Demystifying the Effects of Age at Marriage and Age at First Birth on Completed Family Size in Zambia

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Abstract The link between age at marriage and first birth in explaining completed family size is not always direct, due to heterogeneity in circumstances, that compel individual women to marry or initiate childbearing at a particular age. We analyzed data for 1020 women aged 45-49 in 2014 of the 1965-1969 birth cohort from the 2013-14 ZDHS.   We fitted a bivariate and multivariate multinomial logistic regression to establish the effect of mother's age at first marriage and at first birth on completed family size (CFS). Chi-square test of proportions measuring differences in proportions and relative risk ratios (RRR) with confident intervals at 95% are reported. Our results show that the average CFS was 6.7 (95% CI: 6.5 – 6.9) among women completing their reproductive span in 2014 with mean age at first marriage and birth being 18.3 years (95% CI: 18.0 – 18.5) and 18.9 years (95% CI: 18.7   – 19.1) respectively. Women marrying at younger ages and having their first birth at younger ages were more likely (RRR: 0.262; 95% CI:0.126-0.547 and RRR: 0.176; 95% CI:0.068-0.497 respectively) to have higher CFS than their compatriots that initiated both marriage and childbearing at or after age 22. Having no education, being a rural resident and having a medium household wealth all increased the risk of having higher CFS. Women that marry before age 19 have a higher likelihood of having 6 or more children by the end of their reproductive period. The study concludes that apart from a woman's age at first marriage and first birth, a complex network of factors interact to determined CFS.

Key words Age at first marriage; age at first birth; completed family size; fertility

1. Introduction

Marriage assumes diverse denotations in different settings. Needless to say, every society has some form of a system which regulates the formation of a family and, one salient attribute of the act of family formation – called marriage(Bourgeois-pichat 2012), is that, it founds the basic unit of the social structure. Marriage is an institution where sexual intercourse is sanctioned and childbearing permitted (Bourgeois-pichat 2012; Central Statistical Office (CSO) et al. 2009; Central Statistical Office, Zambia, and Macro International Inc. 1997). Because of these two critical features, timing of entry into marriage, especially the age at which women first enter into a marital union becomes pivotal in measuring trends in fertility and patterns of CFS (Bourgeois-pichat 2012; Marini 1981) and may hold greater sway in efforts to control fertility.   Regardless of the average age at first sexual intercourse or magnitude of sexual activity in a society, unmarried women in any age group are unlikely to produce as many live births as married women in corresponding age groups because of social, cultural and economic penalties against out-of-wedlock childbearing (Population Reports 1979).

In Zambia, marriage begins early – 46% of women age 20-49 marry by age 18, and 66 percent by age 20 – and it is, by and large, universal as 78% women and 90% men aged 35 -39 are married(Central Statistical Office, Ministry of Health, Tropical diseases Research Centre 2009; Central Statistical Office et al. 2015).   As early as women enter into a marital union so does the onset of childbearing. The 2013-14 ZDHS report indicates that 31% of women in age cohort 20-24 in Zambia have had a first birth by exact age 18, 50% by age 19 and, 61.3% by age 20(Central Statistical Office, Ministry of Health, University of Zambia Teaching Hospital, Tropical diseases Research Centre, University of Zambia 2015). Tendencies where childbearing is concentrated at younger ages exert substantial effect on fertility levels because of early marriage rates. Studies suggest that women who marry young are predisposed to three core demographic aspects which influence high fertility and larger CFSs: high frequency of sexual intercourse throughout their most fecund years; the early onset of childbearing and an extended period of exposure to the risk of conception and; a shortened interval before the next generation is born and begins childbearing(Population Reports 1979). The confluence of these factors plunges a population where women marry young into a cycle of high fertility.

As is the case for Zambia, aggregate fertility levels remain one of the highest in sub- Saharan Africa and globally (Central Statistical Office et al. 2015). Although fertility rates continue to exhibit falling trends, the pace is not robust enough. The Total Fertility Rate (TFR) progressively declined from 6.5 births per woman in 1992, 6.1 in 1996, 5.9 in 2010 and currently to 5.3 in 2014 (Central Statistical Office (CSO);, Central Board of Health [Zambia];, and ORC Macro 2003; Central Statistical Office (CSO) et al. 2009; Central Statistical Office et al. 2015; Central Statistical Office, Zambia, and Macro International Inc. 1997; University of Zambia (UNZA), Central Statistical Office (CSO), and Macro International Inc. 1993). There doesn't seem much hope for the short term since current rates of average completed family size still linger quite large, with women nearing the end of their reproductive years attaining a mean parity of 7 children (Central Statistical Office et al. 2015).   This study is well aware that the link between age at marriage and first birth in explaining completed family size is not always direct, due to heterogeneity in circumstances, that compel individual women to marry or initiate childbearing at a particular age. The study was motivated by the fact that a precise understanding of relationships in marriage trends and dynamics thereof are important in identifying causes confounded by intricate country-specific socioeconomic factors. Therefore, the aim of the study was to investigate the independent and controlled effects of age at first entry into marriage and age at first birth on CFS for women aged 45-49.

2. Literature Review

Scholarly investigations of the relationship between timing of marriage and of first birth with completed family size are in abundance. Completed family size remains high in most African countries south of the Sahara due to a delayed onset of fertility transition (Ariho and Kabagenyi 2020; Bongaarts 2017). World-wide comparison show that Africa is yet to undergo or has just begun the fertility transition and though a noticeable decline in fertility in fertility has been achieved, African fertility is still the highest when related other regional blocks (Gerland, Biddlecom, and Kantorová 2017).

The pathways that describe sexual debut and its effect on fertility is somewhat different for young men and women. Studies have shown that education plays a crucial role in adolescents initiation to sexual activity. Most studies have shown that sexual activity, pregnancy and marriage are direct impediment to education attainment especially at secondary school level(Poulin 2007) and that dropping out of school is the main pathway to a myriad of reproductive events of sexual activity, pregnancy, or marriage (Caroline and Alex 2009; Clark, Kabiru, and Mathur 2010), that inevitably threatens completion secondary school prospects. Research indicates that more girls than boys that are sexually active drop out of (Lloyd 2010), and that sexual activity in more detriment to girls' than boys' education (Biddlecom A et al. 2007). This effect of early sexual activity and its eventual effect

on school dropped out contributes to elevated premarital fertility among young people especially in countries that have improved ages at marriage. Another study found that girls that were already falling behind in studies at school had a higher probability of engaging in sexual activity than their counterparts who were doing well (Clark and Mathur 2012; Grant and Hallman 2008).

TFR in Zambia reduced from 6.1 in 1992, 5.9 in 2010, 5.3 in 2014 to 4.7 in 2018 (Central Statistical Office (CSO) [Zambia], Ministry of Health (MOH) [Zambia] 2014; Central Statistical Office Zambia (CSO) 2010; University of Zambia (UNZA), Central Statistical Office (CSO), and Macro International Inc. 1993; Zambia Statistical Agency (ZSA) et al. 2019). This latest TRF is higher than the current average for most of the African region (Bongaarts, Mensch, and Blanc 2017; Gilles Pison 2017). Though fertility has been declining in Africa, it remains high in comparison to other regions (Gilles Pison 2017). TFRs in the African region averaged 4.7 between 2010 and 2015 which is far above the global average of 2.5 though it is expected to drop by 2050, but will still be well above the rest of the world (United Nations Children's Fund (UNICEF) 2014). This high TFR fuels the next generation of mothers who will have fewer children than their preceding cohorts, but still more than the rest of the world. At this rate of fertility change, Africa will constitute 41% of the world's population and 40% of global under-five children by 2050 (Gilles Pison 2017; United Nations Children's Fund (UNICEF) 2014). Desire for family size is also driven by many factors such as education and wealth. A study conducted on East African countries found enormous heterogeneity in CFS (Muhoza, Broekhuis, and Hooimeijer 2014). It concluded that "Wealthy and highly educated people have fertility desires close to replacement level, regardless of religion, while poor, uneducated people, particularly those in Muslim communities, have virtually uncontrolled fertility" (Muhoza, Broekhuis, and Hooimeijer 2014). This somewhat confirms the assertion that higher fertility which is linked with early childbearing leads to reduced investments in the education and health of each child (Quisumbing and Maluccio 2003), which contributes to the intergenerational flow of poverty (Glick, Handy, and Sahn 2015).

The first time a woman enters marriage has huge implications on her health and that of her forthcoming offspring. Early systematic scholarly works by Lesthaeghe and colleagues (Lesthaeghe et al. 1989; Walle 1993) brought to light changes in age at marriage signifying an upward trend in most African countries . Many other scholars have undertaken extensive retrospective investigations that have added to the existing evidence of the increasing of age at first marriage for African females (Garenne 2004; Lloyd et al. 2005; Mensch, Grant, and Blanc 2006; Mensch, Singh, and Casterline 2006; Ortega 2014; Shapiro and Gebreselassie 2014; Westoff 1992). More recent findings by Hertrich confirm substantial change in first marriage patterns across the continent (Hertrich 2017). Work by Hertrich confirms an inverse relationship between age at first marriage and fertility; the higher the age at marriage the lower the fertility and vice versa (Hertrich 2017).

The time an individual starts parenthood is one of life's most challenging yet significant occurrences. A study based on DHS data of 43 countries found that the mean age at first birth was greater than the mean age at first marriage, which was also greater than the mean age at first sex for all regions (Bongaarts, Mensch, and Blanc 2017). Another study found that the effect of being married for 0–3 years was positive and statistically significant, and for being married 3–6years   negative and statistically significant in as far as having a first birth is concerned   in Madagascar implying that the probability of having a first birth is higher during the first years of marriage, but diminishes after the third year (Glick, Handy, and Sahn 2015). Several studies in the region posit that the mean age at first

birth in sub Saharan Africa is about 21 with most of West and Middle African countries having age at first birth at or below 18 years while East and Southern African countries above 22 years (Bongaarts 2017; Bongaarts, Mensch, and Blanc 2017; Mensch, Grant, and Blanc 2006). The increasingly rising age at first birth in most African countries could be as a result of improved education outcomes for women which would translate in better health and reduced risks of maternal related morbidity and mortality and manageable fertility. Generally, reproductive indicators for women (age at sexual debut, first marriage and first birth) play a crucial role in determining the fertility levels and trends for any country.

3. Methods and Data

This study utilized data from the 2013-14 Zambia Demographic and Health Survey (ZDHS). ZDHS is a population-based cross-sectional study dedicated to investigating health status of the Zambia people. Survey data collected during the 2013-14 round of ZDHS covered behavioral, social and demographic indicators that included the fertility history of women, when they got married, and their age when they had their first birth. These variables were of great significance in measuring and understanding completed family size. The ZDHS obtained information on lifetime fertility of women that had completed childbearing and also analyzed the average number of children born to women in Zambia by the end of their reproductive cycle. The 2013-14 ZDHS investigation covered 722 clusters from which 18,052 households were identified. From the identified households, 16, 258 households were found occupied at the time of the investigation. The survey reported 98% (15, 920/16, 258) household response rate from which 17,064 women aged 15-49 and 16, 209 men aged 15-59 were identified and 96% (16,381/17,064) of these women as well as 91% (14,750/16,209) of the men successfully completed an interview. Urban areas exhibited a marginally lower individual response rate than rural areas. A detailed discussion on the methodology of the ZDHS is available elsewhere(Central Statistical Office (CSO) [Zambia], Ministry of Health (MOH) [Zambia] 2014). Data for this study were procured from the measure DHS project(The DHS Program - Available Datasets n.d.). Our analysis concentrates on women belonging to the 1965-1969 birth cohort aged 45-49 during data collection for the 2013-14 ZDHS round.

Eligibility was age-based thus neither marital status nor parity was a determinant for inclusion in the study. A total of 1020 women aged 45-49 in 2013 were enumerated. We conducted a retrospective analysis of how age at first marriage and age at first birth affect the CFS of women during their childbearing period.

3.1. Measures

3.1.1. Outcome

The number of children born alive to mothers of the 1965-1969 birth cohort provided an important entry point to understanding the reproductive behavior of this group of women. Thus, our outcome variable was CFS as measured by the number of live births to women age 45-49 in 2013-14. We categorized CFS to link childbirth to a specific age of the mother. We ended up with four categories for CFS; 0, 1-3, 4-5 and 6+ to cater for variations in women's reproductive behavior.

3.1.2. Predictors

The study utilized two main predictors; 1) age at first birth to investigate the extent to which age of the mother at birth of first child impacts on CFS and, 2) age at first marriage, to assess the influence marriage exerts on completed fertility. Due to concerns of legal marriage age, we considered segmenting the age of mother at first marriage predictor variable in two parts, i.e. those marrying before 18 and those marrying after age 18. Two other categories were constructed for those who marry before and after age 18; ages <15 and 15-18 as well as ages 19-21 and 22 and above. Similarly, in terms of age at first birth, we considered those having their first child before 18 and those after 18.

This we, thought, should provide us with some understanding of differences in completed family size for women marrying early (before age 18) and those marrying at and after the legal age.

3.1.3. Covariates

Fertility among women varies greatly by socioeconomic characteristics. Traditionally, women with more education are more likely to have fewer children than those with no education. This proposition holds true for household wealth holding other factors constant. We included a list of covariates to control for the influence of socioeconomic factor in measuring this relationship. The variables identified as having an effect on CFS and thus considered for modeling were contraception use, education, place of residence and household wealth.

3.1.4. Statistical analysis

During data exploration, we noticed that the relationship between our outcome variable (CFS) and our predictor variables (age at first marriage and age at first birth) was nonlinear. Because of the non-linearity of CFS and the polytomous nature of its categories, we fitted a multinomial logistic regression (MLR) to measure the level and amount of association between our outcome and predictor variables. The MLR is similar to the binary logistic regression except that it is more versatile as it can handle an outcome variable with more than two categories. Added to this, MLR enables the building of a complex statistical model handling complex interrelated relationships of the response variable with more than two levels. To determine associations of the outcome variable with the predictor variables, descriptive analyses were performed mainly as proportions utilizing chi-square tests of proportions and results have been presented in terms of percentages with confidence intervals. We calculated the mean CFS for women in this study, their mean ages at birth and marriage as well as their confidence intervals. We also graphed our data using a fractional polynomial to illustrated predictor-outcome relationship. In building our MLR model, we first examined the relationship between each predictor variable (one at a time) and CFS through bivariate analysis (model 1). In model 2, we fitted a multivariate MLR model that included all predictor variables in model 1 i.e. mother's age at first marriage and mother's age at first birth and additionally controlled for potential confounders: education, place of residence, household wealth and contraceptive use. In model 3, we included all the variables that showed the strongest associations with the outcome but deliberately dropped mother's age at first marriage to check for the effect of correlation between the two predictor variables. In model 4, we brought back mother's age at first marriage and this time removed mother's age at first birth from analysis for the same reason as in model 3. We reported relative risk ratios (RRR) for all our models with their corresponding confident intervals at 95%. All analyses were performed in Stata 14 (StataCorp LLC 2016).

4. Results

4.1. Descriptive findings

The 2014 ZDHS identified 1,020 women belonging to the 1965-1969 cohort aged between 45-49 during the survey. Our findings indicate that the average CFS was 6.7 (95% CI: 6.5 – 6.9). The average age at sex debut for this cohort of women was 17 years (CI: 16.7 – 17.2) while the mean age at first marriage and first birth were 18.3 and 18.9 respectively. Table 1, presents descriptive findings based of the characteristics of the respondents.

Table 1. Background characteristics of respondents.

Variable	*n*	*Mean*	Standard Error	95% Confidence Intervals
Completed Family Size (CFS)	1, 020	6.7	0.093	6.5, 6.9
Age of respondent at first birth	995	18.9	0.120	18.7, 19.1
Age at first Marriage	1012	18.3	0.142	18.0, 18.5

Age at first sex (Sexual debut)	543	17.0	0.127	16.7, 17.2
Age of women aged 45-49 in single years	1, 020	47.0	0.047	46.9, 47.1

In terms of contraceptive use, over half (53.2%; CI: 50.5 – 56.8) reported ever using a method of contraception to prevent pregnancy. Almost two-thirds (58.7%; CI: 55.6 – 61.8) of respondents were rural dwellers. Fifty-three percent (CI: 49.5 – 55.7) had no education followed by 39.7% (CI: 36.7 – 42.8) with primary education. The remaining 3.0% (CI: 2.0 – 4.2) and 4.7% (CI: 3.5 – 6.2) had secondary and tertiary education respectively as presented in table 2.

Table 2. Chi-square test of difference in proportions of completed family size.

Completed Family Size							
	0	**1-3**	**4-5**	**6+**	**Total**	**95% CIs**	**P-Value**
Mother's age at first marriage							0.000
<15	1 (0.1)	13 (1.28)	14 (1.38)	109 (10.77)	137 (13.54)	11.5, 15.8	
15-18	7 (0.69)	31 (3.06)	68 (6.72)	**412 (40.71)**	518 (51.2)	48.1, 54.3	
19-21	6 (0.6)	30 (3.0)	44 (4.4)	114 (11.3)	194 (19.2)	16.8, 21.7	
22+	7 (0.7)	**63 (6.2)**	37 (3.7)	56 (5.5)	163 (16.1)	13.9, 18.5	
Total	21 (2.1)	137 (13.5)	163 (16.1)	691 (68.3)	1012 (100)		
Mother's age at first birth							0.000
<15		7 (0.7)	5 (0.5)	47 (4.7)	59 (5.9)	4.5, 7.6	
15-18		34 (3.4)	51 (5.1)	396 (39.8)	481 (48.3)	45.2, 51.5	
19-21		42 (4.2)	63 (6.3)	181 (18.2)	286 (28.7)	25.9, 31.6	
22+		57 (5.7)	45 (4.5)	67 (6.7)	169 (17.0)	14.7, 19.5	
Total		140 (14.1)	164 (16.5)	691 (69.5)	995 (100)		
Place of residence							0.000
Urban	12 (1.2)	85 (8.3)	76 (7.5)	248 (24.3)	421 (41.3)	38.2, 44.4	
Rural	13 (1.3)	55 (5.4)	88 (8.6)	443 (43.4)	599 (58.7)	55.6, 61.8	
Total	25 (2.5)	140 (13.7)	164 (16.1)	691 (67.8)	1020 (100)		
Ever used contraception							0.000
Yes	2 (0.2)	53 (5.2)	70 (6.9)	418 (41.0)	543 (53.2)	50.5, 56.8	
No	23 (2.3)	87 (8.5)	94 (9.2)	273 (26.8)	477 (46.8)	44.0, 50.3	
Total	25 (2.5)	140 (13.7)	164 (16.1)	691 (67.8)	1020 (100)		
Education							0.000
No education	12 (1.2)	48 (4.7)	63 (6.2)	414 (40.6)	537 (52.6)	49.5, 55.7	
Primary	9 (0.9)	55 (5.4)	75 (7.4)	266 (26.1)	405 (39.7)	36.7, 42.8	

Secondary	1 (0.1)	13 (1.3)	11 (1.1)	5 (0.5)	30 (3.0)	2.0, 4.2
Tertiary	3 (0.3)	24 (2.4)	15 (1.5)	6 (0.6)	48 (4.7)	3.5, 6.2
Total	25 (2.5)	140 (13.7)	164 16.1)	691 (67.8)	1020 (100)	
Household wealth						0.000
Lowest	4 (0.39)	16 (1.57)	31 (3.04)	135 (13.24)	186 (18.24)	15.9, 20.7
Second	1 (0.1)	19 (1.86)	28 (2.75)	158 (15.49)	206 (20.2)	17.8, 22.8
Middle	6 (0.59)	19 (1.86)	31 (3.04)	173 (16.96)	229 (22.45)	19.9, 25.1
Fourth	5 (0.49)	25 (2.45)	34 (3.33)	138 (13.53)	202 (19.8)	17.4, 22.4
Highest	9 (0.88)	61 (5.98)	40 (3.92)	87 (8.53)	197 (19.31)	16.9, 21.9
Total	25 (2.45)	140 (13.73	164 (16.08)	691 (67.75)	1020 (100)	

A chi-square test of differences in proportions in table 2 above shows association of mother's characteristics and CFS. All the Pearson's chi-square tests resulted in statistically significant associations between each characteristic of the mother and CFS.

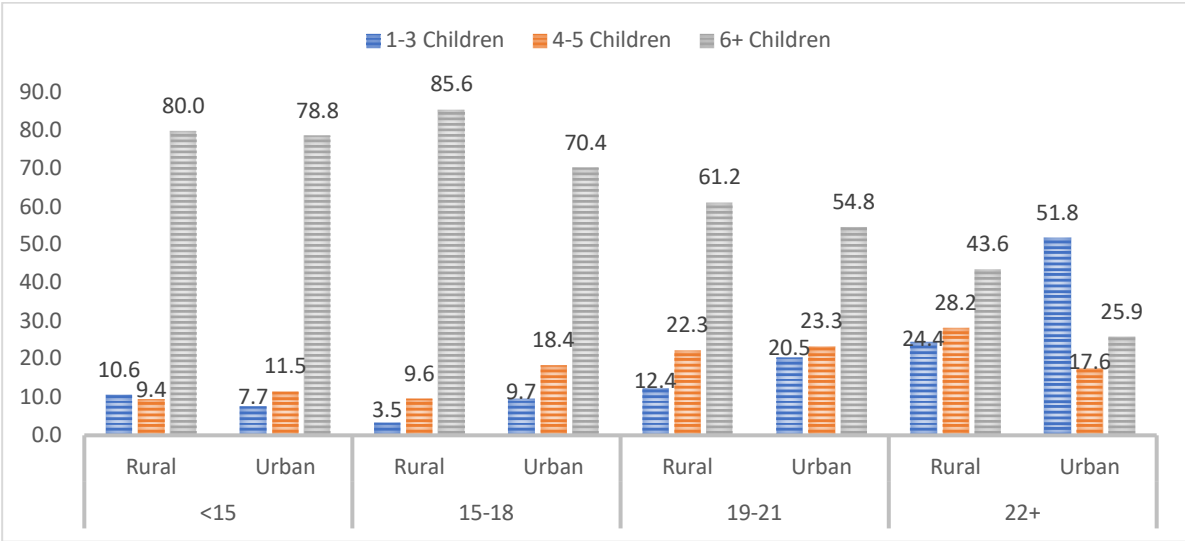
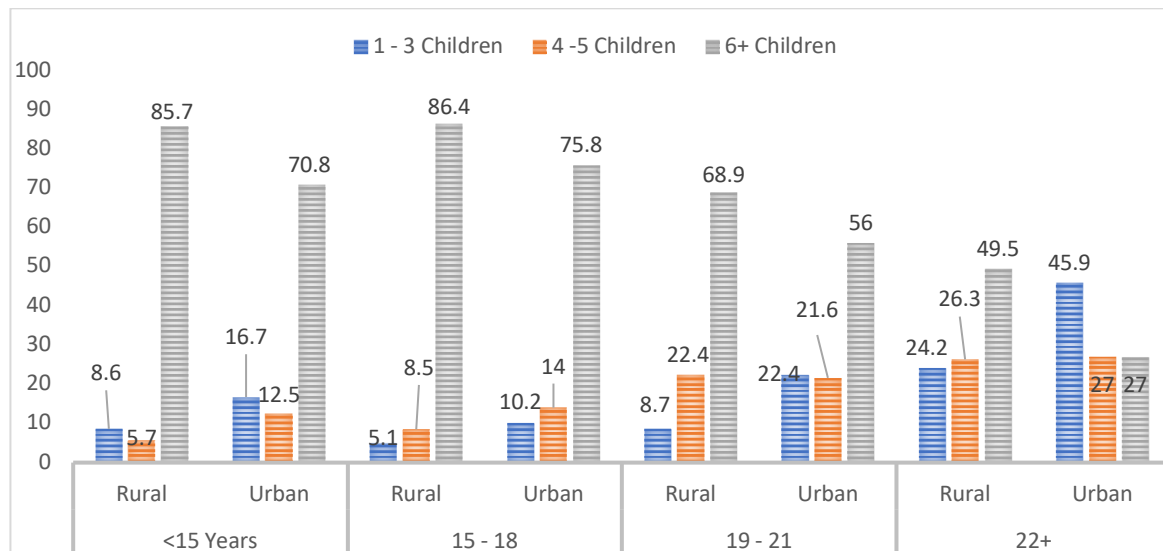
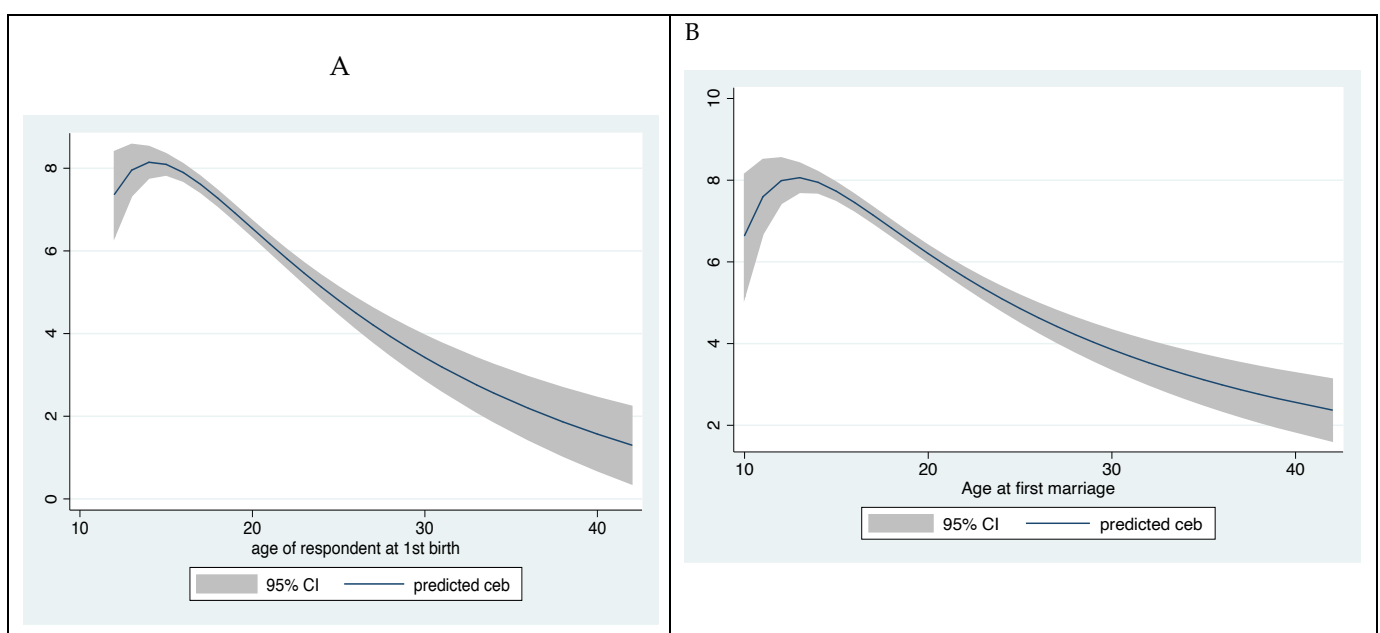
Figure 1. Completed Family Size by Age at First Marriage and Residence.

A comparison of the effect age at first marriage and place of residence revealed that regardless of dwelling place, more women that got married before age 15 and those that married between ages 15and 18 ended up with 6 and more children than those marrying after age 18. A small proportion (25.9%) of women who bore 6 or more children were those from urban areas that got married after age 21. Figure 1 further demonstrates that more than half (51.8%) of urban women marring at ages above 21 had 1-3 children compared to their rural compatriots at only 24.4%. For all ages at marriage except before age 15, the proportion of women who had 1-3 children is lower for rural compared to urban areas. Figure 1 provides details of the relationship between age at first marriage and CFS for urban and rural women aged 45-49.

Figure 2. Completed Family Size by Mother's Age at First Birth and Residence.

Analysis by place of residence illustrates that, both urban and rural women exhibit a distinct pattern of CFS. The proportions of rural women with 6 or more children were relatively higher for all ages at first birth when compared with their urban counterparts. For instance, the proportions of women having 6 or more children increased with age at first birth from 85.7% for those who had their first birth before age 15 to 86.4% for those who had their first birth at ages between 15 and 18 inclusive. As age at first birth increases, higher order births gradually diminish while proportions rise for lower order births. Figure 2, depicts this scenario.

The association between age at first marriage and age at first birth on the hand with CFS on the other was graphically modeled in a fractional polynomial to show the predicted curve of the relationship. Figure 3 shows that for both age at first marriage and age at first birth, CFS declined age at first occurrence of the event increased. Both ages at first marriage as well as first birth were relatively low at around ages 10-12 with about 6-7 children then increased to a peak at around 15-18 with about 8 children. As age rose to above 19, CFS exhibited a corresponding declining effect from around 7 down to 2 children. See figure 3 (A and B).

Figure 3. Relationship between age at first birth as well as age at first marriage with children ever born.

4.2. Bivariate analysis

We can infer from model 1 that women who married before age 15 and 15-18 were less likely to have no children by the end of their reproductive cycle. However, the risk of having no children than 6 or more children was 17.6 times greater for women that had never used contraceptive relative to those that had ever used contraceptives holding all other factors constant. Education (no education [RRR: 0.073; 95% CI: 0.009-0.611] and primary [RRR: 0.136; 95% CI: 0.064-0.402]) and household wealth (lowest, second, and middle) were all statistically significant signifying a relationship when CFS was 0. The risk of having 1-3 children compared to 6 or more children was 89.4%, 93.3% and 76.6% lower for women whose ages at first marriage were <15, 15-18 and 19-21 respectively relative to 22+.

The other characteristics that had statistically significant associations were ever used contraceptives, education (no education and primary), place of residence and household wealth. See table 1 for details.

Table 2. Model 1: Bivariate multinomial regression of children ever born by characteristics of mother.

Children ever born	RRR	95% Confidence Intervals	
0 Children			
Age at first marriage			
<15	0.073*	0.009	0.611
15-18	0.136***	0.046	0.402
19-21	0.421	0.135	1.312
22+ (Reference)			
Ever used Contraception			
No	17.608***	4.118	75.286
Yes (Reference)			
Education attainment			
No education	0.058***	0.013	0.260
Primary	0.068**	0.015	0.315
Secondary	0.400	0.031	5.151
Tertiary (Reference)			
Place of residence			
Rural	0.606	0.273	1.350
Urban (Reference)			
Household Wealth			
Lowest	0.286*	0.086	0.959
Second	0.061**	0.008	0.491
Middle	0.335*	0.116	0.972
Fourth	0.350	0.114	1.080
Highest (Reference)			
1-3 Children			
Age at first birth			
<15	0.175***	0.073	0.417
15-18	0.101***	0.061	0.166
19-21	0.273***	0.168	0.444
22+ (Reference)			
Age at first marriage			
<15	0.106***	0.054	0.209
15-18	0.067***	0.040	0.112
19-21	0.234***	0.136	0.401
22+ (Reference)			
Ever used Contraception			
No	2.513***	1.729	3.653

Yes (Reference)			
Education attainment			
No education	0.029***	0.011	0.074
Primary	0.052***	0.020	0.132
Secondary	0.650	0.166	2.546
Tertiary (Reference)			
Place of residence			
Rural	0.362***	0.249	0.526
Urban (Reference)			
Household Wealth			
Lowest	0.169***	0.092	0.312
Second	0.172***	0.096	0.306
Middle	0.157***	0.088	0.279
Fourth	0.258***	0.151	0.442
Highest (Reference)			
4-5 Children			
Age at first birth			
<15	0.158***	0.058	0.429
15-18	0.192***	0.119	0.309
19-21	0.518**	0.323	0.833
22+ (Reference)			
Age at first marriage			
<15	0.194***	0.097	0.389
15-18	0.250***	0.153	0.407
19-21	0.584	0.340	1.004
22+ (Reference)			
Ever used Contraception			
No	2.056***	1.456	2.903
Yes (Reference)			
Education attainment			
No education	0.061***	0.023	0.163
Primary	0.113***	0.042	0.301
Secondary	0.880	0.213	3.637
Tertiary (Reference)			
Place of residence			
Rural	0.648*	0.460	0.914
Urban (Reference)			
Household Wealth			
Lowest	0.499*	0.291	0.858
Second	0.385**	0.223	0.668
Middle	0.390**	0.228	0.666
Fourth	0.536*	0.315	0.911
Highest (Reference)			
6+	Base outcome		

***P<0·001; **P is < 0·01 and ≥0·001; *P≤0·05 and ≥0·01.

4.3. Multivariate analysis

Table 4 presents multivariate MLR determining the relationship between CFS and the characteristics of the mother. When both the mother's age at first marriage and at first birth were simultaneously included in the regression model (Model 2), the results related to 0 births were redundant because first birth is normally preceded by marriage. While in Model 3 mother's age at first marriage is omitted from the model hence the missing coefficients, model 2 included all the

predictor variables and covariates. Statistical significance was established for mother's age at first birth (15-18), mother's age at first marriage, ever used contraception, education (no education and primary, and household wealth when CFS was 1-3 children. The risk of having 1-3 children compared to 6 or more children was lower for all ages at first marriage relative to women aged above 22 years at first marriage. For mother's age at first birth, the risk of 1-3 children was only statistically significant for women aged 15-18 (RRR: 0.382; 95% CI: 0.194-1.254). For 4-5 children, mother's age at marriage, place of residence and household wealth were statistically non-significant. Model 3 omitted mother's age at first marriage and household wealth from the model which strengthened the model as all coefficients were statistically significant for almost all categories. Model 4 includes the mother's age at first marriage and omitted household wealth and residence. The estimates were all statistically significant except for education when CFS is 0. Table 4 details the results of the models.

Table 4. Multivariate multinomial regression of children ever born by characteristics of the mother.

Completed family size	Model 2			Model 3			Model 4		
	RRR	95% Confidence Intervals		RRR	95% Confidence Intervals		RRR	95% Confidence Intervals	
0 Children									
Age at first marriage									
<15							0.058**	0.007	0.498
15-18							0.131***	0.043	0.400
19-21							0.394	0.122	1.272
Ever used Contraception									
No							36.107**	4.729	275.666
Education attainment									
No education							32424.530	0.000	.
Primary							57098.630	0.000	.
Secondary							1.239	0.000	.
1-3 Children									
Age at first birth									
<15	0.387	0.119	1.254	0.224**	0.088	0.570			
15-18	0.382**	0.194	0.752	0.152***	0.088	0.263			
19-21	0.682	0.364	1.278	0.359***	0.208	0.619			
22+ (Reference)									
Age at first marriage									
<15	0.254**	0.102	0.633				0.153***	0.074	0.319
15-18	0.143***	0.074	0.277				0.102***	0.058	0.179
19-21	0.305***	0.160	0.582				0.268***	0.148	0.484
22+ (Reference)									
Ever used Contraception									
No	6.975***	4.141	11.749	5.137***	3.222	8.191	5.253***	3.250	8.492
Yes (Reference)									
Education attainment									
No education	0.120***	0.037	0.392	0.024***	0.009	0.069	0.031***	0.011	0.089
Primary	0.168**	0.057	0.493	0.064***	0.023	0.177	0.067***	0.024	0.186
Secondary	1.088	0.247	4.793	0.880	0.208	3.727	0.756	0.177	3.229
Tertiary (Reference)									
Place of residence									
Rural	0.764	0.410	1.425						
Urban (Reference)									
Household Wealth									
Lowest	0.211**	0.074	0.600						
Second	0.241**	0.094	0.623						
Middle	0.276**	0.120	0.637						
Fourth	0.326**	0.159	0.669						
Highest (Reference)									
4-5 Children									
Age at first birth									
<15	0.219*	0.068	0.711	0.176**	0.063	0.497			
15-18	0.320***	0.176	0.581	0.247***	0.148	0.412			
19-21	0.731	0.419	1.274	0.619	0.372	1.030			
Age at first marriage									
<15	0.620	0.261	1.471				0.262***	0.126	0.547
15-18	0.566	0.308	1.038				0.349***	0.205	0.592

19-21	0.695	0.376	1.283				0.643	0.361	1.145
Ever used Contraception									
No	3.295***	2.197	4.943	3.277***	2.211	4.856	3.227***	2.186	4.765
Education attainment									
No education	0.082***	0.026	0.261	0.059***	0.021	0.167	0.058***	0.021	0.165
Primary	0.182**	0.062	0.536	0.142***	0.051	0.393	0.131***	0.048	0.363
Secondary	1.200	0.275	5.232	1.173	0.269	5.107	0.998	0.233	4.267
Place of residence									
Rural	0.824	0.489	1.388						
Household Wealth									
Lowest	1.031	0.432	2.463						
Second	0.829	0.368	1.871						
Middle	0.805	0.388	1.671						
Fourth	0.913	0.481	1.734						
6+	Base outcome								

***P<0·001; **P is < 0·01 and ≥0·001; *P≤0·05 and ≥0·01.

Of particular interest in Model 4 was that women who got married before age15 and between 15 and 18 years were less likely (94.2% and 86.9%) to have no children than 6 children compared to women that married after age 22. RRRs for model 2 and 3 for the respective variables were similar.

5. Discussion

This study followed the birth history of 1020 women born during the 1965-1969 cohort based on retrospective data. Our results show that the average CFS was 6.7 (95% CI: 6.5 – 6.9) and that mean age at first marriage and first birth were 18.3 (95% CI: 18.0 – 18.5) and 18.9 (95% CI: 18.7 – 19.1) respectively. The average age at sexual debut for this cohort was 17 years (95% CI: 16.7 – 17.2). About 11% of women with CFS above 6 children married before age 15 and 5% had their first birth within the same age range. Higher CFS of 6 or more children were concentrated among women whose age at first marriage and birth was between 15 and 18 years old (40.7 and 39.8% respectively. Women marrying at younger ages and having their first birth at younger ages were more likely to have higher CFS than compatriots that initiated both marriage and childbearing at or after age 22. Having no education, being a rural dweller and having medium household wealth all reduced the risk of having lower CFS relative to 6 or more children.

The main strength of this study is it followed a cohort of women who had or were about to complete their reproductive cycle and collected fertility information about this group in a manner that provided grounds for exploring determinants. It also controlled for socioeconomic factors to effectively discern associations. Furthermore, the use of probability sampling in the collection of this data gives this study sufficient leverage to generalize findings to the entire 1965-1969 cohort. However, our study also presents some limitations. As are all surveys that depend on retrospective responses, self-reported data may introduce biases such as social desirability bias, non-response bias, recall bias, interviewer bias etc., even in the presence of exceptionally trained enumerators and rigorous probing to encourage accuracy of reporting (Erens et al. 2014; Sedgwick 2014; Setia 2016). The primary limitation of the cross-sectional study design is that because the exposure and outcome are simultaneously assessed, there is generally no evidence of a temporal relationship between exposure and outcome (Carlson and Morrison 2009; Setia 2016). Being a cross sectional survey, ZDHS's ability to measure relationships of causality in nature is limited. For example, the relationship between education attainment and CFS in the survey is masked by heterogeneous factors, including reverse causality (C.J.Mann 2003; Setia 2016).

Understanding changes in CFS is an important indicator of the anticipated future in lifetime fertility behavior of women. Factors that influence these changes become cornerstones for predicting fertility behavior and determining population growth. This study found a CFS of 6.7 children for the 1965-1969 birth cohort based on retrospective data analysis. This finding is consistent with results from the 2013-14 ZDHS that also found the average number of children ever born was 6.7 for women nearing the end of their childbearing cycle and 7.3 for those currently married, alluding the difference in the two measures to lower fertility among the young unmarried women (Central Statistical Office

et al. 2015) in the former index. This CFS is higher than the current TFR for most African countries including Zambia itself (Bongaarts, Mensch, and Blanc 2017; Gilles Pison 2017). TFR in Zambia reduced from 6.1 in 1992, 5.9 in 2010, 5.3 in 2014 to 4.7 in 2018 (Central Statistical Office (CSO) [Zambia], Ministry of Health (MOH) [Zambia] 2014; Central Statistical Office Zambia (CSO) 2010; University of Zambia (UNZA), Central Statistical Office (CSO), and Macro International Inc. 1993; Zambia Statistical Agency (ZSA) et al. 2019). Though fertility has been declining in Africa, it remains high in comparison to other regions (Gilles Pison n.d.). The CFS is the major determinant of the average household size that remains high in most African countries (United Nation Department of Economic and Social Affairs 2017).   The household size in Zambia is high at 5.1 persons (urban 4.8 and rural 5.4) (Central Statistical Office, Ministry of Health, University of Zambia Teaching Hospital, Tropical diseases Research Centre, University of Zambia 2015) relative to the TFR of 4.7 children. TFRs in the African region averaged 4.7 between 2010 and 2015 which is far above the global average of 2.5 though it is expected to drop by 2050, but will still be well above the rest of the world (United Nations Children's Fund (UNICEF) 2014). This high TFR fuels the next generation of mothers who will have fewer children than their preceding cohorts, but still more than the rest of the world. At this rate of fertility change, Africa will constitute 41% of the world's population and 40% of global under-five children by 2050 (Gilles Pison n.d.; United Nations Children's Fund (UNICEF) 2014, n.d.).

Our study further found that women from the 1965-1969 cohort married early (mean= 18.3; CI: 18.0-18.5) and that by the end of their reproductive life, 68.3% of them had birthed 6 children or more. With changes in reproductive behaviors overtime, this rate is expected to be lower for future cohorts. In fact, a study conducted in Malawi found that older cohorts have higher fertility levels than younger ones (Manda and Meyer 2018). As expected, marriage plays a crucial role in shaping the course of fertility, especially in the developing world (Bongaarts, Mensch, and Blanc 2017). The timing of marriage predominantly regulates how many children will be born since marriage is the only institution that sanctions reproduction. Over half (51.2%; CI: 48.1-54.3) of the women from our study cohort married between age 15 and 18 and a substantial number (13.5% CI:11.5-15.8) married at ages below 15 years. Our calculations reveal that almost two-thirds (64.7%) of women from this cohort were married off when they were still underage exposing them to a long period of risk of childbearing. Fifty-one percent of women with 6 or more children got married by age 18. Studies have shown that women that marry early (mostly victims of child marriages), start childbearing early, remain at risk of childbearing for longer periods of times and have poor health outcomes than their counterparts who marry later (Jayaraman, Gebreselassie, and Chandrasekhar 2009; Maswikwa et al. 2015). The timing of marriage in Zambia is affected by a myriad of socioeconomic factors, including education, wealth, social status and cultural responsibility that influence CFS. This study found that the cohort under investigation generally had more children, but the probability of having fewer children was higher for urban women than rural women. To put this into perspective, one study investigated how household economic hard times affect the time of marrying off their children especially in Africa where payment for marriage, whether in cash or kind, is widespread. They found that parents tactfully selected the time for their children's marriage depending on household economic instability thus affecting age at marriage as the payments for marriage constitute a vital source for "consumption smoothing" for the bride's family (Corno, Hildebrandt, and Voena 2017).

The time an individual starts parenthood is one of life's most challenging yet significant occurrences. It indicates the launch of responsibility for providing and maintaining wellbeing and success for the current and future generations (Bongaarts and Blanc 2015). A woman's age at first birth have grave implications for a roller coaster of life events such as education, work-life and completed family size. The results of this study found that the mean age at first birth for the cohort was 0.6 years higher than for marriage and 1.9 years higher than for sex debut. This finding suggests that the birth of the first child, in most instances, was preceded by sexual debut and then marriage. Similar analysis but for 43 countries found that the mean age at first birth was greater than the mean age at first marriage, which was also greater than the mean age at first sex for all regions (Bongaarts, Mensch, and Blanc 2017). A similar study conducted in Pakistan found that hazard of birth increased in the first two years following marriage and their after declined (Gangadharan and Maitra 2003).

Several studies in the region posit that the mean age at first birth in sub Saharan Africa is about 21 with most West and Middle African countries having age at first birth at or below 18 years while East and Southern African countries above 22 years (Bongaarts, Mensch, and Blanc 2017; Mensch, Grant, and Blanc 2006). The increasingly rising age at first birth in most African countries could be as a result of improved education outcomes for women which would translate in better health and reduced risks of maternal related morbidity and mortality and manageable fertility.

Another significant aspect that affects CFS is education of women. We found that women with no education and primary education (52% and 39.7% respectively) tended to have more children than those with secondary (3%) and tertiary education (4.7%). Even though noticeable progress has been attained, rural areas of sub-Saharan Africa still display low education levels for women (Bongaarts, Mensch, and Blanc 2017; Channon and Harper 2019). Thus, the education atmosphere is not favorable to any meaningful change in CFS for rural women in the region (Jayaraman, Gebreselassie, and Chandrasekhar 2009; Manda and Meyer 2018). Not only does education delay age at first birth, it also enhances the power of choice among women such that their consumption patterns enable them to live healthy and pursue healthy choices in child rearing (Bongaarts, Mensch, and Blanc 2017). Our findings show that in all the models, education attainment was inversely related to CFS. The lower the education level attained, the higher the CFS; but age at first marriage and first birth are positively related to education level attained. This, however, is expected as women who attend secondary and tertiary education are selective, such that the timing at which events occur intersect and compete with schooling age; much more in post primary than primary [49,50]. Numerous reasons have been advanced that cause the inverse relationship between a woman's education and fertility that include but not limited to superior autonomy among women, exposure to new gender norms and childbearing practices, improvement in information acquiring useful in women's health and their offspring. Women with more education are also elective in partner choice, have higher need for wealth and understand the costs that accrue or are forgone in timing of reproductive events.

Relatedly, women that reported having never used contraception were 5.3 (95% CI:3.3 – 8.5) more likely to have 1-3 children than 6 or more children compared to participants that have ever used contraceptive. This is an expected result because the variable "Ever used contraception" does not measure frequency of contraceptive use during the active childbearing years nor does it measure current use for those still bearing children. Added, 64.7% of the women started childbearing at or before age 18 implying they did not complete sufficient education to appreciate the effectiveness and benefits of using contraceptives. The best way of understanding the effect of contraceptive use on CFS is to retrospectively investigate the frequency and reasons for contraceptive use for women at the height of their childbearing career. Education has also been cited as a source of instruments necessary for obtaining information that enhances women and girls' ability of comprehending and learning information regarding contraceptive use and the benefits of smaller families. It could be because education is not as widespread in rural areas that women there exhibited higher fertility behaviors than their urban counterparts. In terms of household wealth, our results indicate that the distribution of women by household wealth did not vary much. The range was 18.2% (95%CI: 159-20-7) for lowest to 22.5% (95% CI: 19.9-25.1). Within household wealth classes, the highest proportions were recorded among women with 6 or more children. Table 4 model 2 shows that the higher the household wealth the less the risk of having 1-3 children relative to 6 or more children. The relationship between household wealth and CFS when CFS is 4-5 children was statistically not significant. This outcome could be as a result of measuring household wealth as current and not at during their childbearing years or at the beginning of the childbearing period. Retrospective studies have this limitation in linking duration measures to point estimates.

6. Conclusion

Our findings align with several previous studies accentuating an inverse association between mother's age at marriage and first birth to CFS. Women that marry before age 18 have a higher likelihood of having 6 or more children by the end of the reproductive period than their peers who marry later. Marriage, by and large, is a single most significant predictor of CFS. Holding other factors

constant, women who initiate child birth early have higher CFS related to those that start late. Several determinants are at play here including the fertility inhibiting nature of education, consistence contraception use, rural-urban residence and household wealth, especially at the time of child bearing initiation. It is expected that the timing of events will keep rising as improvements in education, contraception use and wealth are sustained among the women folk. Education is seen as the most important covariate as the changes in other variables are strongly affected by education attainment. Thus, improvements in general education, especially one that promotes post primary education among women will contribute significantly to a rise in timing of reproductive events. Studies have shown that girls that marry early are not only at risk of rapidly repeated births but also of diseases and poor health. Generally, girls who marry young have lower levels of education attainment, lower labor force participation and inferior economic ventures (Behrman and Jejeebhoy 1996; Field and Ambrus 2008; Wang et al. 2016). Child marriages and early births are a source of enormous health risks to girls and their offspring. It robs them of the bright, healthy and economically sound future by exposing them too early to repeated births at short intervals (Raj et al. 2009). A combination of these create fertile ground for obstetric complications that lead to maternal mortality which is highest among young women in developing countries (Patton et al. 2009). The HIV prevalence is characteristically high among young women than young men; more so among young married women than their sexually active unmarried colleagues (Freeman et al. 2006), since, as evidence has shown, they marry older men with whom they have limited negotiating power for protected sexual intercourse even when they suspect that their husband might be infected (Bracher, Santow, and Watkins 2003; Foreman et al. 2018; Koski, Clark, and Nandi 2017). Women's age at first marriage and first birth are strong candidates for explaining changes in CFS. However, it is worth noting that simplistically confining the determinants of CFS to two variables undermines the importance of environmental factors that contribute to fertility change. The interactions between timing of reproductive events on the one hand with other factors such as education, contraception use, household wealth and place of residence on the other, provide a complex network of interrelations that influence change in reproductive behaviors of women that affect the number of children they bear in their lives. To ensure young women have a choice regarding the timing of their reproductive events, national guidelines that protect the lives of young girls need strengthening to ensure women get married and start childbearing at an age when they are well developed to face the social and economic challenges of life that come with motherhood.

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