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Assessing the Relationship between Short Birth-to-Pregnancy Interval and the Maternal and Perinatal Outcomes among Multiparous Women in Northern Ghana

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Abstract

Introduction: The World Health Organization (WHO) recommends an optimal Birth-to-Pregnancy Interval (BPI) of 24-59 months, or a 33-month interval between two successive births, to reduce the risk of untoward maternal and newborn outcomes. Short Birth to Pregnancy Interval (SBPI) and unmet need for Family Planning (FP) are the major contributors to rapid population growth and increased maternal and newborn mortalities. The purpose of this study was to assess the adverse perinatal and maternal outcomes associated with SBPI among multiparous women in three municipalities of the Upper East Region (UER) of Ghana.

Materials and Methods: We employed a cross-sectional design conducted among 904 women aged 15-49 attending Antenatal Care (ANC) clinics in

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three municipalities in the UER who had at least two successive live births prior to data collection. A multistage cluster sampling technique was employed to recruit respondents for this study. This was conducted in four steps. Out of the 46 health facilities, we randomly selected 25 respondents using the systematic random selection method. Data was collected using a structured questionnaire, incorporated into the electronic data collection tool (Kobo collect), and administered by trained research assistants. Birth interval was categorized according to the WHO's classification: <24 months as SBPI, 24-≥59 months as Optimal Birth to Pregnancy Interval (OBPI), and >59 months as Long Birth to Pregnancy Interval (LBPI).
Results: Of the 904 respondents, the majority (56.2%) had an OBPI, while 36.9% had a SBPI. Factors that influenced SBPI were parity, mode of delivery, and the educational status of woman's partner. Participants with a higher parity (≥5 children) had 0.67 times the potential of spacing their births (AOR 0.67; 95% CI 0.46-0.98; p = 0.040). Women who experienced a Caesarean Section (CS) delivery were 3.28 times more likely to have LBPI (AOR 3.28; 95% CI 1.02–10.62; p=0.047). Respondents whose partners had secondary education had a 1.87 chance (AOR 2.07; 95% CI 1.09–3.96; p=0.027) of spacing their births. The birth complications reported were retained products of conception (41.9%), pregnancy-induced hypertension (27.9%), postpartum hemorrhage (11.6%), obstructed labor (10.5%), sepsis (38.1%), neonatal jaundice (23.8%), low birth weight (19%), and preterm birth (14.3%).
Conclusion: A significant proportion of the participants in this study reported having a short duration between the birth of one child and the conception of the next. This was associated with various adverse maternal and perinatal outcomes, such as birth complications and mortalities. The study emphasizes the need for health professionals to address challenges in contraceptive uptake, especially among multiparous women, and promote optimal birth spacing to improve maternal and perinatal outcomes.

Keywords: Birth-to-pregnancy interval; hemorrhage; maternal; multiparous; perinatal; postpartum; puerperal

1.0 Introduction

1.1 Background of the Study

Birth-to-Pregnancy Interval (BPI), which is also known as the interbirth interval, refers to the interval between the date of a live birth and the start of the subsequent pregnancy (Merdad & Ali, 2018). This is the period within which women recuperate from their pregnancy and childbirth experiences. It serves as a ‘‘fallow period’’ for physical, physiological, and psychological restoration after birth.

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The World Health Organization (WHO) recommends an optimal BPI of 24–59 months, or a 33-month interval between two successive births, to reduce the danger of maternal, newborn, and perinatal deaths (Nausheen et al., 2021). This recommendation came after preceding surveys highlighting the inapt effects of both short and long BPIs, such as low birth weight, preterm birth, small-for-gestational-age birth, and a high admission rate at the neonatal intensive care unit (Bauserman et al., 2020; Merdad & Ali, 2018). Women with SBPIs are exposed to negative health consequences, especially when they have less time to physically convalesce from their previous pregnancies (Hailu & Gulte, 2016). Again, too-closed pregnancies increase the depletion of maternal nutrition, leading to maternal malnutrition (Mehra et al., 2019). A BPI of less than six months increases the probability of maternal mortality by 150% (95% CI 22% to 438%) and is linked with premature rupture of membrane, third trimester bleeding, postpartum endometriosis, and anemia (Nausheen et al., 2021). Recent study findings forecast that SBPI has the potential to cause autism in second-born children, particularly for pregnancies spaced less than 12 months apart (Conde-Agudelo et al., 2016). Another glaring consequence of SBI is that, pregnant women are less likely to access antenatal care (ANC) services due to the demand for care for younger infants. For instance, babies are likely to be deprived of or compete for basic needs such as food, breastmilk, and parental attention (Molitoris, 2018). LBPIs, on the other hand, have been associated with an increased risk of pre-eclampsia (Nausheen et al., 2021).

In sub-Saharan Africa (SSA), a survey in eight selected countries disclosed that most mothers ideally space their births. Nonetheless, SBPIs were reported in Chad (30.2%) and the Democratic Republic of the Congo (27.1%), while LBPIs were dominant in southern and eastern Africa, with Zimbabwe recording the highest percentage (Ajayi & Somefun, 2020). A recent study (Alhassan et al., 2022) revealed that Ghana has a SBPI prevalence of 49.7%, a low contraceptive prevalence rate, and high unmet needs for FP.

Several factors determine BPI; however, key among them include socio-demographic, biological, and sociological factors (Molitoris, 2018). Socio-demographic determinants like age, parity, type of residence, wealth index, education, and religion influence BPI (Tesema et al., 2021). Studies show that prolonged postpartum amenorrhea is a primary biological factor in the long birth interval. According to Ajayi et al., contraceptive usage, length of breastfeeding, the death of the previous child, gender of the newborn, infrequent sexual intimacy, and the husband's occupation are strong sociological predictors of BPI. These determinants were also common in other studies (Molitoris, 2018; Dehesh et al., 2020; Ayane et al., 2019).

Globally, SBPI and the unmet need for FP are the major contributors to rapid population growth. Data from the United Nations (UN) states that the

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world is currently battling with a population of 7.6 billion people, which is projected to increase to 8.6 billion in 2030, 9.8 billion, and 11.2 billion in 2050 and 2100, respectively. Persistently elevated fertility rates due to SBPI pose health hazards for women and children, destroy human capital investment, decline economic growth, and deplete environmental resources. Close to 4.7 million mothers, newborns, and children die annually in SSA, with a projected 265,000 mothers dying due to complications of pregnancy and childbirth (Tessema et al., 2020). Similarly, the population of Ghana is presently growing at a rate of 2.15% annually, though it has gradually declined from a growth rate of 2.95% in 1985. The major indicators of growth are deeply rooted in the high fertility rate of 3.89 births per woman and the country's mandates to reduce birth mortalities. Ghana has a high unmet need (30%) in FP (Ghana Maternal Health Survey, 2017). Ghana's maternal mortality ratio (MMR) is still unacceptably high (308 per 100,000 live births) as of 2017. In 2019, the neonatal mortality and infant mortality rates were 23.1 deaths per 1,000 live births and 33.9 deaths per 1,000 live births, respectively. The Upper East Region (UER), for the past three years, has consistently recorded increasing MMRs. The region recorded 32 deaths (80.8/100,000 LBs), 36 deaths (91.8/100,000 LBs), and 43 deaths (98.1/100,000 LBs) in 2019, 2020, and 2021 respectively (Annual Report GHS, 2022). The situation is likely to further exacerbate if rapid, targeted maternal interventions are not put in place. A reduction in the unmet need for FP will minimize the high levels of unintended pregnancies, unsafe abortions, and maternal and neonatal mortality in the country (Guure et al., 2019). Again, by ensuring that women have access to comprehensive sexual and reproductive health services, including contraceptive usage, they will avoid becoming pregnant too early, too late, or too frequently and reduce avoidable pregnancy and childbirth-related deaths globally (Stover & Winfrey, 2017).

Despite the benefits associated with optimal birth spacing, such as reduced maternal and fetal complications and mortalities, improved socioeconomic status of families, and poverty alleviation, the maternal and fetal outcomes in the study settings as well as in northern Ghana have not been explored. Again, the current BPI prevalence in the study sites remains unknown. Therefore, this study seeks to address these gaps by assessing the adverse perinatal and maternal outcomes associated with SBPI among multiparous women in three municipalities of the UER of Ghana.

2.0 Materials and Methods

2.1 Study Settings

The UER is one of the poorest regions of Ghana in terms of health and socioeconomic resources. The region is located in the northeastern part of the country, with an estimated population of 1,318,523 people, with females

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constituting 48.4% of the population (Ghana Maternal Health Survey, 2017; GSS, 2017). The region shares borders with the Republic of Burkina Faso to the north, Togo to the east, the North-East Region of Ghana to the south, and the Upper West Region of Ghana to the west. Administratively, it is made up of 15 districts and municipalities and 101 sub-districts with health infrastructure such as a regional hospital, eight municipal and district hospitals, a few maternity homes, and private faith-based facilities, health centers, and multiple Community Health Planning and Services (CHPS) facilities. The study was conducted in three major municipalities in the region, namely Kassena-Nankana Municipal (KNM), Bolgatanga Municipal (BoM), and Bawku Municipal (BaM). (Figure 1)

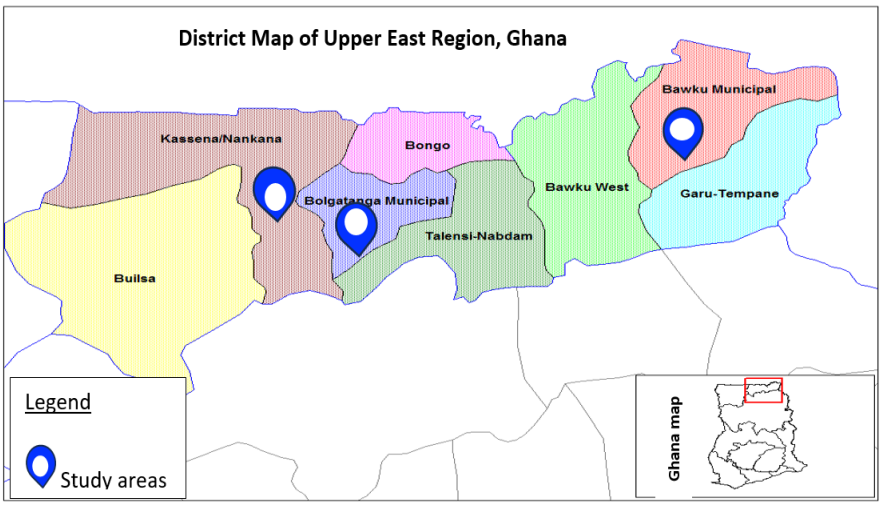

Figure 1. *Map of Ghana showing the Upper East Region and Districts, including the study areas Kassena-Nankana Municipal, Bolgatanga Municipal, and Bawku Municipal. Source: Ghana Statistical Service*

2.2. Study Design

The study employed a cross-sectional design was conducted among 904 multiparous women in three major municipalities in the UER of northern Ghana within the period of October–December 2022.

2.3 Study Population

All multiparous women who experienced at least two successive deliveries within the last five years preceding data collection.

2.4 Inclusion Criteria

1. All multiparous women in the age range of 15–49 years who had two successive live births within the last five years.
2. All the above-described women who stayed in the study area for six months before the data collection.

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2.5 Exclusion Criteria

1. All nulliparous and uniparous women. Any woman below 15 years of age or above 49 years of age.
2. Women whose children were severely sick and needed urgent treatment.

2.6 Data collection methods and instruments

Data was collected using a structured questionnaire that was adopted and modified from different literature (Bauserman et al., 2020). Data collection was carried out by trained research assistants (four nurses and three midwives) and supervised by the investigators. The enumerators visited each selected health facility to interview eligible mothers during ANC clinic days. The data collection was carried out from October to December 2022.

2.7 Sample size determination

The sample size was calculated based on the average skilled deliveries (4,489) in the three municipalities in the last five years (2018–2022). The Cochran formula was used to determine sample size: $\boldsymbol{n = \frac{z^2 \times p(1-P)}{d^2}}$, where n = required sample size, z = reliability coefficient (z-score) of 1.96 at 95% confidence level, p = estimated proportion of skilled delivery (50%), and d = margin of error of 5% (0.05). Since the prevalence of SBI was unknown in the region, we assumed 50%; this gives a sample of 384 respondents for each municipality.

2.8 Sampling Strategy

A multistage cluster sampling method was employed to recruit respondents for this study. It was conducted in four steps. Step 1: The study population was divided into clusters, of which the three municipalities serve as naturally occurring clusters. Within each cluster are the sub-municipalities. All sub-municipalities were considered for the sampling. Step 2: We randomly selected within each sub-municipality's health facilities providing ANC service, of which there were a total of 67 health facilities (sample frame) in the three municipalities. Step 3: Out of the sample frame (67), we purposefully selected 46 health facilities. This included all health centers, hospitals, and CHPs facilities. Step 4: Of the 46 health facilities, 25 respondents were randomly selected using the systematic random selection method. In selecting the respondents, a proportionate quota was assigned to each facility depending on the population of ANC registrants. A total of 1,152 respondents were selected from the three municipalities for data collection.

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2.9 Study Variables

The main exposure variable of interest was SBPI. A SBPI was defined in this study as an interval below 24 months occurring between the index and the current pregnancy. The major control variables included the age of the woman at first birth, sex of the index child, death of the index child, maternal and partner educational levels, place of residence, contraceptive usage, history of maternal infertility, etc. The main outcome variables were risks of maternal severe morbidity or a maternal near miss (e.g., mechanical ventilation, blood transfusion >2 units, admission into an intensive care unit, organ failure, etc.) and fetal outcomes such as stillbirth, severe illness following delivery, delivery <28 weeks, and spontaneous and indicated preterm delivery (Schummers et al., 2018).

2.10 Statistical Analysis

Data analysis was done using descriptive statistics and Chi-square tests. In the descriptive analysis, frequency distribution and percentages were conducted to describe the demographic, socio-economic, obstetric, and childcare factors. In the Chi-square test, bivariate analysis was performed to identify factors associated with BPI. A multivariable logistic regression analysis was done to verify the variables linked with maternal and perinatal outcomes. The results of the regression analysis were presented using the Crude Odds Ratio (COR) and Adjusted Odds Ratio (AOR) with their corresponding Confidence Interval (CIs) and p-values. A p-value of <0.05 was considered statistically significant, showing the level of precision.

2.11 *Ethical Approval/Informed Consent*

Ethical approval was given by the Navrongo Health Research Centre Institutional Review Board of Ghana with the ethical approval identification number (NHRCIRB448) and the Ghana Health Service through the Upper East Regional Health Directorate. Written permission to carry out the study was sought from the municipal health authorities. Informed consent was written and explained to interviewees in their preferred languages. Participation was voluntary, and all participants had the right to withdraw from the study at any time. The identities of respondents were anonymized, and their records were made available to only the researchers. Participants' records were kept safely in a cabinet and locked. Literate participants were made to sign a copy of the consent form, while non-literate participants thumbed it. Consent was sought from legal guardians for participants who were under the age of 18.

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3.0 Results

The study had a 21.5% dropout rate due to enumerators being unable to interview some respondents at the BaM study site as a result of an outbreak of conflict during the data collection period. Hence, out of the 1,152 respondents targeted, 904 were interviewed.

3.1 Sociodemographic Characteristics

In terms of educational attainment, 21.4% (193/904) of the respondents did not achieve any formal education, 56.6% (512/904) had primary and junior level education, and 22% (199/904) had secondary and tertiary education. More than a quarter (26.6%, 240/904) of the women partners did not have any formal education, while 31% (280/904) of them had secondary and tertiary education. For age categorization, only 16 (1.8%) of the respondents were teenagers, while 63.2% (571/904) were in the age group of 25–34 years. Nearly 98% (883/904) of the women were married, with more than half of them (56%, 502/904) marrying at the age of 15–19 years, and 35% (314/904) marrying within the age brackets of 20-24 years. The majority, 92% (830/904) of the couples stay together. With regards to religion, 78.8% (712/904) of the women were Christians, and 18% (163/904) were Muslims. On ethnicity, about 42% (376/904) of the women were Frafras, and 22% (198/904) were Kassenas. As shown in Table 1 below,

Table 1. Demographic characteristics of respondents

Variables and category	Frequency	Percentage (%)
Municipal(n=904)		
BaM	135	14.9
BoM	384	42.5
KNM	385	42.6
Educational level of woman(n=904)		
No education	193	21.4
Primary	294	32.5
JHS	218	24.1
Secondary	126	13.9
Higher	73	8.1
Educational level of woman's partner (n=904)	240	26.6
No education	189	20.9
Primary	195	21.5
JHS	162	17.9
Secondary	118	13.1
Higher		
Age of woman (n=904)		
15–19	16	1.8
20–24	122	13.5
25–29	281	31.1
30–34	290	32.1
34–39	129	14.2

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40–44	59	6.5
45–49	7	0.8
Mean ±SD: 30.3±5.6		
Marital status(n=904)		
Married	883	97.7
Single	8	0.9
Separated	8	0.9
Divorced	1	0.1
Widow	4	0.4
Age of woman at marriage, n=896		
<15years	7	0.8
15–19years	502	56.1
20–24years	314	35.0
25–29years	61	6.8
30–34years	11	1.2
40–44years	1	0.1
Number of people in a household (n=904)		
<5 people	89	9.9
5–6 people	304	33.6
7 people and above	511	56.5
Religious affiliation (n=904)		
Christian	712	78.8
Islam	163	18.0
Traditionalist	18	2.0
No religion	11	1.2
Ethnic background (n=904)		
Frafra	376	41.6
Kassena	198	21.9
Nankana	154	17.0
Kusaasi	80	8.9
Builsa	26	2.9
Moshie	25	2.8
Bisa	13	1.4
Akan	10	1.1
Others[1]	22	2.4
Couple staying together? (n=904)		
No	74	8.2
Yes	830	91.8

[1] ***Hausa =4, Zambarama =3, Sissaala =3, Busanga =3, Fulami =3, Kantosis =2, Dagomba =2, Gonja =1, Guan =1***

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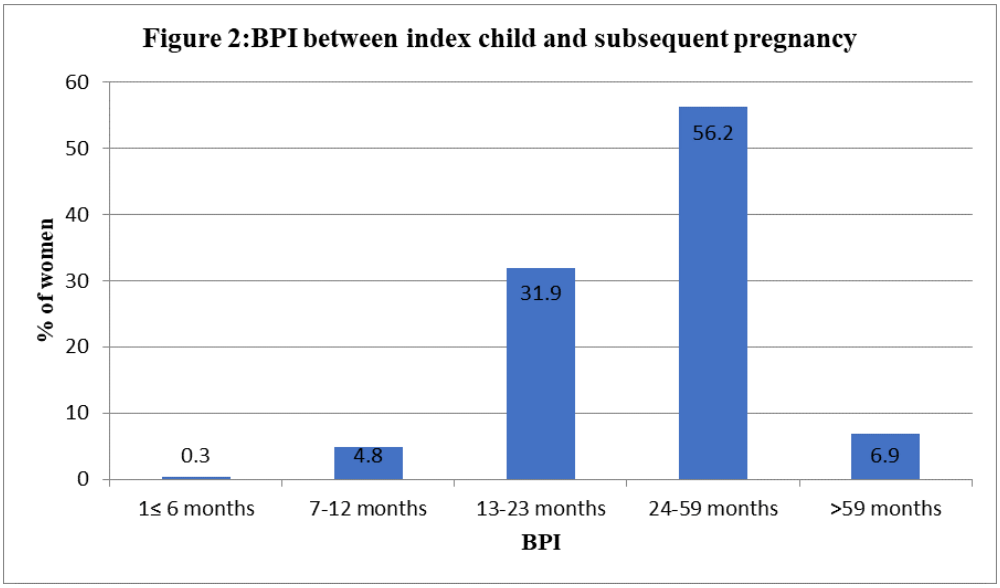

From **Figure 2**, it is shown that 63.1% of the women for between 24 to 59 months to have another pregnancy after their index (first born) child whilst 36.9%) used 1-23 months to have their subsequent pregnancy after their index child.

3.2 Association between delivery, and newborn care, and BPI

As indicated in Table 2 below, the reason for the preferred sex of the child was found to have a strong association with interbirth spacing ($\chi2=15.1948$, $p=0.010$). Also, the mode of delivery of the last child was a determinant of interbirth spacing ($\chi2=12.9219$, $p=0.005$). We observed that women who delivered through CS spaced their births longer within 24–59 months. Again, parity ($\chi2=5.1544$, $p=0.023$) was associated with BPI, as women with fewer than 1-3 children had SBPI compared to those with 4–7 children (64.3% versus 54.7%). Furthermore, the number of children a woman wishes to have ($\chi2=14.1677$, $p<0.001$) and gravida ($\chi2=15.4730$, $p<0.001$) are strongly linked with BPI. The period of commencement of sexual intercourse after delivery ($\chi2=42.8910$, $p<0.001$) and those who received a postpartum FP method ($\chi2=10.4212$, $p<0.001$) were strong predictors of BPI. The study found that women who breastfed their previous children ($\chi2=5.8653$, $p=0.015$), practiced exclusive breastfeeding ($\chi2=31.0284$, $p<0.001$), and the duration of exclusive breastfeeding ($\chi2=45.3461$, $p<0.001$) were all strongly associated with BPI. Women who ever had a problem conceiving ($\chi2=10.8256$, $p<0.001$) and the frequency of couples' sexual intercourse ($\chi2=26.5771$, $p<0.001$) were found to be strong determinants of BPI.

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Table 2. Association between delivery, and newborn care and BPI

Variable	BPI			
	1-23 months n (%)	**24-≥59 months n (%)**	**Total n (%)**	**χ2 (p-value)**
Place of birth of the last baby				6.8880 (0.229)
CHPS Compound	76 (31.1)	168 (68.9)	244 (100.0)	
Health Centre	67 (36.0)	119 (64.0)	186 (100.0)	
Clinic	25 (40.3)	37 (59.7)	62 (100.0)	
Hospital	161 (40.0)	242 (60.0)	403 (100.0)	
Home/TBA	2 (50.0)	2 (50.0)	4 (100.0)	
Aborted	3 (60.0)	2 (40.0)	5 (100.0)	
Sex of the index child				0.4322 (0.511)
Boy	195 (37.9)	320 (62.1)	515 (100.0)	
Girl	139 (35.7)	250 (64.3)	389 (100.0)	
Reasons for preferred sex of the child				15.1948 **(0.010)***
I have no preferred sex	268 (36.8)	461 (63.2)	729 (100.0)	
Already had a girl (s)	7 (29.2)	17 (70.8)	24 (100.0)	
Already had a boy (s)	7 (35.0)	13 (65.0)	20 (100.0)	
My husband's preferred choice	19 (54.3)	16 (45.7)	35 (100.0)	
Woman's preferred sex	33 (41.3)	47 (58.7)	80 (100.0)	
Help in household activities	0 (0.0)	16 (100.0)	16 (100.0)	
Mode of delivery of the last child				12.9219 **(0.005)***
Spontaneous Vagina delivery (SVD)	321 (38.5)	512 (61.5)	833 (100.0)	
Caesarean section (CS)	7 (14.3)	42 (85.7)	49 (100.0)	
Vacuum extraction	0 (0.0)	1 (100.0)	1 (100.0)	
Forceps delivery	6 (28.6)	15 (71.4)	21 (100.0)	
Ever experienced birth complications during delivery (woman)?				1.8627 (0.394)
Yes	27 (31.4)	59 (68.6)	86 (100.0)	
No	307 (37.6)	510 (62.4)	817 (100.0)	
Do not remember	0 (0.0)	1 (100.0)	1 (100.0)	

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Parity 1–3 4–7	 234 (35.7) 73 (45.3)	 422 (64.3) 88 (54.7)	 656 (100.0) 161 (100.0)	5.1544 **(0.023)***
Ever lost a child? Yes No	 49 (39.8) 285 (36.5)	 74 (60.2) 496 (63.5)	 123 (100.0) 781 (100.0)	0.5106 (0.475)
Number of children ever lost 1 2 3	 40 (39.6) 6 (37.5) 2 (50.0)	 61 (60.4) 10 (62.5) 2 (50.0)	 101 (100.0) 16 (100.0) (100.0)	0.210 (0.900)
Total number of children wanted 1–4 5+	 82 (32.4) 244 (38.4)	 171 (67.6) 392 (61.6)	 253 (100.0) 636 (100.0)	14.1677 (**<0.001)***
Gravida (number of pregnancies) 1-4 5-9	 236 (33.6) 98 (48.8)	 467 (66.4) 103 (51.2)	 703 (100.0) 201 (100.0)	15.4730 (**<0.001)***
Age of current pregnancy(n=511) 1 month 2 months 3 months 4 months 5 months 6 months 7 months 8 months 9 months Post Date	 3 (37.5) 17 (47.2) 21 (38.9) 37 (52.1) 34 (40.0) 18 (29.5) 25 (30.5) 22 (29.3) 10 (32.3) 3 (37.5)	 5 (62.5) 19 (52.8) 33 (61.1) 34 (47.9) 51 (60.0) 43 (70.5) 57 (69.5) 53 (70.7) 21 (67.7) 5 (62.5)	 8 (100.0) 36 (100.0) 54 (100.0) 71 (100.0) 85 (100.0) 61 (100.0) 82 (100.0) 75 (100.0) 31 (100.0) 8 (100.0)	14.0982 (0.119)
Ever had a childbirth complication(baby) (n=904) Yes No	 6 (28.6) 328 (37.1)	 15 (71.4) 555 (62.9)	 21 (100.0)	0.6474 (0.421)

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			883 (100.0)	
Start of sexual intercourse after delivery (n=904) 1–3 weeks after delivery 1–3 months after delivery 4–6 months after delivery 7–12 months after delivery >12 months	 3 (33.3) 192 (48.0) 62 (27.2) 69 (32.1) 8 (15.4)	 6 (66.7) 208 (52.0) 166 (72.8) 146 (67.9) 44 (84.6)	 9 (100.0) 400 (100.0) 228 (100.0) 215 (100.0) 52 (100.0)	42.8910 (**<0.001)***
Ever been counseled on FP? (n=904) Yes No	 243 (37.2) 91 (36.4)	 411 (62.8) 159 (63.6)	 654 (100.0) 250 (100.0)	0.0444 (0.833)
Ever used FP methods? (n=904) Yes No	 243 (37.2) 91 (36.4)	 411 (62.8) 159 (63.6)	 654 (100.0) 250 (100.0)	0.444 (0.833)
Ever used an FP method after delivery? Yes No	 225 (41.1) 109 (30.5)	 322 (58.9) 248 (69.5)	 547 (100.0) 357 (100.0)	10.4212**(0.001)***
Breastfed previous child? (n=904) Yes No	 319 (36.3) 15 (60.0)	 560 (63.7) 10 (40.0)	 879 (100.0) 25 (100.0)	5.8653 (**0.015)***
Ever practiced exclusive breastfeeding? (n=904) Yes No	 230 (32.3) 104 (54.2)	 482 (67.7) 88 (45.8)	 712 (100.0) 192 (100.0)	31.0284 (**<0.001)***
Duration of breastfeeding (n=712) less than 6 months 6 months to one year Above one year	 3 (7.3) 135 (45.5) 92 (24.6)	 38 (92.7) 162 (54.5) 282 (75.4)	 41 (100.0) 297 (100.0) 374 (100.0)	45.3461 (**<0.001)***
Ever experienced infertility issues? (n=904)	3 (9.4)	29 (90.6)		10.8256**(0.001)***

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Yes No	331 (38.0)	541 (62.0)	32 (100.0) 872 (100.0)	
Frequency of couples' sexual intercourse (n=904) Once a week More than once in a week Once a month More than once in a month Once a year More than once in a year	 56 (29.2) 163 (42.9) 15 (20.5) 93 (41.5) 6 (26.1) 1 (8.3)	 136 (70.8) 217 (57.1) 58 (79.5) 131 (58.5) 17 (73.9) 11 (91.7)	 192 (100.0) 380 (100.0) 73 (100.0) 224 (100.0) 23 (100.0) 12 (100.0)	26.5771 **(<0.001)***

3.3 Logistic regression analysis of the relationship between independent variables and BPI

Table 3 beneath shows the relationship between the independent variables and interbirth spacing. The binary logistic regression (BLR) analysis was carried out. In the BLR analysis, the factors that were significantly associated with interbirth spacing and those from the literature were sent to the multivariable logistic regression level for further analysis. After adjusting for confounders, women whose partners had higher educational attainment were twice as likely to space their births with no education as the reference (AOR 2.07; 95%CI1.09-3.96; p=0.027). Also, women whose partners had secondary education were 1.87 times more likely to have longer birth intervals concerning women whose partners had no education (AOR 1.87; 95%CI1.1-3.17; p=0.021). We found that women who went through CS delivery were 3.28 times more likely to space their children compared to those who had SVD (AOR 3.28; 95% CI 1.02-10.62; p=0.047). It was further observed that multiparous women (five or more children) were 0.67 times more likely to have a longer BPI compared to women with less than five children (AOR 0.67; 95%CI 0.46-0.98; p=0.040). Finally, after the adjustment, it was found that the frequency of the couple's sexual intercourse was linked with BPI. The more frequent the sexual contacts, the shorter the interbirth interval.

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	Interbirth interval between index child and subsequent pregnancy			
	1-23 months, n (%)		**24-≥59 months, n (%)**	
Independent variables	**Unadjusted Odds Ratio (95%CI)**	**p-value**	**Adjusted Odds Ratio (95% CI)**	**p-value**
Location/municipal				
BaM	**Reference**		**Reference**	
BoM	0.39 (0.2472-0.6068)	**(<0.001)***	1.09 (0.267-0.4.474)	0.902
KNM	0.55 (0.3472-0.8578)	**0.009**	1.57 (0.310-7.947)	0.586
Educational level of woman's partner				
No education	**Reference**		**Reference**	
Primary	0.85 (0.573-1.258)	0.414	1.39 (0.858-2.242)	0.182
JHS	0.71 (0.481-1.042)	0.080	0.99 (0.619-1.598)	0.983
Secondary	1.09 (0.715-1.651)	0.698	1.87 (1.099-3.168)	**0.021***
Higher	1.50 (0.925-2.435)	0.100	2.07 (1.085-3.959)	**0.027***
Religious affiliation				
Christian	**Reference**		**Reference**	
Islam	1.85 (1.26-2.704)	**0.002***	1.15 (0.547-2.424)	0.710
Traditionalist	0.41 (0.156-1.064)	0.067	0.69 (0.242-1.978)	0.492
No religion	1.71 (0.449-6.494)	0.432	1.03 (0.210-5.012)	0.973
Ethnic background				
Frafra	**Reference**		**Reference**	
Kassena	1.20 (0.846-1.709)	0.305	0.83 (0.245-2.842)	0.771
Nankana	1.35 (0.915-1.986)	0.131	0.53 (0.149-1.891)	0.329
Kusaasi	3.24 (1.785-5.898)	**<0.001***	1.51 (0.299-7.609)	0.618
Builsa	5.74 (1.694-19.453)	**0.005***	3.38 (0.559-20.446)	0.185
Moshie	3.93 (1.324-11.677)	**0.014***	2.97 (0.456-19.426)	0.255
Bisa	1.68 (0.510-5.568)	0.392	0.66 (0.075-5.746)	0.704
Akan	1.12 (0.312-4.046)	0.859	0.59 (0.120-2.945)	0.523
Others	0.62 (0.263-1.480)	0.285	0.27 (0.060-1.205)	0.086
Distance to Health Facility (HF)				
0–5km.	**Reference**		**Reference**	
6–10km	1.62 (1.201-2.188)	**0.002***	0.86 (0.506-1.446)	0.559
11–14km	2.05 (1.328-3.150)	**0.001***	0.97 (0.467-2.016)	0.936
Travel time to HF				
1–5min	**Reference**		**Reference**	
6–15min	0.94 (0.469-1.865)	0.850	0.75 (0.339-1.650)	0.472
16–29min	1.32 (0.648-2.706)	0.442	1.03 (0.450-2.367)	0.941
30min-1hrs	2.10 (0.996-4.409)	0.051*	1.35 (0.527-3.478)	0.529
1hr–2hrs	1.96 (0.0.690-5.590)	0.206	1.21 (0.310-4.762)	0.781
2hrs and above	1 (empty)		1 (empty)	
Means of transport to HF				
Bicycle	**Reference**		**Reference**	
Car	0.72 (0.258-2.024)	0.536	0.53 (0.151-1.833)	0.314
Foot	0.61 (0.384-0.959)	**0.032***	0.60 (0.328-1.092)	0.094
Motorbike	0.81 (0.505-1.289)	0.370	0.66 (0.358-1.234)	0.196
Tricycle	1.32 (0.746-02.339)	0.340	0.88 (0.430-1.703)	0.724
Reasons for preferred sex of the child				

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I have no preferred sex	**Reference**		**Reference**	
Already had a girl (s)	1.41 (0.578-3.448)	0.449	0.76 (0.232-2.478)	0.647
Already had a boy (s)	1.08 (0.426-2.739)	0.872	0.64 (0.194-2.129)	0.470
Husband's preference	0.49 (0.248-0.0.968)	**0.040***	0.45 (0.194-1.029)	0.058
Women's preferred sex.	0.83 (0.518-1.325)	0.431	0.86 (0.423-1.703)	0.662
Help in household chores	1 (empty)		1 (empty)	
Mode of delivery of the last child				
SVD	**Reference**		**Reference**	
CS	3.76 (1.670-8.475)	**0.001***	3.28 (1.015-10.616)	**0.047***
Vacuum extraction	1 (empty)		1	
Forceps delivery	1.57 (1.387-1.834)	0.357	1.18 (0.327-4.272)	0.798
Parity				
1–3	**Reference**		**Reference**	
4–7	0.67 (0.472-00.948)	**0.024***	0.66 (0.433-1.009)	0.055
Total number of children wanted				
1–4	**Reference**		**Reference**	
5+	0.57 (0.421-0.763)	**<0.001***	0.67 (0.462-0.982)	**0.040***
Start of sexual intercourse after delivery				
1–3 weeks after delivery	**Reference**		**Reference**	
1–3 months after delivery	0.54 (0.134-0.2.196)	0.391	0.43 (0.077-2.385)	0.334
4–6 months after delivery	1.34 (0.325-5.518)	0.686	1.02 (0.181-5.782)	0.979
7–12 months after delivery	1.06 (0.257-4.356)	0.938	1.85 (0.316-10.868)	0.494
>12 months	2.75 (0.568-0.13.317)	0.206	2.25 (0.330-15.375)	0.407
Frequency of couples' sexual intercourse				
Once a week	**Reference**		**Reference**	
More than once in a week	0.55 (0.378-0.0.795)	**0.002***	0.67 (0.422-1.091)	0.109
Once a month	1.59 (0.833-0.3.042)	0.159	0.96 (0.438-2.095)	0.914
More than once in a month	0.58 (0.385-0.873)	**0.009***	0.35 (0.186-0.641)	**0.001***
Once a year	1.17 (0.437-0.3.113)	0.758	0.61 (0.191-1.915)	0.393
More than once in a year	4.53 (0.571-035.918)	0.153	2.59 (0.270-24.885)	0.409

Table 3. Logistic regression analysis of the relationship between independent variables and BPI

Figure 3: BPI between index child and subsequent pregnancy and maternal complications

As depicted in **Figure 3**, approximately, 9.5% (86/904) of the women reported experiencing complications during childbirth with the retained product of conception (41.9%), pregnancy- induced hypertension (27.9%), and bleeding after delivery (11.6%) being the most commonly reported complications.

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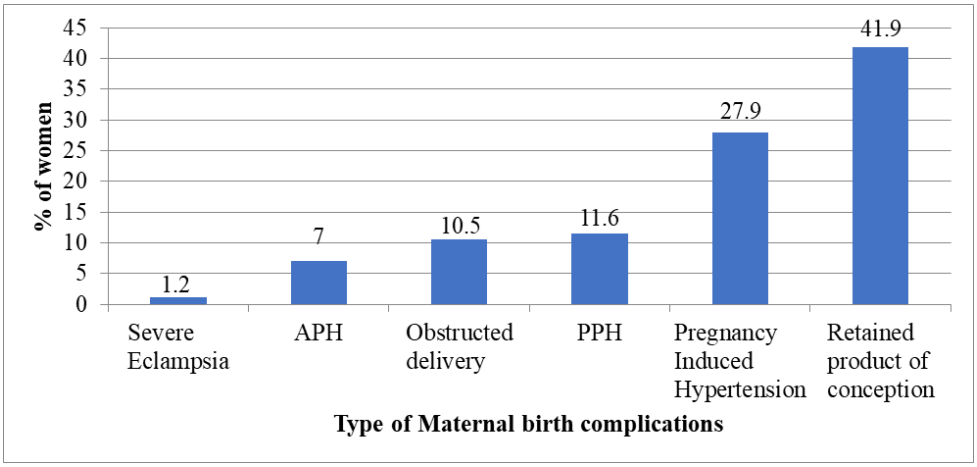

Figure 3. Maternal birth complications during childbirth

Figure 4: BPI between index child and subsequent pregnancy and perinatal complications

In terms of perinatal birth complications, 2.3% (21/904) of the respondents reported ever experiencing a complication including, neonatal sepsis (38.1%) and neonatal jaundice (23.8%); the rest are represented on the bar graph in figure 4 below.

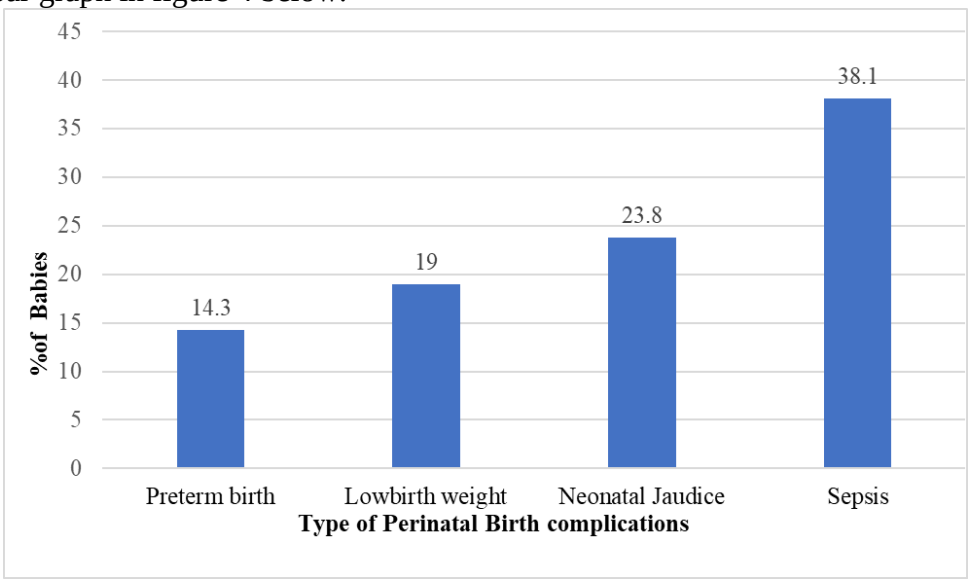

Figure 4. Perinatal birth complications

4. 0 Discussion

This study investigated the association between SBPI and perinatal and maternal outcomes among 904 women in three municipalities in the UER of Ghana. The prevalence of the SBPI (<24 months) was 36.9% among the

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respondents in this study. This proportion is quite lower than a study that was conducted in Ghana (Alhassan et al., 2022), which showed a SBPI of 49.7%. The disparities could be due to variations in sample size between the two studies. Again, this finding is in line with recent studies that reveal similar but higher SBPI prevalence in Sudan (60.6%)(Damtie et al., 2021), Ethiopia (58.74%) (Belachew et al., 2023), and Uganda (52.4%) (Aleni et al., 2020). A much lower prevalence was found in studies conducted in Iran (28.8%) and rural Bangladesh (24.6%).

The results also revealed that BPI was significantly associated with some adverse maternal and perinatal consequences. However, there was not much difference in terms of complications experienced between women with an SBPI (<24 months) and the optimal interval (24–59 months). Eight percent (8.1%) of the women who had an SBPI (<24 months) reportedly experienced birth complications, while 10.4% of them within 24–59 months reported birth complications. The major birth complications encountered by women during childbirth were retained products of conception (41.9%), pregnancy-induced hypertension (27.9%), postpartum hemorrhage (11.6%), and obstructed labor (10.5%). Similarly, sepsis (38.1%), neonatal jaundice (23.8%), low birth weight (19%), preterm birth (14.3%), and early neonatal death were the reported perinatal complications in this study. Previous studies have shown resembling maternal and perinatal complications. For instance, a systematic review study (Hutcheon et al., 2019) in 2019 indicated that inadequately spaced births result in birth complications. A recent meta-analysis research revealed that women with SBPI had nearly 1.5 times the odds of developing either a preterm or low-birthweight infant (David et al., 2017). A United States study (Byamukama et al., 2022) showed that SBPI was associated with premature rupture of membranes. Another systematic review study in China (Xu et al., 2022) found that short birth spacing was associated with an increased risk of uterine rupture, placenta previa, and placental abruption. A prior study (Rao et al., 2022) conducted in 2022 indicated low birth weight (OR 3.5, 95% CI:1.2–10.3, $P < 0.05$), preterm birth (OR 5.5, 95% CI:1.5–21.3, $P < 0.05$), and postpartum hemorrhage (OR 19.6, 95% CI:4.4–90.9, $P < 0.05$), were significantly higher in respondents with SBPI than in those with an OBPI (24–59 months).

The educational level of respondents' partner (AOR 2.07; 95%CI1.09-3.96; p=0.027), mode of delivery of the last child (AOR 3.28; 95% CI 1.02-10.62; p=0.047), parity of five or more children (AOR 0.67; 95% CI 0.46-0.98; p=0.040) and frequency of sexual intimacy were strongly associated with BPI after adjusting for confounders. Women whose partners had secondary education were 1.87 times more likely to space their births compared to those with partners without education. This result confirms studies that were conducted in Ethiopia (Hailu & Gulte, 2016), and Korea (Pimentel et al.,

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2020). However, unlike our study, these two studies and many more found associations between women's education with BPI instead. A survey among college students postulated that couples with lower or no education had a lesser chance of spacing their births than educated ones (Shen, 2019). This could be because educated females are exposed to available health information and are more likely to utilize birth control methods to lengthen their birth intervals. Similarly, a recent study opined that mothers with low education levels are at increased risk of SBPI (Pimentel et al., 2020).

We found that women who went through CS during delivery were 3.28 times more likely to space their children compared to those who had SVD. This finding conforms with a study (Byamukama et al., 2022), which stated that long birth intervals were significantly associated with CS (0.69; 0.56–0.82), which have a greater risk of premature rupture of membranes (PROM) (1.57; 1.20–2.06) and low birth weight (1.46; 1.03–2.06). This revelation could be linked to the fact that when women undergo an operation during childbirth, they need more time to recover before initiating the next pregnancy, especially in the case of birth complications (Huber et al., 2020).

In terms of parity, this study found a significant positive impact on the risk of having a subsequent birth. Akin to these findings, a study in Manipur and Babol, Northern Iran, indicated that birth interval increases with increasing parity (Nausheen et al., 2021). This sought to explain that women with fewer children tend to have short intervals while those with more children have longer intervals. The association between the number of children and women whose children die immediately after birth has shorter intervals. For example, a study in Poland by Merklinger-Gruchala et al. revealed that the mother of a deceased baby will again try to become pregnant more quickly, hence her BPI becomes very short.

It was further discovered in this study that couples who had more frequent sexual contact had a high probability of having a shorter interbirth spacing compared to couples who with less frequent intimacy. It is assumed that when couples engage in frequent sexual intimacy, could easily result in pregnancy, hence a shorter BPI. This is valid for couples who live together in the same household. The majority of respondents in this study live in the same households with their partners. This further explains that couples using modern contraceptives have a higher percentage of widening their birth interval than those who are not practicing any form of FP. In this study, contraceptive usage was high. The majority of respondents (72.3%) ever used a modern contraceptive to prevent pregnancy. This finding is in line with a study (Yussuf et al., 2020; Zimmerman et al., 2019) in Tanzania and Ethiopia respectively.

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The study result should be interpreted carefully since it is still unclear whether the link between SBPI and adverse health outcomes is causal or confounded by differences in health characteristics. Further research is therefore needed to determine if the association between SBPI and adverse health outcomes is due to a direct cause-and-effect relationship or if it is influenced by other factors such as lifestyle choices or access to healthcare. Understanding these potential confounding variables will provide a more comprehensive understanding of the relationship between SBPI and adverse health outcomes.

4.1 Strengths and Limitations of the Study

The sample size was large enough for this study hence the results are more accurate and representative of the population. Again, quality control measures were adhered to such as adequate training for research enumerators before data collection, and the use of electronic data collection tools to ensure accurate data capture and to avoid data entry errors. The study had some limitations. There was a dropout rate of respondents from the BaM study site, due to an outbreak of a tribal conflict during the period of data collection in the area. This prevented the enumerator from gaining access to the study area. However, the dropout rate was marginal and did not affect the sample size since there was a predetermined 10% dropout rate added to the sample prior to data collection. Furthermore, the study did not conform strictly to the inclusion criteria (women with two successive live births before data collection), as a few uniparous women were unintentionally interviewed in the study.

Conclusion

The study found an association between SBPI and the perinatal and maternal health outcomes in the study area. Of the 904 respondents, approximately 36.9% had an SBPI which was associated with poor maternal and perinatal outcomes, viz; retained products of conception, pregnancy-induced hypertension, postpartum hemorrhage, obstructed labor, sepsis, neonatal jaundice, low birth weight, preterm birth, and early neonatal death. Parity, educational status, mode of delivery, and frequency of sexual intimacy were associated with SBPI in this survey The contraceptive prevalence rate among respondents was high, about, 72.3% of the respondents verbalized having ever used an FP method to avoid pregnancy, while 60.5% of the respondents reported having utilized a modern contraceptive method shortly after delivery. Despite the improved contraceptive utilization among respondents, the number with short interbirth intervals was high.

The evidence of this study prongs to critical periods at which women should avoid getting pregnant to preempt poor prenatal and maternal outcomes

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associated with inappropriate birth intervals. The study recommends health professionals, especially those in direct contact with family, maternal, reproductive, and child health, identify the challenges facing contraceptive uptake, particularly among multiparous women, and intensify birth spacing campaigns to improve optimal birth spacing and to support women's decision-making.

Maternal and newborn mortalities in Ghana and SSA remain radically high, while contraceptive uptake has dwindled. Hence, this study's findings provide empirical evidence for policy interventions to foster optimal birth spacing to ensure a reduction in the high fertility, maternal, and child mortality rates.

Conflict of Interest: The authors declare no conflict of interest in the conduct of this study.

Data Availability: All the data is incorporated within the paper's content. No data has been excluded.

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Declaration for Human Participants: This study has been approved by: the Navrongo Health Research Centre Institutional Review Board in Ghana with the ethical identification number NHRCIRB448, and the principles of the Helsinki Declaration were followed.

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