter pregnancy intervals, and to assess knowledge of optimal birth spacing among women delivering at Douala Laquintinie Hospital and Nylon District Hospital in Douala, Cameroon.

Specific objectives

1) To identify socio demographic and reproductive determinants of short inter pregnancy intervals in the two hospitals.

2) To determine maternal and perinatal outcomes associated with short inter pregnancy intervals in this population.

3) To assess the level of maternal knowledge regarding optimal birth spacing and inter pregnancy intervals among women attending maternity services in the study sites.

4. Methods

Study design

We conducted a hospital based cross sectional analytic study among women admitted for delivery at two public hospitals in Douala, Cameroon. The design enabled estimation of the prevalence of short IPI and assessment of associations with selected determinants and outcomes.

Study setting

The study took place in the obstetrics and gynaecology units of Douala Laquintinie Hospital (DLH) and Nylon District Hospital (NDH) in Douala, the economic capital of Cameroon with an estimated population of about 3.9 million inhabitants. DLH is a second category referral hospital with a bed capacity of approximately 917 and serves as a major teaching facility for the Faculty of Medicine and Pharmaceutical Sciences, University of Douala. Its obstetrics and gynaecology department includes maternity, post-partum, post operative, pathological and non-pathological pregnancy care, and gynecological units staffed by eight obstetrician gynaecologists and roughly 30 nurses and midwives.

NDH is a first category district hospital serving a densely populated, lower income catchment area, with an obstetrics and gynaecology unit comprising maternity, post-partum and delivery room sub units staffed by three gynaecologists and about 18 nurses and midwives. Both facilities conduct a high volume of deliveries and provide routine antenatal, intrapartum and postnatal care as well as family planning services.

Study period and duration

Data was collected prospectively over four months, from February to May 2022.

Study population

The study population comprised pregnant women admitted for delivery at DLH and NDH during the study period who had at least one previous live birth within the preceding five years study inclusion window irrespective of route of delivery (vaginal or Caesarean).

Inclusion criteria

- Pregnant women with at least one prior live birth within the last five years.
- Admitted to deliver at DLH or NDH during the study period.
- Provided written or verbal informed consent.

Exclusion criteria

- Non consenting women.
- Women whose immediately preceding pregnancy ended in miscarriage or induced abortion.
- Women unable to recall the date of birth of their previous child.

Sample size and sampling

The minimum sample size was calculated using Cochran's formula: $n = z^2 p(1-p)/e^2$, assuming a standard normal deviate of 1.96 (95% confidence), a prevalence of short IPI of 40.9% based on an Ethiopian study by Mamo *et al.*, and a margin of error of 5%. This yielded a sample size of 371, which was increased

by 10% to account for non-response, giving a final target of 408 participants. A total of 450 women were screened to attain the sample size of 408.

A non-probability purposive sampling technique was used; eligible women were consecutively enrolled as they were admitted for delivery. The sample was allocated proportionally to the two hospitals based on their average monthly delivery volumes: approximately 100 at NDH and 180 at DLH. Thus, 146 women (35.8%) were recruited from NDH and 262 (64.2%) from DLH (Figure 1).

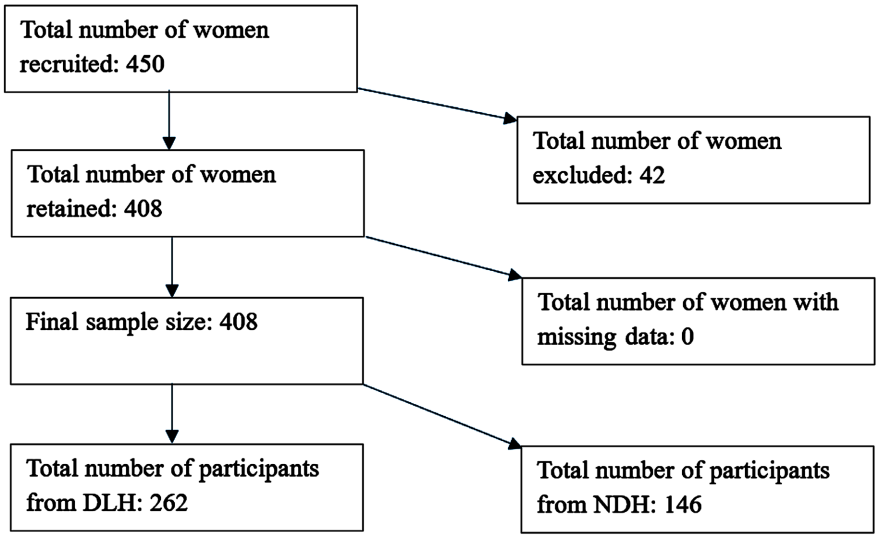

Figure 1. Flow diagram of participants.

Study variables

Exposure (*predictor*) *variables*

- Socio demographic: maternal age, marital status, educational level, religion, employment status; husband's educational level and employment status.
- Reproductive and obstetric: parity, breastfeeding duration after previous birth, pattern of menstrual cycles, use of modern contraceptives prior to conception, pregnancy intention, sex preference of previous child, decision making power regarding family planning.

Outcome variables

- Primary exposure variable: Inter pregnancy interval, defined as the time in months between the date of the previous live birth and the date of conception of the index pregnancy, calculated from reported last menstrual period or early ultrasound dating. Short IPI was defined as less than 24 months; optimal IPI as 24 - 59 months; and long IPI as 60 months or more.
- Maternal outcomes: anemia in pregnancy, third trimester bleeding, postpartum hemorrhage (PPH).
- Perinatal outcomes: preterm birth, birth asphyxia, stillbirth and other adverse neonatal outcomes.
- Knowledge outcome: level of maternal knowledge regarding optimal birth spacing and recommended IPI.

Data collection procedures

After obtaining ethical and administrative approvals, trained research staff approached eligible women in the labour wards of each hospital. Study objectives and procedures were explained using a participant information sheet, and written informed consent (or documented verbal consent when literacy was limited) was obtained before enrolment.

Data was collected using an interviewer administered structured questionnaire complemented by review of patient files and admission registers. The questionnaire was developed based on the literature and pre tested on 10% of the target sample; identified issues were addressed before final deployment. It was available in English and French to facilitate comprehension.

The questionnaire captured:

- Socio demographic characteristics of the woman and her partner.
- Reproductive history and current pregnancy characteristics, including parity, breastfeeding practices after the previous birth, menstrual cycle regularity, contraceptive use and decision making on family planning.
- Maternal and perinatal outcomes for the index pregnancy, obtained from clinical records (e.g. hemoglobin levels, diagnosis of PPH, gestational age at birth, Apgar scores, stillbirth).
- Knowledge and attitudes regarding optimal birth spacing and inter pregnancy intervals using a series of Likert scale questions.

Each participant was followed through delivery and immediate postpartum to ensure complete outcome data for mother and neonate.

Knowledge assessment

Knowledge of optimal birth spacing was evaluated using a five-point Likert scale for statements regarding recommended minimal and maximal IPIs, benefits of spacing, and definitions of short and long intervals. Responses ranged from "strongly disagree" (1 point) to "strongly agree" (5 points). For each statement, scores of 1 - 2 indicated poor responses, 3 average, and 4 - 5 good responses. An overall knowledge score was computed by averaging responses across items; scores ≥ 3 was classified as sufficient knowledge and scores < 3 as insufficient knowledge.

Knowledge Instrument and Scoring Structure

The questionnaire assessed maternal knowledge of optimal birth spacing and Inter-Pregnancy Intervals (IPI) through a dedicated section consisting of six items. Each item was evaluated using a five-point Likert scale.

- Items and Content: The six items covered the minimum (2 years) and maximum (5 years) recommended intervals, the benefits of spacing (prevention of nutrient depletion), risks to the neonate (preterm birth), maternal risks (anemia), and the role of family planning.
- Scoring Range: Each item was scored from 1 ("Strongly Disagree") to 5 ("Strongly Agree"). This resulted in an overall mean score range of 1 to 5 per participant.
- Categorization: Responses for individual items were classified as "poor" (1 - 2

points), "average" (3 points), or "good" (4 - 5 points).

Rationale for the "Sufficient Knowledge" Threshold

The threshold of a mean score ≥ 3 was established to identify women who, on average, at least "Agreed" with the correct health-seeking behaviors and biological rationales presented in the instrument. A score of 3 represents the "Average" or neutral point on the scale. By setting the cutoff at ≥3, the study classified "Sufficient Knowledge" as the ability to correctly identify or agree with the fundamental principles of birth spacing, rather than possessing only "poor" or incorrect perceptions (scores < 3).

Piloting and Reliability

To ensure the instrument's robustness, the questionnaire underwent a formal pilot test prior to final deployment. Pilot Sample: The test was conducted on 10% of the target sample size. Refinement: Results from the pilot were used to identify and address issues with question clarity and comprehension, ensuring the tool was effective in both English and French for the study population.

Data management and statistical analysis

Data was double entered into Microsoft Excel and exported to SPSS version 25 for analysis. Categorical variables were summarized using frequencies and percentages; continuous variables such as age and parity were described using means and standard deviations.

Multivariable models included socio-demographic factors (age, education) and reproductive history (parity, contraceptive use) to control for confounding.

Bivariate analysis was performed to examine associations between potential determinants and short IPI as the dependent variable, using odds ratios (OR) with 95% confidence intervals (CI). Variables with p value < 0.05 at bivariate level were entered into a multivariable logistic regression model to control for confounding, and adjusted odds ratios (AOR) with 95% CI were reported. Similar bivariate and multivariable models were used to assess associations between short IPI and maternal and perinatal outcomes. Statistical significance was set at a two tailed p value < 0.05.

Ethical considerations

Ethical clearance was obtained from the Institutional Review Board of the Faculty of Medicine and Pharmaceutical Sciences, University of Douala (ref. 3217IEC-UD/06/2022/T). Administrative authorizations were granted by the Faculty of Medicine and Pharmaceutical Sciences, Douala Laquintinie Hospital (ref. 01067/AR/MINSANTE/DHL) and Nylon District Hospital. Participation was entirely voluntary; informed consent was obtained from all participants, confidentiality was protected through use of unique identifiers and password protected databases, and no identifying information appears in this manuscript.

5. Results

5.1. Participant Characteristics

A total of 408 women with at least one previous live birth within five years were enrolled, of whom 262 (64.2%) were from DLH and 146 (35.8%) from NDH.

5.2. Socio-Demographic and Reproductive Characteristics of Participants

Table 1 describes the baseline characteristics of the 408 women recruited for the study.

Table 1. Socio demographic characteristics of study participants.

Variables	Modality	Frequency (N = 408)	Percentage (%)
Age (years)	≤20	9	2.2
	21 - 30	234	57.3
	31 - 40	161	39.5
	>40	4	1.0
Educational Status	Primary education	54	13.2
	Secondary education	189	46.3
	University	130	31.9
	No formal education	35	8.6
Employment Status	Unemployed	215	52.7
	Self-employed	97	23.8
	Employed	96	23.5
Religion	Christian	365	89.5
	Muslim	43	10.5
Marital Status	Married	320	78.4
	Single	88	21.6

- Age Distribution: The vast majority of participants (96.8%) were aged between 21 and 40 years, with the largest concentration (57.3%) in the 21 - 30 age bracket. Very young mothers (≤20 years) represented only 2.2% of the sample.
- Educational Attainment: Approximately 78.2% of the women had at least a secondary education, with 31.9% having reached the university level. However, a notable minority (21.8%) had only primary or no formal education.
- Employment and Economic Status: Over half of the participants (52.7%) were unemployed at the time of the study, while the remainder were split almost evenly between being self-employed (23.8%) and formally employed (23.5%).
- Marital and Religious Profile: The cohort was predominantly married (78.4%) and of Christian faith (89.5%).
- Facility Distribution: Recruitment was weighted toward DLH, which provided 64.2% of the participants, reflecting its higher delivery volume compared to NDH (35.8%).

No significant missing data was reported; all 408 participants contributed to the

final regression models.

5.3. Prevalence of Short IPI

The prevalence of short IPI (<24 months) amongst women attending these two study hospitals was 42.9%, while the remainder had optimal or long intervals. This indicates that nearly two in five pregnancies in this urban hospital based population occurred after a short interval.

5.4. Key Determinants or Predictors of Short IPI

Table 2 highlights the factors that remained significantly associated with short inter-pregnancy intervals (<24 months) after controlling for confounders following bivariate analysis.

Table 2. Multivariate analysis of independent predictors for short IPI.

Predictor Variable	Adjusted Odds Ratio (AOR)	95% Confidence Interval (CI)	p-value
Age ≤ 20 years	2.78	1.12 - 15.46	0.03
Primary Education	1.98	1.13 - 3.24	<0.001
Parity ≥ 4	21.24	1.22 - 2.36*	0.03
Irregular Menstrual Cycle	1.32	1.22 - 2.50	<0.001
Breastfeeding < 6 months	1.48	1.13 - 3.24	<0.001
No Contraceptive Use	2.98	1.82 - 4.92	<0.001

*Note: High parity CI reflects extreme variance observed in the study groups. Extreme variance in parity ≥ 4 (AOR 21.24) was due to the small, specific sub-sample size.

- Contraceptive Non-use: This was the strongest behavioral predictor, with women not using modern contraceptives being nearly three times more likely to experience a short IPI (AOR 2.98, $p < 0.001$).
- Maternal Age: Younger women (≤20 years) had 2.78 times higher odds of short IPI compared to older cohorts ($p = 0.03$).
- Educational Level: Having only a primary education nearly doubled the risk (AOR 1.98, $p < 0.001$) compared to those with higher educational attainment.
- Breastfeeding Duration: Women who breastfed for less than 6 months had a significantly higher likelihood of early subsequent conception (AOR 1.48, $p < 0.001$).
- Reproductive Physiology: An irregular menstrual cycle was associated with increased odds of short IPI (AOR 1.32, $p < 0.001$).
- High Parity: Women with a parity of 4 or more showed a very high point estimate (AOR 21.24, $p = 0.03$), though the wide confidence interval (1.22 - 2.36 listed in the table, noted elsewhere as reflecting extreme variance) suggests this is driven by a small, specific sub-sample size.

5.5. Outcomes of Short IPI

Table 3 presents the risk of adverse maternal and perinatal outcomes specifically attributed to having a short inter-pregnancy interval. Short IPI was significantly associated with several adverse maternal outcomes. In the multivariable analysis, women with short IPI had:

Table 3. Multivariate analysis of maternal and perinatal outcomes.

Outcome Variable	Adjusted Odds Ratio (AOR)	95% Confidence Interval (CI)	p-value
Maternal Anemia	2.33	1.43 - 4.58	< 0.001
Postpartum Hemorrhage	1.44	1.37 - 2.16	<0.001
Preterm Birth	2.27	1.17 - 5.29	<0.001
Still Birth	1.13	0.88 - 2.45	0.44

- Higher odds of anemia in pregnancy (AOR 2.33, 95% CI 1.43 - 4.58, $p < 0.001$).
- Increased risk of postpartum hemorrhage (AOR 1.44, 95% CI 1.37 - 2.16, $p < 0.001$).

Regarding perinatal outcomes, short IPIs were significantly associated with preterm birth (AOR 2.27, 95% CI 1.17 - 5.29, $p < 0.001$) and not to birth asphyxia nor to stillbirth ($p = 0.44$).

5.6. Assessment of Knowledge Regarding Optimal Birth Spacing

Table 4 reflects the participants' responses to specific knowledge-based questions regarding birth spacing.

Table 4. Appreciation of participants' knowledge of optimal birth spacing.

Knowledge Indicators	Good n (%)	Average n (%)	Poor n (%)
Minimum 2 years is essential between pregnancies	213 (52.2%)	177 (28.7%)	78 (19.1%)
Maximum 5 years is recommended	125 (30.6%)	150 (36.8%)	133 (32.6%)
Short IPI leads to nutrient depletion for fetus	263 (64.5%)	88 (21.6%)	57 (14.0%)
Short IPI increases risk of premature baby	199 (29.2%)	209 (51.2%)	80 (19.6%)
Short IPI increases risk of anemia in pregnancy	277 (67.9%)	87 (21.3%)	44 (10.8%)
Birth spacing can be achieved with family planning	297 (72.8%)	57 (14.0%)	54 (13.2%)

Overall, 62% of women achieved a mean knowledge score ≥ 3 on the Likert scale and were classified as having sufficient knowledge of optimal birth spacing. However, only 30.6% correctly identified the recommended maximum interval of five years, indicating gaps in understanding of the upper limit for optimal IPI. Awareness of the minimal recommended interval (52%) and the health benefits of spacing (64%) was higher than knowledge of specific numeric recommendations.

6. Discussion

6.1. Magnitude of Short Inter Pregnancy Interval

In this hospital-based sample, 42.9% of women had a short IPI, underscoring that closely spaced pregnancies are common in urban Douala. This prevalence is comparable to figures reported in Ethiopia (around 40% - 45%) [7] [19] and exceeds proportions described in some Tanzanian and Central African settings, where short IPI rates ranging from 20% to 33% have been reported [20] [21]. The relatively high prevalence in our study may reflect the combination of high fertility, unmet need for contraception and socio-economic vulnerabilities in the catchment populations [10] [22]. Our findings are consistent with analyses from several African countries, including Rwanda, Uganda, and Ethiopia, where short IPIs remain common and contribute to poor outcomes [23] [24]. The observed high frequency signals an important missed opportunity for preventive interventions as defined by WHO [3]. The estimated prevalence in our study also aligns with global meta-analytic data indicating that a substantial proportion of births occur after short intervals in low- and middle-income countries. Given the WHO recommendation of at least 24 months between a live birth and subsequent conception, the observed high frequency of short IPIs in Douala signals an important missed opportunity for preventive interventions.

6.2. Determinants of Short Inter Pregnancy Interval

Younger maternal age (≤20 years) more than doubled the odds of short IPI, consistent with literature showing adolescents often have limited access to contraception and higher unmet need [25]. A recent Ethiopian study similarly identified young age as a key predictor, suggesting social pressure for rapid childbearing contributes to this trend [7]. Our findings support targeted postpartum and interconception counseling for adolescents and young adults in Cameroon.

Primary education was associated with nearly twice the odds of short IPI, which concurs with studies where low educational attainment consistently predicts short intervals [26]. Education enhances health literacy and agency in reproductive decision-making [27]. High parity (≥4) was a strong determinant, echoing reports that grand multiparous women often experience clustered births to meet desired family size [28]. Irregular menstrual cycles, breastfeeding for <6 months, and nonuse of modern contraception were also independently associated with short IPI [29].

These determinants align well with documented mechanisms: irregular cycles make fertility awareness methods less reliable. while short breastfeeding duration reduces lactational amenorrhea and accelerates return of ovulation, increasing the risk of early conception [30]. Multiple studies from Sub Saharan Africa and global reviews have highlighted that nonuse or inconsistent use of modern contraceptives is one of the strongest drivers of short birth intervals. Our data thus reinforces the central role of postpartum family planning—including counselling before discharge, early postnatal visits, and integration of contraception provision into child immunization services—in preventing short IPIs. Our data reinforces the role of postpartum family planning in preventing short IPIs [31].

6.3. Maternal Outcomes and Short Inter Pregnancy Interval

Short IPI was associated with a more than two-fold increase in the odds of anemia and a significant increase in postpartum hemorrhage, consistent with the maternal depletion and folate depletion hypotheses [11]. Systematic reviews from Sub Saharan Africa have reported that short intervals are linked to maternal anemia, antepartum hemorrhage, PPH and, in some settings, increased maternal mortality. Our findings converge with these results and suggest that inadequate time between pregnancies in Douala may exacerbate preexisting nutritional deficiencies and limit recovery from prior blood loss [32].

The association with PPH may be mediated through anemia, uterine atony and other obstetric complications more frequent in women who have not fully recovered from previous pregnancies [33]. Studies from Ethiopia and Tanzania have also noted elevated risks of PPH, preterm membrane rupture and hypertensive disorders among women with short IPIs. Our results therefore strengthen the rationale for emphasizing birth spacing as part of comprehensive strategies to reduce maternal morbidity and mortality in Cameroon.

6.4. Perinatal Outcomes and Short Inter Pregnancy Interval

We observed that short IPI was significantly associated with preterm birth, in line with numerous studies demonstrating that closely spaced pregnancies increase the risk of prematurity, low birth weight and small for gestational age infants [34] [35]. A recent study evaluating short IPI and perinatal outcomes in Africa found that women with short intervals had about double the risk of low birth weight, preterm birth and low Apgar scores. Meta analyses similarly indicate that short birth intervals contribute substantially to adverse perinatal outcomes and perinatal mortality.

The mechanisms linking short IPI to preterm birth include incomplete restoration of maternal nutritional and vascular status, residual inflammation, and impaired placentation [36]. In our setting, additional factors such as infection, limited antenatal care and socio economic stress may interact with short IPI to potentiate the risk of prematurity. Although our thesis examined stillbirth and birth asphyxia, the strongest and most consistent association was with preterm birth, echoing findings from Ethiopia, Tanzania and other African countries [37].

6.5. The Disconnect between Knowledge Gap of Optimal Birth Spacing and Short IPI

Despite 62% of women being classified as having sufficient overall knowledge of optimal birth spacing, only 30.6% correctly identified the recommended maximum interval of five years. This partial knowledge mirrors findings from other African settings where women may understand the general benefits of spacing but lack precise knowledge of recommended intervals [38]. In Ethiopia, for example, substantial proportions of women could not accurately define short or long birth intervals, even when they recognized that very closely spaced pregnancies were risky [38].

The analysis of the study data reveals a critical disconnect between general awareness and specific, actionable knowledge among women in Douala. While a majority of participants (62%) demonstrated sufficient overall knowledge of birth spacing, a significant gap exists regarding the recommended upper limit of the inter-pregnancy interval (IPI).

There is thus a direct link between knowledge gaps and short IPI from our study. The high prevalence of short IPI (42.9%) in this population is likely exacerbated by this specific lack of "precision knowledge".

- Awareness vs. Accuracy: Although 52% of women recognized the 2-year minimum requirement, only 30.6% were aware of the 5-year maximum interval recommended for optimal health.
- The "Vague Spacing" Trap: Routine counseling at Douala Laquintinie and Nylon District Hospitals may emphasize the general concept of spacing without providing clear, numeric boundaries (the 24 - 59 month window).
- Impact on Outcomes: This lack of specific knowledge contributes to the high rate of short IPIs, which the study directly linked to a more than two-fold increase in maternal anemia (AOR 2.33) and preterm birth (AOR 2.27), as well as increased risks of postpartum hemorrhage.

Our results suggest that routine counselling in DLH and NDH may emphasize the idea of spacing without consistently providing clear numeric recommendations or explaining the rationale (24 - 59 months, and preferably 3 - 5 years). Strengthening the content and delivery of birth spacing messages, including visual aids and culturally adapted examples, could help bridge this gap [31]. Engaging male partners and community leaders may further enhance the translation of knowledge into practice.

7. Strengths of the Study

This study has several strengths. First, it uses primary data from two large urban public hospitals, providing robust insights into short IPI among women delivering in high volume facilities in Douala. Second, we assessed a comprehensive set of socio demographic and reproductive determinants and adjusted for confounding using multivariable logistic regression, enhancing the internal validity of associations. Third, we directly linked IPI to objectively measured maternal and perinatal

outcomes (anemia, PPH, preterm birth) extracted from clinical records, rather than relying solely on self report. Finally, we integrated an assessment of knowledge of optimal birth spacing, enabling us to relate observed behaviors to underlying awareness and attitudes.

7.1. Limitations of the Study

The cross sectional design precludes firm causal inference between determinants and outcomes; although temporality is plausible (prior characteristics leading to short IPI and then to outcomes), residual confounding cannot be excluded. As a hospital based study in two urban facilities, our findings may not be generalizable to rural settings, private facilities or home deliveries in Cameroon. Recall bias is possible for variables such as breastfeeding duration, last menstrual period and contraceptive use; however, we restricted inclusion to women with a previous live birth within five years to improve recall. Misclassification of IPI could occur when gestational age estimations were imprecise, though the use of clinical records mitigated this. Finally, some confidence intervals, notably for parity, appear narrow relative to the point estimates, suggesting potential typographical or analytical issues in the original thesis that should be carefully rechecked in future analyses.

7.2. Recommendations

Based on our findings and the broader literature, several programmatic and policy recommendations emerge:

Strengthen postpartum family planning

Systematically integrate counselling on optimal birth spacing and provision of modern contraceptive methods into immediate postpartum and early postnatal care at DLH and NDH, with emphasis on long acting reversible contraceptives for women wishing to delay or limit future pregnancies.

Target high risk groups

Develop tailored strategies for adolescents and young women, grand multiparous women, and those with low education, including youth friendly services, community outreach, and peer education models that address barriers to contraceptive use.

Promote optimal breastfeeding and cycle awareness

Reinforce messages on exclusive breastfeeding for at least six months and continued breastfeeding up to two years or beyond, while clarifying the limits of lactational amenorrhea and combining it with modern contraception as appropriate.

Enhance birth spacing education

Standardize counselling tools that clearly communicate recommended IPIs (minimum 24 months, ideally 3 - 5 years) and explain the maternal and perinatal benefits, targeting both women and their partners.

Integrate IPI monitoring into routine care

Encourage documentation of previous birth dates and calculation of IPI during antenatal and delivery admissions, enabling providers to identify women with

short intervals and prioritize them for intensified monitoring and counselling.

Further research

Conduct larger, multi-site prospective studies, including rural areas, to confirm these findings, explore additional determinants (e.g. social support, intimate partner dynamics), and evaluate the impact of targeted postpartum family planning interventions on IPI and outcomes.

8. Conclusion

Short interpregnancy intervals are common among women delivering at Douala Laquintinie and Nylon District Hospitals, affecting approximately 43% of the study population. Young maternal age, low educational attainment, high parity, irregular menstrual cycles, short breastfeeding duration and non-use of modern contraception were key determinants of short IPI. Short intervals were independently associated with increased risks of maternal anemia, postpartum hemorrhage and preterm birth, corroborating the maternal depletion and folate depletion hypotheses and aligning with evidence from other African and global studies. While overall knowledge of optimal birth spacing was moderate, specific gaps—particularly regarding the recommended upper limit of 5 years—persisted. Integrating strengthened postpartum family planning counselling and focused educational interventions into routine maternity services in the two hospitals in Douala could substantially reduce short IPIs and improve maternal and perinatal outcomes.

Authors' Contributions

Data collection was done by Dr FOFUNGTUM Massateh Ajui-Aseh while Dr NGALAME Alphonse drafted the manuscript. Critical revision of the manuscript was done by Prof. ESSOME Henri. Florence MENDOUA, Merlin BOTEN, Reine KOUNDO MOTAH, Moustapha BILKISSOU, Fulbert MANGALA, Ingrid OFAKEM, Lionel Oscar ESSOME TOCKY, Grace TOCKI TOUTOU and Estelle WAFO all read and corrected the manuscript. Overall supervision, coordination of writing and editing was ensured by Prof. EGBE Obinchemti Thomas. All authors read and approved of the final manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

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