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Patterns and determinants of short and long birth intervals among women in selected sub-Saharan African countries

Anthony Idowu Ajayi, BSc, MSc, PhD[a,*], Oluwaseyi Dolapo Somefun, BSc, MSc, PhD[b]

Abstract

Optimal birth spacing (defined as a birth spacing of 24–59 months) is incontrovertibly linked to better health outcomes for both mothers and babies. Using the most recent available Demographic and Health Survey data, we examined the patterns and determinants of short and long birth intervals among women in selected sub-Saharan African (SSA) countries.

Reproductive health and sociodemographic data of 98,934 women from 8 SSA countries were analyzed. Unadjusted and adjusted multinomial logistic regression models were used to examine the net relationship between all the independent variables and short and long birth intervals.

Overall, the majority of women in all the countries optimally spaced births. However, a significant proportion of women had short birth intervals in Chad (30.2%) and the Democratic Republic of Congo (Congo DRC) (27.1%). Long birth spacing was more common in Eastern and Southern African countries, with Zimbabwe having the highest rate of long term birth interval (27.0%). Women who were aged 35 years and above in Uganda (RRR = 0.72, CI = 0.60–0.87), Tanzania (RRR = 0.62, CI = 0.49–0.77), Zimbabwe (RRR = 0.52, CI = 0.31–0.85), Nigeria (RRR = 0.82, CI = 0.72–0.94) and Togo (RRR = 0.67, CI = 0.46–0.96) had significantly lower odds of having short birth intervals compared to women aged 15–24 years. Older women (above 34 years) had increased odds for long birth intervals in all countries studied (Chad (RRR = 1.44, CI = 1.18–1.76), Congo DRC (RRR = 1.73, CI = 1.33–2.15), Malawi (RRR = 1.54, CI = 1.23–1.94) Zimbabwe (RRR = 1.95, CI = 1.26–3.02), Nigeria (RRR = 1.85 CI = 1.56–2.20), Togo (RRR = 2.12, CI = 1.46–3.07), Uganda (RRR = 1.48, CI = 1.15–1.91), Tanzania RRR = 2.12, CI = 1.53–2.93).

The analysis suggested that the determinants of long and birth intervals differ and varies from country to country. The pattern of birth spacing found in this study appears to mirror the contraceptive use and fertility rate in the selected SSA countries. Birth intervals intervention addressing short birth intervals should target younger women in SSA, especially in Chad and Congo DRC, while intervention for long birth spacing should prioritize older, educated and wealthy women.

Abbreviations: CI = confidence interval, Congo DRC = Democratic Republic of Congo, DHS = demographic and health surveys, RRR = relative risk ratio, SSA = sub-Saharan Africa, USAID = The United States Agency for International Development, WHO = World Health Organization.

Keywords: long birth interval, Short birth interval, sub-Saharan Africa

1. Introduction

Optimal birth spacing (defined as inter-birth interval length of 24–59 months) is incontrovertibly linked to better health outcomes for both mothers and babies.[1–4] There is a growing body of evidence associating short birth spacing (defined as inter-birth interval length of fewer than 24 months) with adverse maternal and child health outcomes.[1,3,5] Pregnancies that starts in less than 18 months after birth are linked with delayed prenatal care, increased risk of maternal mortality, and adverse birth outcomes, including miscarriages, preterm births, stillbirths, low birth weight, and neonatal morbidity.[6,7] Further, short birth spacing has longer-term effects on childhood nutrition status.

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Supplemental Digital Content is available for this article.

The datasets generated during and/or analyzed during the current study are publicly available.

[a] Sociology Department, University of Fort Hare, East London Campus, 50, Church Street, East London, [b] Demography and Population Studies (DPS), University of the Witwatersrand, Johannesburg, South Africa.

[*] Correspondence: Anthony Idowu Ajayi, Sociology Department, University of Fort Hare, East London Campus, 50, Church Street, 5200, East London, South Africa (e-mail: ajayianthony@gmail.com, aajayi@aphrc.org).

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Children that are spaced closely face the risk of under-nutrition and stunting. According to Gribble,[8] a birth spacing of fewer than 24 months is associated with increased odds of stunting. Short birth spacing suggests shorter breastfeeding duration, which indicates that the infant would miss out on the benefits of the WHO recommended two years of breastfeeding.[9–12] Consequently, the risk of dying and under-nutrition are higher among children that are spaced too closely.[13]

Likewise, long birth spacing (defined as inter-pregnancy interval greater than 60 months) is linked to adverse outcomes such as women's physiological regression, preterm birth, low birth-weight and an increased risk of labor dystocia and preeclampsia.[1,2,14] Very long birth interval (>75months) is linked to increased risk of maternal mortality.[7] Timæus and Moultrie[15] questioned whether very long birth interval should be viewed as "spacing" or "postponement". They argued that a very long birth interval is not synonymous with birth spacing and should be considered to be birth postponement since the underlying reason for delaying subsequent birth for such a long interval might be unrelated to the age of the existing child. We posit that very long birth interval could be due to "birth postponement", miscarriages, abortions and "secondary infertility". It is also possible that women who delay or postpone having a subsequent birth for over 5 years got pregnant as teenagers or outside a committed relationship, which in most cases are unplanned pregnancy. As such, their subsequent births have nothing to do with the age of the existing child. While the proportion of women spacing births for over 5 years are increasing, the associated factors are less understood. This is important considering that very long birth interval is as deleterious as a short birth interval.

The affecting birth spacing could be categorized into two factors; "sociological" and "biological".[16] The biological factors include differences in length of post-partum amenorrhea, pregnancy wastage and menstrual interval. According to Potter, variation in birth spacing is primarily determined by biological factors.[17] Lincoln and colleagues conducted a prospective study of birth spacing dynamics in rural Bangladesh and found that lengthy post-partum amenorrhea was primarily responsible for prolonged birth intervals and accounted for 45 percent of the variation in birth interval length.[16] The sociological factors affecting birth intervals included contraceptive use, breastfeeding length, the death of the previous child, gender of new-born, infrequent sex, and husband's occupation.[16,18–21] Baschieri and Hinde argued that birth intervals are determined mainly by the use of modern contraception.[22] However, the relationship between contraceptive use (both modern and traditional) and birth spacing is mixed.[23] While many studies reported that birth spacing is associated with contraceptive use,[24,25] some studies did not find such associations.[23] The socio-demographic factors which contribute to variation in birth spacing include; parity, age, residence type, wealth index, education, and religion.[16,18–21] The interaction between socio-demographic factors and birth spacing differ from society to society and change over time.

The deleterious consequences of long birth intervals are well known. Yet, recent evidence suggests an increasing trend towards longer inter-birth intervals in all regions of the world, and especially in sub-Saharan Africa (SSA).[26,27] Understanding the regional variation of long birth spacing and its demographic determinants could be crucial towards crafting policy that will address this phenomenon. This is currently missing in the literature. In addition, the determinants of short birth intervals are extensively documented in the literature; however, little is known about factors that determine long birth intervals. It is also unclear whether the factors that influence short birth intervals also influence long birth intervals in the SSA context. As such, we used the most recent demographic and health surveys to examine the patterns and the determinants of long and short birth intervals among childbearing women in 8 SSA countries.

2. Data and methods

The data for this present study was drawn from the Demographic and Health Survey (DHS) of eight purposively selected countries from the key regions of SSA. The choice was also informed by the availability of data in the past 5 years (from 2013–2018), geographical representation and variations in fertility and contraceptive prevalence rates. The child recode dataset of the following countries was used; Chad (2014–2015) and Congo DRC (2013–14) from the Central Africa region; Uganda (2016) and Tanzania (2015–16) from the East Africa region; Nigeria (2013) and Togo (2013–2014) from the West Africa region; and Malawi (2015–2016) and Zimbabwe (2015) from the Southern Africa region. To determine the proportion of women who had long, short and optimal birth spacing, only women who have had more than one birth are eligible. Women who had only one birth were dropped from the sample. The full analytic sample size has been presented in Supplementary Digital Content (Supplementary Digital Content, Table 1, http://links.lww.com/MD/E180).

The DHS program is a nationally representative, cross-sectional survey that is collected every 5 years in participating countries. The child recode, which was used for this study, has one record for every child born in the 5 years preceding the survey of interviewed women. It contains the information relating to the mother's pregnancy, the child's delivery, postnatal care and immunization, among others. The data for the mothers of each of these children are included.

2.1. Outcome variable

The dependent variable for this study is birth spacing. This has been described as the duration between a preceding birth and index birth measured as the number of months between the birth of the child being studied and the immediately preceding child birth of the mother.[1,3,5] The objective of this study is to estimate the proportion of women who had short, optimal, and long birth spacing in the selected countries. This could only be achieved by focusing only on closed birth intervals. Although the limitations of using closed birth intervals have been well documented in demographic research,[15,27,28] there is public health and clinical relevance of studying the prevalence of short and long birth spacing. Although the World Health Organization (WHO) and other international organizations have suggested a waiting period of at least 2 to 3 years between pregnancies to reduce infant and child mortality, and also to benefit maternal health, recent studies supported by the United States Agency for International Development[29] have encouraged longer birth spacing, of 3 to 5 years, as possibly being more advantageous.[30] The variable measuring the self-reported length of time in months between the most recent birth (index birth) and the previous birth is continuous. This variable was based on the WHO and USAID definition of optimal birth spacing into: <24 months "short birth spacing", 24 to 60 months "optimal birth spacing" and >60 months "long birth spacing". Optimal birth spacing was used as the reference interval for all analyses, based on previous literature reporting this interval as the best.

2.2. Independent variables

Based on the literature, we have included several covariates in our models that are likely to be associated with both short and long term birth intervals. The independent variables include age, sex of preceding child, survival of preceding birth, place of residence, marital status, educational level, employment status and wealth status, which is a proxy for household socioeconomic status captured through a wealth index based on household possessions and amenities. Detailed methodology on how the DHS constructs the wealth index has been discussed in the literature.[31] Age was defined as the age of the mother at the time of the index birth and was categorized as; "15 to 24", "25 to 34" and "35+". Due to the uncertainty associated with child survival in several countries in SSA, we controlled for sex and the survival of the preceding child. Educational attainment was classified as either no education, primary only, secondary and higher education. Employment status was categorized into women who were working and not working. The wealth quintile given in the DHS was regrouped into low (lowest and second quintiles), middle and high (fourth and highest quintiles) to examine the effect of socioeconomic status on the different birth intervals.

2.3. Statistical analysis

Three levels of analysis were employed in this paper, that is, univariate analysis, bivariate descriptive, unadjusted and adjusted multinomial logistic modeling. The univariate analysis presented the median birth-spacing according to socio-demographic characteristics. In the bivariate analysis, the percentage distributions of birth spacing were presented according to the selected demographic characteristics. Unadjusted and adjusted multinomial logistic regressions were then employed to examine the independent and net relationship between all the independent variables and the outcome variable due to the nature of the outcome.[32] The multinomial logistic regression was used because the outcome variable had three categories: <24 months "short birth spacing", 24 to 60 months "optimal birth spacing" and >60 months "long birth spacing". Optimal birth spacing was used as the reference interval for all analyses. A P value $<.05$ was considered statistically significant. We used asterisk to indicate certain level of P value in tables as follows: $^{*}P<.05$; $^{**}P<.01$; $^{***}P<.001$. Sampling weights were applied to adjust for differences in the probability of selection and to adjust for non-response in order to produce the proper representation. Individual weights were used for descriptive statistics in this study, using Stata 14 for Windows.

2.4. Ethical consideration

This study was exempted from ethical review by the committee because the study used deidentified publicly available datasets which are completely anonymous and do not contain any personal, confidential and identifying information or characteristics of the respondents. The study adhered to the ethical standards of the Helsinki Declaration by the World Medical Association. The DHS datasets can be downloaded online and are freely available for use by researchers upon request. In order to access the data from the website, a written request needed to be submitted to the measure DHS and permission was granted to use the data for this survey. Datasets are available from; https://dhsprogram.com/data/available-datasets.cfm.

3. Results

3.1. Descriptive results

Given that birth spacing length is not normally distributed, we estimated median birth spacing in place of mean birth spacing for all countries studied, and results were grouped by socio-demographic characteristics, the survival of preceding birth and sex of preceding birth (Table 1). The median birth spacing was highest in Malawi and Zimbabwe, but lowest in Chad and the Congo DRC. Women whose preceding child survived had higher median birth interval length compared those whose child did not survive. Women living in urban areas had higher median birth spacing length compared women residing in rural areas in all countries except in Chad and Congo DRC.

The median birth spacing of women is varied by age, education, and marital status. In all countries, women aged 35 + had higher median birth spacing length compared to women aged 15 to 24 years. For instance, the median birth spacing for women aged 35 and above was 57 months in Zimbabwe, compared to 32 months for their counterparts aged 15 to 24. Similar trends were seen in Tanzania (37 months for women aged 35+ vs 27 months for counterparts aged 15–24). The median birth spacing length was higher among never-married women compared to those currently married in all countries except in Zimbabwe. Median birth spacing was higher among women who had a higher education compared to women with no education in most of the countries studied. However, in Nigeria and Congo DRC, there was no difference in the median birth spacing of women by their educational status. In a number of the countries, the variations in the median birth spacing between women with secondary education and women with higher education were about 3 to 6 months.

3.2. Long and short birth spacing

We grouped the birth interval length into short, optimal and long and estimated the proportion of long, short and optimal birth spacing for all countries of interest. In all countries, the majority of women spaced their births optimally (see Supplementary Digital Content (Supplementary Digital Content, Table 2A–D, http://links.lww.com/MD/E181, http://links.lww.com/MD/E182, http://links.lww.com/MD/E183, http://links.lww.com/MD/E184)). Nevertheless, the prevalence of short birth interval was highest in Chad (30.18%) and the Congo DRC (27.12%) (See Supplementary Digital Content, Table 2A, http://links.lww.com/MD/E181). The prevalence of long-term birth spacing was highest among women in Zimbabwe (27%) (see Supplementary Digital Content, Table 2D, http://links.lww.com/MD/E184) and lowest among women in Chad (6%). Percentage distribution of birth spacing differed by demographic characteristics in the different countries (see Supplementary Digital Content, Table 2A, http://links.lww.com/MD/E181, 2B, http://links.lww.com/MD/E182, 2C, http://links.lww.com/MD/E183, 2D, http://links.lww.com/MD/E184). For example, there was a higher percentage of women aged 35 and above having short birth intervals in Central Africa (Chad 29.95%; Congo DRC 22.3%), compared to women in East Africa aged 35 and above (Uganda 18.8%, Tanzania 14.2%) (see Supplementary Digital Content Table 2B, http://links.lww.com/MD/E182) and Southern Africa

Table 1

Median birth spacing by socio-demographic characteristics.

Variable	Chad	Congo DRC	Uganda	Tanzania	Malawi	Zimbabwe	Nigeria	Togo
All respondents	29	30	31	33	41	44	31	37
Age								
15–24	27	27	27	27	34	32	28	31
25–34	29	30	32	34	42	44	30	36
35+	30	33	35	37	46	57	35	41
Preceding child sex								
Male	29	30	31	33	41	44	31	37
Female	29	30	31	33	41	43	31	37
Survival of preceding birth								
Not alive	23	22	20	22	21	20	23	24
Alive	27	27	27	27	33	31	28	31
Place of residence								
Urban	29	31	35	40	48	48	32	40
Rural	29	30	30	32	40	42	31	37
Marital status								
Never married	34	32	37	41.5	52	41	33	46.5
Currently married	29	30	31	33	41	44	31	37
Formerly married	29	33	35	37	43	46	33	40
Education								
No education	28	30	30	32	40	41	31	37
Primary	29	30	31	34	40	42	32	38
Secondary	30	30	33	35	45	44	31	38
Higher	34	30	39	33	50	50	32	45.5
Occupation								
Not working	29	30	30	32	41	43	32	37
Working	27	29.5	31	34	41	45	31	49
Wealth status								
Poor	29	30	30	30	38	40	30	36
Middle	29	29	31	34	40	44	32	38
Rich	29	30	34	38	46	48	32	40

(Malawi 10.0%; Zimbabwe 6.7%). On the other hand, there were a higher proportion of women aged 35 and above having long birth intervals in Southern Africa (Malawi 31.6%; Zimbabwe 44.7%) compared to Western Africa (Nigeria 16.1%; Togo 22.98%) and Central Africa (Chad 9.2%; Congo DRC 14.1%). More women who were working in Eastern (Uganda 11.2%, Tanzania 17.8%) and Southern Africa (Zimbabwe 29.5%, Malawi 20.9%) had long birth intervals, compared working women in Central Africa (Chad 6.1%, Congo DRC 8.2%).

3.3. Determinants of short birth intervals

To examine the determinants of short birth intervals, we fitted both unadjusted and adjusted multinomial logistic regression models. The results of the unadjusted models are displayed in Tables 2 and 5, while the results of the adjusted model are presented in Tables 6 and 9. Age 35 years above, the survival of the preceding child, urban residence, higher education, and belonging to the rich quintile was significantly and independently associated with lower odds of short birth spacing among women in most of the countries. The direction of effect and the magnitude of effect remain in the adjusted model. Women who were 35 years and above in Uganda (RRR=0.72, CI=0.60–0.87), Tanzania (RRR=0.62, CI=0.49–0.77), Zimbabwe (RRR=0.52, CI=0.31–0.85), Nigeria (RRR=0.82, CI=0.72–0.94) and Togo (RRR=0.67, CI=0.46–0.96) had significantly lower odds of having short birth intervals compared to women aged 15 to 24 years. In all of the study countries, the survival of a preceding child was negatively associated with short birth intervals. However, there was no significant association between place of residence and short birth intervals except in Tanzania, where women in rural areas had significantly higher odds of having short birth intervals.

The findings on the association between education and birth spacing are mixed. There was no association between education and short birth spacing in Uganda, Tanzania, Togo, and Zimbabwe. However, in Nigeria, women with higher education (RRR=1.44, CI=1.16–1.79), and secondary education (RRR=1.22, CI=1.08–1.39) had significantly higher odds of having short birth intervals compared to women with no formal education. Compared to women who had no formal education, women who had secondary education had lower odds of having short birth spacing in Chad and Congo DRC. Women in Malawi (RRR=0.75, CI=0.59–0.95) with primary education had lower odds of having short birth intervals compared to their counterparts with no education.

Also, women who were working in Chad (RRR=0.83, CI=0.74–0.92) Tanzania (RRR=0.81, CI=0.67–0.98), and Nigeria (RRR=0.81, CI=0.74–0.89) had lower odds of having short birth intervals. Finally, women in the rich quintile had significantly higher odds of having short intervals in Uganda (RRR=1.22, CI=1.04–1.44).

Being married is associated with lesser odds of having short birth spacing in Chad while higher odds were observed in Congo DRC.

Table 2

Unadjusted relative risks of association between selected characteristics, and birth spacing among women in Central Africa.

	Chad		Congo DRC	
	Short Birth Spacing vs Optimal Birth Spacing	Long Birth Spacing vs Optimal Birth Spacing	Short Birth Spacing vs Optimal Birth Spacing	Long Birth Spacing vs Optimal Birth Spacing
Age				
15–24				
25–34	0.86 (0.78–0.94)***	1.40 (1.25–1.56)***	0.90 (0.81–1.00)	1.70 (1.50–1.92)***
35+	0.99 (0.88–1.10)	1.90 (1.69–2.15)***	0.86 (0.77–0.97)*	2.69 (2.36–3.06)***
Preceding child sex				
Male				
Female	0.97 (0.90–1.04)	1.00 (0.92–1.08)	1.02 (0.95–1.11)	0.92 (0.85–0.99)
Preceding child survival				
Not alive				
Alive	0.51 (0.44–0.59)***	1.33 (1.06–1.67) *	0.39 (0.33–0.45)***	0.94 (0.73–1.22)
Place of residence				
Urban				
Rural	0.96 (0.87–1.05)	1.01 (0.92–1.12)	0.94 (0.86–1.03)	0.80 (0.74–0.87)***
Marital status				
Never married				
Currently married	0.69 (0.27–1.75)	0.50 (0.20–1.25)	1.29 (0.91–1.84)	1.32 (0.90–1.93)
Formerly married	0.80 (0.31–2.06)	0.69 (0.27–1.72)	0.72 (0.53–0.97) *	1.19 (0.86–1.65)
Education				
No education				
Primary	0.87 (0.79–0.95)***	0.99 (0.89–1.09)	0.88 (0.79–0.97)*	0.85 (0.77–0.94)***
Secondary	0.64 (0.54–0.75)***	0.97 (0.83–1.13)	0.84 (0.75–0.93)**	0.99 (0.89–1.10)
Higher	1.44 (0.71–2.93)	2.78 (1.45–5.30)***	1.55 (1.02–2.37)*	1.56 (1.02–2.38)*
Occupation				
Not working				
Working	0.89 (0.83–0.96)***	1.06 (0.98–1.14)	0.98 (0.89–1.07)	1.04 (0.95–1.14)
Wealth status				
Poor				
Middle	1.07 (0.97–1.18)	1.13 (1.02–1.26)	1.04 (0.94–1.15)	0.96 (0.87–1.06)
Rich	1.01 (0.93–1.10)	1.05 (0.96–1.14)	1.05 (0.96–1.15)	1.13 (1.03–1.23)***

RRR = relative risk ratio.
* $P < .05$.
** $P < .01$.
*** $P < .001$.

Table 3

Unadjusted relative risks of association between selected characteristics, and birth spacing among women in East Africa.

	Uganda Tanzania		Tanzania	
	Short Birth Spacing vs Optimal Birth Spacing	Long Birth Spacing vs Optimal Birth Spacing	Short Birth Spacing vs Optimal Birth Spacing	Long Birth Spacing vs Optimal Birth Spacing
Age				
15–24				
25–34	0.70 (0.62–0.77)***	1.98 (1.75–2.23)***	0.61 (0.52–0.71)***	2.26 (1.91–2.66)***
35+	0.64 (0.56–0.73)***	2.70 (2.37–3.09)***	0.54 (0.45–0.64)***	2.98 (2.50–3.54)***
Preceding child sex				
Male				
Female	1.01 (0.92–1.10)	1.06 (0.98–1.15)	1.10 (0.97–1.24)	1.02 (0.92–1.12)
Preceding child survival				
Not alive				
Alive	0.29 (0.23–0.37)***	0.85 (0.58–1.25)	0.35 (0.27–0.45)***	1.00 (0.65–1.56)
Place of residence				
Urban				
Rural	0.82 (0.72–0.94)***	0.54 (0.48–0.61)***	1.11 (0.94–1.31)	0.48 (0.43–0.55)***
Marital status				
Never married				
Currently married	0.86 (0.57–1.30)	0.48 (0.34–0.68)***	1.50 (0.80–2.83)	0.56 (0.37–0.85) ***
Formerly married	0.95 (0.61–1.47)	0.78 (0.55–1.12)	1.16 (0.60–2.26)	0.82 (0.53–1.26)
Education				
No education				
Primary	1.12 (0.99–1.27)	1.17 (1.04–1.32)***	1.07 (0.93–1.23)	1.47 (1.30–1.66)***
Secondary	1.19 (1.02–1.40)	1.60 (1.38–1.85)***	1.20 (0.98–1.48)	1.70 (1.43–2.02)***
Higher	1.09 (0.82–1.44)	2.61 (2.09–3.27)***	1.88 (0.86–4.10)	1.80 (0.88–3.67)
Occupation				
Not working				
Working	0.85 (0.76–0.95)***	1.07 (0.96–1.20)	0.80 (0.69–0.92)***	1.09 (0.96–1.23)
Wealth status				
Poor				
Middle	1.22 (1.09–1.38)***	1.37 (1.22–1.53)***	0.94 (0.80–1.11)	1.48 (1.29–1.70)***
Rich	1.25 (1.12–1.39)***	2.03 (1.85–2.23)***	0.99 (0.86–1.14)	2.38 (2.13–2.67)***

RRR = relative risk ratio.
* $P < .05$.
** $P < .01$.
*** $P < .001$.

Table 4

Unadjusted relative risks of association between selected characteristics, and birth spacing among women in Southern Africa.

	Malawi		Zimbabwe	
	Short Birth Spacing vs Optimal Birth Spacing	Long Birth Spacing vs Optimal Birth Spacing	Short Birth Spacing vs Optimal Birth Spacing	Long Birth Spacing vs Optimal Birth Spacing
Age				
15–24				
25–34	0.32 (0.28–0.37)***	0.46 (0.41–0.51)***	0.25 (0.19–0.32)***	0.33 (0.27–0.40)***
35+	0.31 (0.26–0.36)***	0.33 (0.30–0.38)***	0.12 (0.09–0.17)***	0.19 (0.15–0.25)***
Preceding child sex				
Male				
Female	0.95 (0.84–1.06)	0.97 (0.90–1.05)	1.01 (0.83–1.23)	1.10 (0.96–1.25)
Preceding child survival				
Not alive				
Alive	0.18 (0.14–0.24)***	1.58 (1.11–2.25)**	0.16 (0.11–0.23)***	1.54 (0.87–2.72)
Place of residence				
Urban				
Rural	1.59 (1.34–1.89)***	1.79 (1.60–2.01)***	1.11 (0.90–1.35)	1.41 (1.22–1.62)***
Marital status				
Never married				
Currently married	1.49 (0.74–3.00)	1.76 (1.09–2.84)	1.46 (0.62–3.45)	0.70 (0.44–1.11)
Formerly married	1.26 (0.61–2.59)	1.39 (0.85–2.27)	1.10 (0.44–2.77)	0.67 (0.40–1.11)
Education				
No education				
Primary	0.77 (0.66–0.89)***	1.10 (0.98–1.23)	2.35 (0.71–7.76)	0.90 (0.52–1.56)
Secondary	0.54 (0.44–0.66)***	0.72 (0.63–0.83)***	2.25 (0.68–7.37	0.76 (0.44–1.31)
Higher	0.48 (0.26–0.88)***	0.40 (0.25–0.63)***	1.38 (0.39–4.93)	0.53 (0.28–0.97)
Occupation				
Not working				
Working	0.98 (0.86–1.10)	1.04 (0.96–1.13)	0.95 (0.78–1.15)	0.89 (0.78–1.02)
Wealth status				
Poor				
Middle	0.74 (0.64–0.86)***	0.84 (0.76–0.93)***	0.73 (0.55–0.99)	0.73 (0.60–0.89)***
Rich	0.51 (0.44–0.58)***	0.56 (0.52–0.61)***	0.79 (0.64–0.98)*	0.60 (0.52–0.69)***

RRR = relative risk ratio.
* $P < .05$.
** $P < .01$.
*** $P < .001$.

Table 5

Unadjusted relative risks of association between contraceptive use, selected characteristics, and birth spacing among women in West Africa.

	Nigeria		Togo	
	Short Birth Spacing vs Optimal Birth Spacing	Long Birth Spacing vs Optimal Birth Spacing	Short Birth Spacing vs Optimal Birth Spacing	Long Birth Spacing vs Optimal Birth Spacing
Age				
15–24				
25–34	0.93 (0.85–1.01)	1.89 (1.71–2.08)***	0.73 (0.57–0.93)*	1.79 (1.44–2.22)***
35+	0.79 (0.71–0.87)***	3.18 (2.87–3.53)***	0.62 (0.47–0.82)***	2.89 (2.31–3.62)***
Preceding child sex				
Male				
Female	0.99 (0.93–1.06)	0.99 (0.93–1.05)	1.00 (0.84–1.18)	1.02 (0.91–1.14)
Preceding child survival				
Not alive				
Alive	0.38 (0.34–0.43)***	1.00 (0.84–1.19)	0.27 (0.20–0.37)***	1.04 (0.70–1.54)
Place of residence				
Urban				
Rural	0.97 (0.91–1.04)	0.82 (0.78–0.88)***	0.80 (0.66–0.98)*	0.68 (0.60–0.78)***
Marital status				
Never married				
Currently married	1.12 (0.68–1.84)	0.95 (0.62–1.46)	0.82 (0.16–4.27)	0.21 (0.08–0.56)***
Formerly married	1.16 (0.68–1.97)	1.40 (0.88–2.21)	0.83 (0.15–4.54)	0.30 (0.11–0.82)**
Education				
No education				
Primary	0.88 (0.81–0.96)***	1.23 (1.14–1.32)***	0.89 (0.74–1.08)	1.10 (0.97–1.25)
Secondary	1.10 (1.01–1.19)*	1.22 (1.14–1.32)***	1.04 (0.81–1.35)	1.18 (1.00–1.41)
Higher	1.17 (1.01–1.36)*	1.45 (1.27–1.66)***	1.47 (0.44–4.91)	1.78 (0.76–4.18)
Occupation				
Not working				
Working	0.83 (0.77–0.89)***	1.23 (1.15–1.31)***	0.93 (0.75–1.16)	1.03 (0.89–1.20)
Wealth status				
Poor				
Middle	0.96 (0.88–1.04)	1.27 (1.18–1.37)***	1.02 (0.81–1.28)	1.17 (1.00–1.36)
Rich	1.01 (0.94–1.09)	1.37 (1.28–1.46)***	1.21 (0.98–1.48)	1.59 (1.38–1.82)***

RRR = relative risk ratio.
* $P < .05$.
** $P < .01$.
*** $P < .001$.

Table 6

Adjusted Relative Risks of Association between Selected Characteristics, and Birth Spacing Among Women in Central Africa.

	Chad		Congo DRC	
	Short Birth Spacing vs Optimal Birth Spacing	Long Birth Spacing vs Optimal Birth Spacing	Short Birth Spacing vs Optimal Birth Spacing	Long Birth Spacing vs Optimal Birth Spacing
Age				
15–24				
25–34	0.93 (0.83–1.06)	1.21 (1.03–1.43)*	0.95 (0.84–1.08)	1.25 (1.03–1.52)**
35+	1.19 (1.03–1.39)	1.44 (1.18–1.76)***	0.93 (0.80–1.08)	1.73 (1.33–2.15)***
Preceding child sex				
Male				
Female	1.01 (0.91–1.11)	0.98 (0.86–1.12)	1.03 (0.93–1.14)	0.90 (0.78–1.03)
Preceding child survival				
Not alive				
Alive	0.50 (0.43–0.58)***	1.31 (1.04–1.64)*	0.38 (0.33–0.45)***	0.97 (0.75–1.25)
Place of residence				
Urban				
Rural	0.96 (0.93–1.11)	1.22 (1.00–1.47)	0.91 (0.78–1.05)	0.82 (0.66–1.00)
Marital status				
Never married				
Currently married	0.18 (0.03–0.88)*	0.12 (0.02–0.65)*	1.70 (1.10–2.63)*	0.72 (0.43–1.21)
Formerly married	0.22 (0.04–1.09)	0.10 (0.02–0.58)*	1.93 (1.20–3.10)***	0.80 (0.45–1.43)
Education				
No education				
Primary	0.90 (0.79–1.03)	1.01 (0.85–1.20)	0.89 (0.78–1.01)	0.84 (0.70–1.00)
Secondary	0.71 (0.57–0.87)***	0.84 (0.64–1.10)	0.85 (0.72–0.99)*	0.76 (0.61–0.94)*
Higher	2.48 (0.92–6.66)	1.39 (0.34–5.63)	1.72 (0.99–2.99)	1.18 (0.53–2.63)
Occupation				
Not working				
Working	0.83 (0.74–0.92)**	1.00 (0.86–1.15)	1.03 (0.91–1.16)	1.16 (0.97–1.39)
Wealth status				
Poor				
Middle	1.10 (0.96–1.26)	1.27 (1.07–1.52)**	0.99 (0.87–1.13)	0.87 (0.72–1.05)
Rich	1.04 (0.91–1.18	1.19 (1.01–1.41)*	1.07 (0.92–1.25)	0.80 (0.64–1.00)

RRR = relative risk ratio.
* $P<.05$.
** $P<.01$.
*** $P<.001$.

3.4. Determinants of long birth intervals

The adjusted and unadjusted multinomial regression models were used to examine the determinants of long birth intervals in all countries selected. The results are presented in Tables 2–9. The results of the unadjusted model indicate that age 35 and above, higher education, being employed and living in urban areas were associated with higher odds of having long birth spacing ($P<.05$). The results of the adjusted model were mixed in all countries studied. While older age is associated with long birth interval for all countries ($P<.05$), the survival of the preceding child was associated with long birth interval only in Chad (RRR = 1.31, CI = 1.04–1.64, $P<.05$) and Malawi (RRR = 1.53, CI = 1.07–2.19, $P<.05$). Also, sex of preceding child and work status were not significantly associated with long birth spacing in all countries studied. Similarly, place of residence was not significantly associated with long birth spacing in all selected countries except for Uganda (RRR = 0.66, CI = 0.51–0.85, $P<.05$). Women who were currently married had lower odds of having long birth intervals in Chad (RRR = 0.12, CI = 0.02–0.65, $P<.05$).

The findings on the association between women's education and long birth spacing are mixed. Education did not significantly influence long birth spacing in Chad, Malawi, Zimbabwe, Nigeria, and Togo. However, women who had secondary education in Congo DRC (RRR = 0.76, CI = 0.61–0.94, $P<.05$) had lower odds of having long birth intervals compared to their counterparts with no education. In contrast, women with tertiary education (RRR = 1.84, CI = 1.15–2.93, $P<.05$) were significantly more likely to have longer birth intervals compared to their counterparts with no formal education in Uganda while women with primary education (RRR = 1.53, CI = 1.17–2.01, $P<.05$) were significantly more likely to have longer birth intervals compared to their counterparts with no formal education in Tanzania.

Lastly, wealth status was not significantly associated with long birth spacing in Congo DRC, Nigeria, Togo and Malawi ($P>.05$). However, the wealth status increases the odds of having long birth spacing in Chad, Zimbabwe, Tanzania and Uganda. Women in the rich quintile in Tanzania (RRR = 1.82, CI = 1.35–2.45, $P<.05$), Chad (RRR = 1.19, CI = 1.01–1.41, $P<.05$) had significantly higher odds of having long birth intervals compared to women in the poorest quintile. In Uganda (RRR = 1.26, CI = 1.00–1.59, $P<.05$) and Zimbabwe (RRR = 1.69, CI = 1.14–2.52, $P<.05$), women in the middle-income quintile had higher odds of having a long birth spacing compared to those in the poorest quintile.

Table 7

Adjusted relative risks of association between selected characteristics, and birth spacing among women in Eastern Africa.

	Uganda		Tanzania	
	Short Birth Spacing vs Optimal Birth Spacing	Long Birth Spacing vs Optimal Birth Spacing	Short Birth Spacing vs Optimal Birth Spacing	Long Birth Spacing vs Optimal Birth Spacing
Age				
15–24				
25–34	0.78 (0.68–0.90)***	1.13 (0.92–1.39)	0.73 (0.60–0.87)***	1.74 (1.29–2.34)***
35+	0.72 (0.60–0.87)***	1.48 (1.15–1.91)***	0.62 (0.49–0.77)***	2.12 (1.53–2.93)***
Preceding child sex				
Male				
Female	0.98 (0.86–1.10)	1.13 (0.95–1.34)	1.04 (0.89–1.22)	1.07 (0.86–1.32)
Preceding child survival				
Not alive				
Alive	0.29 (0.23–0.37)***	0.85 (0.58–1.26)	0.33 (0.25–0.44)***	1.06 (0.68–1.65)
Place of residence				
Urban				
Rural	0.83 (0.68–1.00)	0.66 (0.51–0.85)***	1.34 (1.04–1.73)*	0.97 (0.71–1.32)
Marital status				
Never married				
Currently married	0.92 (0.53–1.59)	0.68 (0.33–1.39)	2.08 (0.99–4.34)	1.78 (0.60–5.22)
Formerly married	1.02 (0.57–1.82)	0.91 (0.43–1.94)	1.67 (0.76–3.65)	2.23 (0.73–6.81)
Education				
No education				
Primary	1.02 (0.85–1.22)	0.98 (0.76–1.26)	1.10 (0.91–1.32)	1.53 (1.17–2.01)***
Secondary	1.12 (0.89–1.42)	1.30 (0.94–1.80)	1.18 (0.88–1.59)	1.33 (0.90–1.98)
Higher	0.99 (0.66–1.47)	1.84 (1.15–2.93) *	2.16 (0.89–5.24)	1.48 (0.48–4.51)
Occupation				
Not working				
Working	0.89 (0.77–1.04)	0.84 (0.68–1.04)	0.81 (0.67–0.98) *	1.09 (0.84–1.43)
Wealth status				
Poor				
Middle	1.38 (1.17–1.62)***	1.26 (1.00–1.59)*	1.03 (0.83–1.28)	1.43 (1.07–1.90)***
Rich	1.22 (1.04–1.44)***	1.14 (0.90–1.44)	1.09 (0.86–1.38)	1.82 (1.35–2.45)***

RRR = relative risk ratio.
* $P<.05$.
** $P<.01$.
*** $P<.001$.

4. Discussion

This study examined the patterns of birth spacing and the determinants of long and short birth intervals among childbearing women in eight purposively selected SSA countries. We found a wide variation in the length of birth intervals among the countries. The median birth spacing length was significantly shorter in Western and Central Africa countries when compared to Eastern and Southern African countries. Overall, the majority of women optimally spaced births in all countries. However, the prevalence of short birth spacing was highest in Chad and the Congo DRC. Short birth spacing is common in these two countries and considering its associated adverse effects,[1–4] there is a need for intervention. Long birth interval, which is also associated with adverse maternal health outcomes,[1–3,7] is more common in Eastern and South African countries than other regions of SSA.

The determinants of long and short birth intervals varied from country to country. Some factors which influenced short birth spacing did not influence long birth spacing. This finding corroborates Timæus and Moultrie[15] assertion that very long birth interval is not synonymous with birth spacing and should be viewed as birth postponement since the underlying reason for delaying subsequent birth for such a long interval might be unrelated to the age of the existing child. Based on the findings of this study, it is clear that the factors that determine short birth spacing differ from those that influence long birth spacing. This study reveals that median birth interval length is longer among never-married women. It could be that women who experienced long birth interval purposely chose to postpone birth or they experienced secondary infertility. In contrast, most women who spaced birth closely have been reported to have experienced an unplanned pregnancy.[33]

Our study shows that age is an important determinant of both short and long birth intervals in all sub-Saharan countries. The finding that younger age is associated with short birth spacing is consistent with the literature.[20,21] Younger women tend to have shorter birth intervals, while older women are more prone to long birth intervals. The plausible explanation for this could be as a result of the difference in contraceptive use. There is an array of evidence showing that older women are more likely to use contraceptives compared to younger women.[34–36] There is also evidence that younger women are more likely to experience unplanned pregnancy compared to older women.[37] Studies have shown that older age is associated with fertility decline, increased time to conception and risk of spontaneous miscarriage.[38,39] All these could explain why longer birth intervals are prevalent in older age. It is also possible that older women are postponing births or experiencing an unplanned pregnancy after deciding to

Table 8

Adjusted relative risks of association between selected characteristics, and birth spacing among women in Southern Africa.

	Malawi		Zimbabwe	
	Short Birth Spacing vs Optimal Birth Spacing	Long Birth Spacing vs Optimal Birth Spacing	Short Birth Spacing vs Optimal Birth Spacing	Long Birth Spacing vs Optimal Birth Spacing
Age				
15–24				
25–34	0.78 (0.64–0.94)*	1.51 (1.27–1.80)***	0.70 (0.50–0.96)*	1.46 (1.04–2.05)
35+	1.04 (0.82–1.32)	1.54 (1.23–1.94)***	0.52 (0.31–0.85)***	1.95 (1.26–3.02)***
Preceding child sex				
Male				
Female	1.01 (0.85–1.19)	1.04 (0.89–1.21)	0.90 (0.68–1.21)	0.97 (0.74–1.28)
Preceding child survival				
Not alive				
Alive	0.18 (0.14–0.23)***	1.53 (1.07–2.19)*	0.15 (0.10–0.22)***	1.55 (0.87–2.77)
Place of residence				
Urban				
Rural	0.75 (0.55–1.01)	0.83 (0.63–1.08)	0.69 (0.39–1.24)	1.12 (0.67–1.89)
Marital status				
Never married				
Currently married	0.89 (0.33–2.38)	0.63 (0.27–1.49)	3.14 (0.98–10.00)	3.19 (0.92–10.95)
Formerly married	1.00 (0.36–2.74)	0.64 (0.26–1.56)	2.08 (0.58–7.41)	1.16 (0.29–4.66)
Education				
No education				
Primary	0.75 (0.59–0.95)*	1.00 (0.80–1.26)	6.14 (0.68–54.70)	1.30 (0.39–4.29)
Secondary	0.77 (0.55–1.09)	1.19 (0.88–1.62)	6.26 (0.70–55.66)	1.19 (0.36–3.92)
Higher	1.24 (0.49–3.14)	1.81 (0.80–4.09)	7.39 (0.75–72.06)	1.20 (0.31–4.66)
Occupation				
Not working				
Working	0.98 (0.82–1.18)	0.83 (0.71–0.98)	1.32 (0.97–1.79)	0.82 (0.61–1.10)
Wealth status				
Poor				
Middle	0.91 (0.73–1.14)	1.10 (0.90–1.34)	0.77 (0.48–1.23)	1.69 (1.14–2.52)*
Rich	1.03 (0.82–1.29)	1.20 (0.98–1.47)	1.00 (0.55–1.80)	1.70 (1.00–2.87)

RRR = relative risk ratio.
* $P < .05$.
** $P < .01$.
*** $P < .001$.

limit births. It could also be that women, with increasing age, understand better ways of achieving birth spacing.

Survival of the preceding child was associated with the decreased rate of short birth spacing in all countries studied but was not associated with long birth spacing. Our finding on the relationship between survival of preceding child and short birth spacing is consistent with previous studies.[16,18–21] The reason why women whose preceding child died have short birth spacing is apparent; however, what is less understood is whether their risk for adverse pregnancy outcomes is the same as those whose baby survived. While most births that are closely spaced reflect unplanned pregnancies, this is not the case among women whose preceding child had died.[33,40] Rather women whose prior child died may have more reason to become pregnant quickly and not wait for 2 years before having another child. It is unclear whether the elevated risks among women who spaced birth closely are due to women's bodies not having time to recover if they conceive soon after delivery or to factors associated with unplanned pregnancies such as delayed access to antenatal care.[40]

Our findings on the relationship between maternal education and long and short birth intervals are mixed. While women with higher education were more likely to have short birth spacing in Nigeria, this was not the case in other SSA countries included in this study. The Nigeria result is consistent with a study in India which found that higher maternal education was positively linked with short birth intervals.[21] Also, a study conducted in the United States shows that affluent women appear to deliberately spaced births closely.[41] Education is one of the reasons women delay childbearing. The Nigeria result is, however, not the norm in SSA given the results of other countries. Unlike the relationship between maternal education and short birth spacing, the findings on the link between education and long birth spacing are more consistent and show that education is positively associated with long birth spacing across countries in SSA. Women who are educated are more likely to favor long birth interval compare to those who are uneducated. This is not surprising given that educated women are more knowledgeable about contraceptives compared to uneducated women, which will help them to avoid unplanned pregnancy.

In contrast to previous studies in India and Nigeria,[42,43] our study did not find a significant association between sex of the preceding child and short birth spacing. One plausible explanation for this is that other factors, such as access to contraceptive, education, and survival of the preceding child, are more important determinants of short birth spacing than the sex of the preceding child. In patriarchal societies, the desire for a male child may make women with only female children to have a short birth interval. However, the overall effect of this compared to

Table 9

Adjusted relative risks of association between contraceptive use, selected characteristics, and birth spacing among women in West Africa.

	Nigeria		Togo	
	Short Birth Spacing vs Optimal Birth Spacing	Long Birth Spacing vs Optimal Birth Spacing	Short Birth Spacing vs Optimal Birth Spacing	Long Birth Spacing vs Optimal Birth Spacing
Age				
15–24				
25–34	0.98 (0.88–1.09)	1.47 (1.26–1.72)***	0.79 (0.58–1.06)	1.26 (0.90–1.77)
35+	0.82 (0.72–0.94)***	1.85 (1.56–2.20)***	0.67 (0.46–0.96)**	2.12 (1.46–3.07)***
Preceding child sex				
Male				
Female	1.00 (0.92–1.09)	1.05 (0.94–1.17)	0.95 (0.75–1.19)	1.00 (0.80–1.25)
Preceding child survival				
Not alive				
Alive	0.36 (0.32–0.40)***	1.01 (0.85–1.21)	0.25 (0.18–0.34)***	1.03 (0.69–1.55)
Place of residence				
Urban				
Rural	0.96 (0.86–1.07)	0.98 (0.85–1.13)	0.67 (0.39–1.16)	0.88 (0.51–1.52)
Marital status				
Never married				
Currently married	1.09 (0.61–1.94)	0.75 (0.35–1.60)	0.71 (0.12–4.03)	0.27 (0.07–1.06)
Formerly married	1.43 (0.75–2.72)	0.70 (0.29–1.65)	0.89 (0.14–5.62)	0.19 (0.04–0.89)
Education				
No education				
Primary	0.97 (0.86–1.10)	1.06 (0.91–1.23)	0.95 (0.72–1.25)	1.08 (0.83–1.39)
Secondary	1.22 (1.08–1.39)***	1.00 (0.84–1.19)	1.06 (0.74–1.52)	0.78 (0.53–1.13)
Higher	1.44 (1.16–1.79)***	0.80 (0.58–1.11)	1.57 (0.34–7.26)	1.20 (0.25–5.56)
Occupation				
Not working				
Working	0.81 (0.74–0.89)***	0.93 (0.82–1.05)	0.94 (0.70–1.27)	0.66 (0.50–0.86)***
Wealth status				
Poor				
Middle	1.06 (0.94–1.20)	1.05 (0.90–1.23)	1.00 (0.73–1.38)	0.83 (0.61–1.15)
Rich	1.15 (1.00–1.33)	0.88 (0.73–1.05)	1.15 (0.64–2.05)	1.24 (0.70–2.18)

RRR = relative risk ratio.
* $P < .05$.
** $P < .01$.
*** $P < .001$.

other factors seem negligible compared to proximate determinants of birth spacing.

Our study also showed that women in the rich quintile in Chad and Tanzania had significantly higher odds of having long birth intervals compared to women in the poor quintile. Intervention to prevent prolonged birth intervals should be targeted at these women. Similarly, the link between place of residence and birth spacing could be attributable to variations in access to contraceptives by place of residence.

The finding of this study has public health implications. Countries such as Nigeria, Togo, Chad, and Congo DRC have a high prevalence of adverse birth outcomes and infant mortality. As such, interventions aimed at addressing these adverse outcomes must include educating women on the risk of short birth intervals. Likewise, women in Southern Africa countries need to be informed of the risk of very long birth intervals as a matter of public health intervention.

The pattern of birth spacing found in this study appears to mirror the contraceptive use in the selected SSA countries.[44] For example, of all the selected countries, Zimbabwe has the highest contraceptive use prevalence (66.8%)[44] and also the longest birth spacing interval. The diffusion of contraceptives in Zimbabwe could be linked to the prolonged birth spacing observed in their context. An earlier study on birth intervals showed that Zimbabwean women are savvy about birth spacing and believe that too many children born close together will "burn" each other.[45] Similarly, Malawi has the second-highest rate of contraceptive use (59.2%)[44] of all the countries included, and likewise, the second-highest birth spacing length. This pattern is not a mere coincidence considering that contraception is crucial for achieving the desired birth spacing length. Access to contraceptives is an important contextual factor found to influence birth spacing.[46–48] A study on birth spacing in Zimbabwe shows that access to modern contraceptives was the main determinant of the birth spacing interval.[49] Since the adoption of modern contraceptives in Zimbabwe, birth spacing length has substantially increased. Another plausible reason for long birth spacing in Zimbabwe may perhaps be "birth postponement", although this needs to be further investigated. There is at least evidence of this in a similar context where very long birth intervals were reported to be due to increasing "birth postponement".[50] Contrastingly, Chad and the Congo DRC are among the lowest users of modern contraception[44] thus, it is not surprising that birth spacing length was lowest in these countries.

Interestingly, the pattern of birth spacing length found in this study also mirrors the rate of fertility decline in the selected countries.[51,52] Studies have shown that birth spacing is one of the main determinants of fertility. Sayi found that the increase in birth intervals from 28 months in the 1960s to 51 months in the year 2000 coincided with the period of fertility decline.[49] In other words, the changes in fertility and birth spacing are akin both in terms of timing and tempo. Chad and the Congo DRC have the highest fertility rates as well as the shortest birth spacing length of all the selected countries. Evidently, high fertility rate, low fertility decline, and low use of contraceptives suggest a shorter birth spacing interval, while high fertility decline, low fertility rate and high contraceptive prevalence connote long birth spacing intervals.

Our use of DHS data, which are mainly conducted, once in every 5 years), through verbal interviews with women and household heads, means that women have to recall past events. In our study, women had to recall the date of birth of their index baby as well as the preceding birth. While it is feasible to accurately recall the birth dates of the index and the preceding births, the methodology is subjected to recall and reporting biases. Also, due to the cross-sectional nature of the data, cause and effect relationships between independent variables and birth spacing length could not assume. Another limitation of this study is that we focused on only births in the past 5 years and not all births a woman experienced. As such, we could only examine the interval between the preceding birth and the index births. By analyzing only closed intervals, this sample is a selective sample of experiences of women and should be interpreted as such.

This study examined patterns of birth spacing and the determinants of long and short birth spacing in SSA. The findings showed that the length of birth intervals vary from country to country and regionally. While short birth intervals are common in West and Central Africa, long birth intervals are common in Southern and Eastern Africa. Factors that determine short and long birth spacing differ and also vary from country to country. Maternal age was the only factor influencing both long and short birth spacing in all countries. Intervention addressing short birth spacing should target younger women in SSA, while intervention for long birth spacing should prioritize older, educated and wealthy women.

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Author contributions

Anthony Idowu Ajayi and Oluwaseyi Dolapo Seyi both contributed to the conceptualization of the study and drafting of the manuscript. All authors read the final version of the manuscript.

Conceptualization: Anthony Idowu Ajayi, Oluwaseyi Dolapo Somefun.
Data curation: Oluwaseyi Dolapo Somefun.
Formal analysis: Oluwaseyi Dolapo Somefun.
Methodology: Oluwaseyi Dolapo Somefun.
Project administration: Anthony Idowu Ajayi.
Writing – original draft: Anthony Idowu Ajayi.
Writing – review & editing: Anthony Idowu Ajayi, Oluwaseyi Dolapo Somefun.

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