

1 **Survival Analysis and Determinants of Timing of First Birth after Marriage in Nigeria**

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10 Abstract

11 The timing of first birth after marriage among women in developing countries has important
12 consequences on the demographic dynamics of the population as it is an integral part of fertility
13 outcomes. This study was aimed at understanding dynamics of First Birth Interval (FBI) in
14 Nigeria and its determinants.

15 We right-censored FBI of women aged 15-49 years using 2013 Nigeria DHS data. We used
16 Kaplan Meier survival function and Cox Proportional Hazard (CPH) and Generalized Gamma
17 (GG) regression to model factors affecting FBI.

18 The median FBI in Nigeria was 1.75 years and decreased with increasing age at marriage.
19 Women with higher education have shorter FBI than those with no education (TR=0.86(95% CI:
20 0.85-0.88)). Urban women were more likely to have earlier FBI (HR=1.28 95% CI: 1.24-1.32)).
21 Fertility was significantly associated with FBI. The longer the FBI the lower the fertility level
22 and vice versa except for women aged 15-19 years.

23 Women characteristics affected first birth interval. There was association between fertility and
24 delayed first birth after marriage. The association was strongest among women who are likely to
25 have completed their family size. Delaying first birth as fertility reduction strategy should be
26 embraced.

27 Keywords: first birth interval, Cox proportional hazard, Generalized Gamma model, fertility

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31 **Introduction**

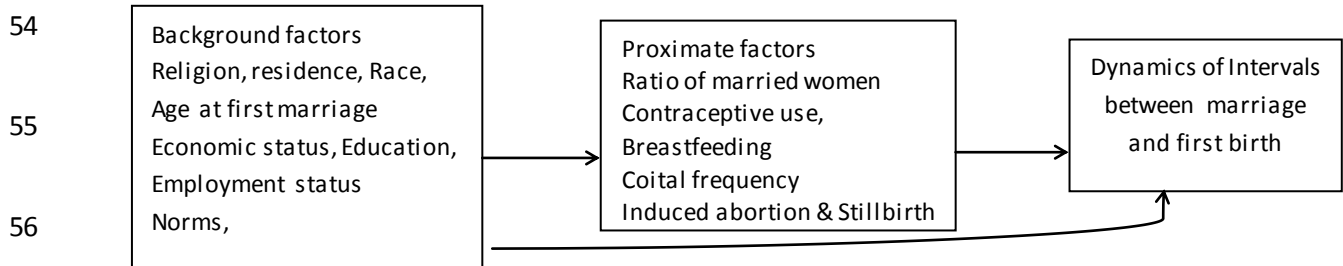
32 Across the globe, landmark reproductive events such as sexual debut, marriage, birth and
33 pregnancy have been used by demographers to understand fertility behavior of women (1–4).
34 The time interval between marriage and first birth (FBI) is prominent among the events and it
35 could shape the reproductive characteristics and health as well as psychological behavior of
36 women(1,2). It might dictate the number of children a woman will have in her reproductive
37 cycle. In contemporary African setting and in most developing countries, families, friends and
38 couples usually expect first births within one year of marriage, after which they become
39 apprehensive(5).

40 Women's fertility and country's fertility level are affected by mirage of factors including
41 availability of reliable birth control methods, religious beliefs, traditions and cultural norms,
42 acceptability of abortion, age at marriage, infant mortality rate, educational and career
43 development opportunities, economic factors, urbanization (1,2,4). These factors could be
44 categorized as cultural, social, economic and health factors. They operate through ratio of
45 women in sexual unions, using contraception, who are not currently fecund and the level of
46 induced abortion (6–8). However, Trussell et al (1985) found that these factors don't have any
47 independent effect on the birth intervals; rather, they influence fertility through proximate
48 determinants of the birth interval such as breastfeeding, contraceptive use, coital frequency and
49 induced abortion (9) as illustrated in Figure 1.

50

51

52 Figure 1: Theoretical and Empirical relationship between socio-demographic and other factors
53 and Intervals between marriage and first birth



57

58 FBI may determine women's reproductive patterns (3) and also affect a country's fertility
59 transitions. It is believed that women who had their first birth soon after marriage may have more
60 births than equally fecund women who had delays. The shorter intergenerational time that results
61 from high fertility due to non-delayed first births from younger women could escalate the
62 population growth(1,2,4).

63 Demographic and socio-economic factors including mothers education, residence, age at
64 marriage, knowledge and use of contraceptives, employment status have been identified to
65 influence FBI. These factors also include other socio-cultural factors such as race, values and
66 norms (1-5,7). Education was found to have impacted FBI substantially with women having
67 lower or no educational attainment to have births sooner than others(1-3,5,10,11). The age at
68 marriage has been identified as a determinant of timing of first births (5,12,13). Younger women
69 often make reproductive decisions that could shorten FBI and other intervals and thereby
70 increase fertility(3).

71 Contraceptive use and its length of use play a critical role in determining FBI and fertility in
72 general(5). Theories of fertility and other fertility determinants models have documented the role

73 of contraceptive use in fertility outcomes (8,14). Rural-urban differentials in respondents' place
74 of residence also affected FBI, the higher the development level of the region where a woman
75 lives, the wider the FBIs(15). However, the reverse could be the case as argued in an Indian
76 study(1). The study cited fertility behavior of a woman who lives in rural area and her husband
77 staying in urban area to make ends meet. The authors opined that she is likely to have a delayed
78 FB. Cultural practices and social custom could also significantly affect marriage to FB. Certain
79 culture which requires the woman to spend some time with either her parent or husband's parents
80 after marriage could lead to postponement of first births (1).

81 While the less developed countries accounted for over 80% of the world population by 2012, its
82 annual infant death was 79:1 compared to the developed countries. The less developed countries
83 have a Gross National Income (GNI) Purchasing Power Parity (PPP) of \$1 compared with \$6 in
84 the most developed countries. Astronomical population in economically less developed countries
85 could be linked with its high fertility. Its Total Fertility Rate (TFR) of 2.6, is clearly above 1.6
86 TFR prevalent in the most developed countries. Nigeria TFR of 5.6 exceeds the average in the
87 world (2.4), Africa (4.7), sub-Sahara (5.1) and natural increase rate of 2.6 compared with global
88 average of 1.2 (16–18).

89 The study of marriage to FBI among women in Nigeria is crucial in ensuring better
90 understanding of the dynamics of its population growth and to inform policy makers so as to
91 channel appropriate efforts at controlling this major player in population growth. The burning
92 question is what are the demographic and socio-economic factors affecting timing of first birth
93 after marriage in Nigeria? What are the magnitudes of these effects using a censored data? In this
94 study we hypothesized that due to improved education coverage in the country(17–21), the FBI
95 might be shorter among the better educated as higher educational attainment often increase age at

96 first marriage(17,18,22). However there could be interplay between education and other social
97 changes such as marriage system, employment, sexuality, family planning etc. In this study, we
98 hypothesized that there is no association between women's FBI and number of children ever
99 born. We also aimed at determining if the data obtained in the 2013 Nigeria Demographic and
100 Household Survey (NDHS) (17) was sufficiently detailed to account for non-random variation
101 in FBI of the sampled women.

102 **Statistical analysis**

103 **Study design and setting**

104 We used the 2013 NDHS(17) data to answer questions surrounding FBIs among women in
105 Nigeria. The cross-sectional and nationally representative data provided up to date information
106 about demographics and fertility of women of reproductive age in Nigeria. It used a four-stage
107 sampling procedure. First stage was selection of local government areas on rural-urban basis
108 from every state and the Federal Capital Territory (FCT), then selection of clusters, selection of
109 households and finally the selection of the individuals. The individuals were administered the
110 pre-tested semi-structured questionnaires by well-trained interviewers and field supervisors
111 during face-to-face interviews. A total of 39,902 women age 15-49 were identified as eligible for
112 individual interviews of which 38948(98%) were successfully interviewed. Written informed
113 consent was given by participants for their clinical records to be used in the study.

114

115 **Data**

116 The respondents provided information on their background characteristics (age, religion,
117 education etc.), reproductive history (time interval between marriage and first birth, age at first
118 marriage and age at first birth) and children mortality, knowledge, source, and use of family

119 planning methods. We used time interval between marriage and first birth (FBI) as the dependent
120 variable while geographical zones of residence, education, religion, residence, age at first
121 marriage, husband education, type of family, age difference between husband and wife, if
122 respondent ever had a terminated pregnancy or not and whether she has ever used something to
123 prevent pregnancy used as independent variables. Ethnic affiliation was not used in the analysis
124 because it was strongly associated with religion affiliation. Among the 38948 women who
125 participated in the 2013 NDHS, 9820(25.2%) who were never married, 871(2.2%) living with
126 non-marital partners, 1977(7.1%) who had births before marriage and 3587(13.4%) were
127 pregnant before marriage (they reportedly had their first child before ninth month of marriage)
128 were excluded from further analysis. Included in the analysis are the 22888 women who were
129 married and either had first births after 8th month of marriage (89.9%) or who have no birth
130 (10.1%). We grouped FBI into 3: 0-1.5 years, 1.5-3 years and over 3 years as used in an Iranian
131 study(3).

132

133 **Rationale for use of survival analysis**

134 Following up reproductive events in the life of a woman, although retrospectively, follows the
135 fundamental principle of survival analysis. Survival analysis describes time duration to
136 occurrence of an event of interest. Usually a follow up study might come to an end without every
137 participant experiencing the event of interest such as first births after marriage been studied.
138 Also, some participants might have been lost to follow up or probably withdrew from the study.
139 The event of interest is said to be censored among these groups of participant and are included in
140 the analysis. This is quite understandable because any of them could experience the event of
141 interest immediately after the study or much longer. Their inclusion will overcome systematic

142 bias as these participants could possess unique characteristics that could better explain the
 143 outcome of interest. In this study, the populations at risk are married women who had given birth
 144 after marriage or who are likely to give birth after the survey.

145 Survival analysis requires the survival time and censoring index to be well defined. In this study,
 146 we created a variable “censoring index” and coded it as “1” for those who had births and “0” for
 147 those who have not. The “survival time” among those who have not given birth is the time period
 148 between their dates of marriage and interview while time interval between marriage and first
 149 births were survival times for those with births. The survivor function $S(t)$ and hazard function
 150 $h(t)$ were used to determine the probability that a woman “survives” longer than some specified
 151 time t before having a first birth and the instantaneous potential per unit time to have a first
 152 childbirth, given that the individual had not had a up to time t . Survival and hazard function are
 153 mathematically denoted by

154
$$s(t) = S'(t) = \frac{d}{dt}S(t) = \frac{d}{dt} \int_t^{\infty} f(u) du = \frac{d}{dt}[1 - F(t)] = -f(t). \dots\dots\dots(1)$$

155 and

156
$$\lambda(t) = \lim_{dt \rightarrow 0} \frac{\Pr(t \leq T < t + dt)}{dt \cdot S(t)} = \frac{f(t)}{S(t)} = -\frac{S'(t)}{S(t)}. \dots\dots\dots(2)$$

157 In contrast to the survivor function ($s(t)$), which describes the probability of not experiencing the
 158 event of interest before time t , hazard function ($h(t)$) addresses the failure rate at time t among
 159 those individuals who have not experienced the event at time t . Hazard function measures the
 160 potential for the event to occur at a particular time t , given that the event did not yet occur.
 161 Larger values of the hazard function indicate greater potential for the event to occur.

162 We used Kaplan-Meier estimator, developed for scenarios where survival time is measured on a
 163 continuous scale whereby only intervals containing an event contribute to the estimate, to
 164 compute the survival estimates. The Kaplan-Meier estimates of $S(t)$ were obtained as

165
$$s(t) = \prod_{j=1}^k \frac{(n_j - d_j)}{n_j} \dots \dots \dots (3)$$

166 where n_j is the number of subject observed at time t_j and d_j is the number of subject that
 167 experienced the event of interest at time t_j . The incidence rate (IR) of FBI, which is the
 168 probability that a woman would have a first birth after marriage at time t_{k+1} given that she has not
 169 had a child by time t_k , was also determined. It is the probability of first birth occurring after a
 170 particular interval (time after marriage) given that the woman has had no birth before then.

171 We model the determinants of FBI using the Cox Proportional Hazard (CPH) regression,
 172 developed by David Cox (23). The Cox model is in terms of hazard function which gives an
 173 expression for the hazard at time t for an individual with a given specification of a set of
 174 independent variables denoted by x to predict individuals' hazard. The model assumes the
 175 relationship for one covariate where $h_0(t)$ is the baseline hazard function, x_i are the covariates
 176 and β_i are the coefficients.

177
$$h(t; x) = h_0(t) \exp(x\beta) \dots \dots \dots (4)$$

178 Cox regression estimates were stratified. In the stratified estimator, the hazard at time t for a
 179 subject in group i is assumed to be

180
$$h_i(t) = h_{i0}(t) \exp(\beta_1 x_{i1} + \dots + \beta_k x_{ik}) \dots \dots \dots (5)$$

181 The coefficients β_i indicates whether the changes in the expected duration will be statistically
182 significant or not. The hazard ratio (HR), expressed as the exponentials of the coefficients,
183 implies more exposure to event of interest if it is >1 , $HR < 1$ means lower exposure while $HR=1$
184 has no effect on the exposure. Log rank test was used to compare the survival experience
185 between different groups under study. Variables significant in the independent Cox regression
186 were used in the multiple Cox regression while controlling for confounders.

187

188 We used the Generalized Gamma (GG) model, an accelerated failure time model, to check the
189 performance of the CPH. Beside been a parametric model, it has the advantage of estimating the
190 coefficients more precisely and easier interpretation over the Cox model, a semi-parametric
191 model. In parametric models, direct effects of the explanatory variables on the survival time are
192 easily measured through “Time Ratio” (TR) instead of hazard. For each covariate in the model, a
193 $TR>1$ implies that an individual experiences the event at a later timing and vice versa. We made
194 provision for intra cluster correlation and also weighed the data to adjust for differences in
195 population in each state and FCT.

196 We used two approaches to test the hypothesis of no association between women’s FBI and
197 number of children ever born. Firstly, we normalised the two variables because they did not
198 follow normal distribution and used Pearson’s correlation coefficient between to determine
199 strength and direction of association the variables. Also, we evaluated the Chi-square
200 significance of association between grouped FBI (<1.5 , $1.5-2.9$ & $3+$ year) and number of
201 children ever born (0, 1-2, 3-4 & 5+ births). The two test of hypothesis were evaluated for each
202 age group and at each age of women involved in the study since fertility experience might be

203 different at different reproductive age. Statistical significance was determined at 5% p-value. We
 204 used the STATA (version 13) statistical analysis software for all the analysis.

205 **Ethical Consideration**

206 Ethical approvals for the study was sought and obtained from the Nigeria National Health
 207 Research Ethics Committee assigned number NHREC/01/01/2007 as earlier documented(17).
 208 Written informed consent was given by participants before the questionnaires were administered.
 209 Also, participant’s personal information were anonymized and de-identified as the data was been
 210 collected prior to analysis. Written informed consent was given by participants for their clinical records
 211 to be used in the study.

212 **Results**

213 The history of first births among the 20596(89.9%) women who had experienced at least a birth
 214 is shown in Table 1. The median FBI was 1.7years (20 months), 2.1 years among women who
 215 married before age 15 and 1.3 years among those who married after attaining age 25 years. The
 216 median FBI was 1.8 and 1.4 years in rural and urban areas respectively and 2.8 years among
 217 never educated women compared with 1.3 years among those with higher education. All the
 218 socio demographics of the respondents as well as their husbands characteristics were
 219 significantly associated with FBI at $p<0.05$.

220 Table 1: Socio-demographic characteristics of married women with at least a birth in Nigeria

	n	Median	Mean±σ	Max	FBI (years)		
					<1.5	1.5-2.9	3.0+
Age at 1st marriage*							
<15	6398	2.08	3.0±2.7	25.5	29.7	36.7	33.6
15-19	9308	1.58	2.2±2.1	22.9	44.1	36.3	19.7
20-24	3469	1.33	1.8±1.5	15.8	55.9	32.4	11.7
25+	1421	1.25	1.7±1.6	17.9	60.4	29.7	9.9
HW age difference*							
Same	213	1.33	2.4±3.0	25.5	58.4	24.4	17.3
Wife older	177	1.67	2.8±3.1	17.3	42.7	33.0	24.3
Husb older 1-10	11078	1.58	2.3±2.1	24.1	44.9	34.8	20.3

Husb older 11+"	7880	1.75	2.5±2.3	22.9	38.1	36.2	25.7
Zone*							
North Central	3088	1.42	2.1±2.1	22.9	49.2	32.5	18.2
North East	4163	1.75	2.5±2.4	24.1	40.5	34.7	24.8
North West	7054	2.08	2.9±2.4	23.8	29.3	41.3	29.4
South East	1702	1.25	1.8±1.9	25.5	60.6	28.3	11.1
South South	2144	1.42	1.9±1.7	14.8	54.2	31.2	14.6
South West	2445	1.25	1.8±1.6	15.3	61.3	27.2	11.5
Residence*							
Urban	6916	1.42	2.0±1.9	25.5	50.7	34.1	15.3
Rural	13680	1.75	2.6±2.4	24.1	38.1	36.0	25.9
Education*							
No education	10276	2.00	2.8±2.5	24.1	33.1	37.4	29.6
Primary	4292	1.42	2.1±1.9	25.5	49.7	33.3	17.0
Secondary	4626	1.33	1.9±1.7	22.9	53.2	34.6	12.2
Higher	1402	1.25	1.8±1.8	22.6	60.5	27.8	11.8
Husb Education*							
No education	8417	2.00	2.8±2.6	24.1	32.6	37.7	29.7
Primary	3919	1.50	2.2±1.9	22.6	46.8	33.9	19.3
Secondary	5294	1.42	2.0±1.8	25.5	51.1	34.1	14.8
Higher	2765	1.42	2.0±2.0	22.9	52.6	32.4	14.9
Family type*							
Monogamy	12322	1.58	2.2±2.0	25.5	45.9	35.1	19.0
Polygamy	7026	1.92	2.7±2.5	24.1	35.7	35.5	28.7
Religion							
Catholics	1938	1.33	1.9±1.8	22.1	56.4	28.1	15.5
Other Christian	5928	1.33	1.9±1.7	25.5	55.6	28.9	15.5
Islam	14676	1.92	2.7±2.4	24.1	36.4	35.1	28.4
Others	352	1.70	2.4±2.3	18.1	44.5	34.7	20.8
Wealth Status							
Poorest	10944	2.0	2.8±2.5	24.1	34.3	35.1	30.6
Middle	4111	1.5	2.1±2.0	25.5	48.6	30.5	20.9
Richest	7833	1.4	2.0±1.8	22.6	52.8	31.2	16.0
Ever PP*							
No	16021	1.75	2.5±2.4	25.5	38.4	36.7	24.9
Yes	4575	1.33	1.8±1.6	15.8	57.0	30.6	12.5
Ever HPT*							
No	17860	1.67	2.4±2.2	24.1	42.9	35.1	22.0
Yes	2736	1.75	2.5±2.2	25.5	39.6	37.2	23.3
Total	20596	1.67	2.4±2.2	25.5	42.5	35.3	22.2

*Significant at 5% X² statistics HPT Had pregnancy terminated PP Used something to prevent pregnancy

221

222 Overall Median Survival Time (MST) to FBI was 1.75 years (21 months) with 1.50 years in the

223 urban areas and 1.92 years in the rural areas. Also, FBI MST was 1.33 years among women

224 having higher education and 2.08 years among those who had no formal education, 1.33 among

225 women who had used contraceptives and 1.92 among those who didn't. The overall incidence

226 rate (IR) of FBI, (risk of having a birth within a unit time) was 0.35, 0.37 among women of same

227 age with their husband and 0.29 among women older than their husband. In the bivariate
 228 analysis, the prognostic factors identified as significant by the CPH and GG regression models
 229 were identical. The GG showed that a woman with higher education has a shorter FBI than those
 230 with no education (TR=0.86, 95% CI: 0.85-0.88) while the CPH showed that risk of first birth
 231 after marriage was higher among women with higher education by 46% than uneducated women
 232 (HR=1.46, 95% CI: 1.38-1.54). The CPH showed higher risk of first birth after marriage among
 233 urban women than rural women (HR=1.28, 95% CI: 1.24-1.32) with a corresponding TR of 0.94,
 234 95% CI: 0.93-0.94) in the GG model (Table 2).

235 Table 2: Median survival times and Unadjusted Cox Proportional Hazard Model of relationship between FBI and
 236 respondents' characteristics

Characteristics	Incidence rate	Median ST	Cox Proportional		Generalized Gamma	
			HR	95% CI	TR	95% CI
Age at 1st marriage						
<15	0.28	2.17	Ref			
15-19	0.37	1.67	1.32	1.28-1.37*	0.91	0.90-0.92*
20-24	0.46	1.42	1.66	1.59-1.73*	0.86	0.84-0.87*
25+	0.37	1.42	1.38	1.31-1.46*	0.85	0.83-0.87*
HW age Difference						
Same	0.37	1.42	1.21	1.06-1.39*	0.94	0.89-0.98*
Wife Older	0.29	1.75	0.98	0.85-1.14	0.94	0.89-0.99*
Husband older 1-10	0.38	1.67	1.18	1.14-1.21*	0.97	0.96-0.98*
Husband older 11+	0.32	1.92	Ref			
Zone						
North Central	0.40	1.50	Ref			
North East	0.31	1.83	0.77	0.74-0.81*	1.08	1.06-1.10*
North West	0.29	2.17	0.68	0.65-0.71*	1.18	1.16-1.20*
South East	0.44	1.33	1.14	1.08-1.21*	0.96	0.94-0.99*
South South	0.45	1.42	1.09	1.03-1.15*	0.99	0.97-1.01
South West	0.51	1.25	1.28	1.21-1.35*	0.94	0.92-0.96*
Residence						
Urban	0.41	1.50	1.28	1.24-1.32*	0.94	0.93-0.95*
Rural	0.33	1.92	Ref			
Wife Education						
No education	0.30	2.08	Ref			
Primary	0.42	1.50	1.42	1.37-1.47*	0.90	0.89-0.91*
Secondary	0.45	1.42	1.55	1.49-1.60*	0.88	0.87-0.89*
Higher	0.41	1.33	1.46	1.38-1.54*	0.86	0.85-0.88*
Husband Education						
No education	0.29	2.08	Ref			
Primary	0.40	1.58	1.36	1.31-1.41*	0.91	0.9-0.92*
Secondary	0.43	1.50	1.49	1.44-1.54*	0.89	0.88-0.9*
Higher	0.40	1.50	1.41	1.35-1.47*	0.89	0.87-0.9*
Family type						

Monogamy	0.38	1.67	1.23	1.19-1.26*	0.95	0.94-0.96*
Polygamy	0.31	1.92	Ref			
Religion						
Catholics	0.42	1.33	Ref			
Other Christian	0.45	1.42	1.04	0.98-1.07	1.00	0.98-1.02
Islam	0.31	2.00	0.69	0.65-0.72*	1.13	1.11-1.16*
Others	0.36	1.75	0.81	0.72-0.91*	1.06	1.01-1.11*
Wealth Status						
Poorest	0.29	2.08	Ref			
Middle	0.39	1.5	1.34	1.29-1.38*	0.91	0.90-0.93*
Richest	0.43	1.42	1.47	1.42-1.52*	0.89	0.88-0.90*
Ever PP						
No	0.32	1.92	Ref			
Yes	0.52	1.33	1.64	1.58-1.69*	0.91	0.90-0.92*
Ever HPT						
No	0.35	1.75	1.12	1.07-1.16*	0.99	0.98-1.01
Yes	0.32	1.92	Ref			
Total	0.35	1.75				

TR Time Ratio, HR Hazard Ratio HW Husband- Wife HPT Had pregnancy terminated *Significant at 5%
PP Used something to prevent pregnancy ST Survival time

237

238 The survival functions of FBI across the independent variables are shown in Figure 1. The
239 survival curves of respondents' FBI across the characteristics considered appeared similar but
240 were found to be significantly different using long rank tests ($p < 0.05$).

241 **Figure 1: The Kaplan Meier survival functions of FBI by Respondents' characteristics**

242 We fitted two models to adjust for influences of the independent variables in determining FBI in
243 Nigeria. Model 1 consists of only the characteristics of women while Model 2 consists of Model
244 1 in addition to husbands' characteristics. In Model 1, based on the GG model, women from
245 North East (TR=1.04 95% CI: 1.02-1.06) and North West (TR=1.13 95% CI: 1.11-1.15) had a
246 delayed transition to first birth after marriage compared to those from the North Central while
247 those from the South East (TR=0.97 95% CI: 0.95-0.99) and South West (TR= 0.95 95% CI:
248 0.93-0.98) had a faster transition than the North Central. This is similar to outcomes of the CPH
249 model where women in North East and North West had higher risk of first birth after marriage
250 than women in the North Central by 12%, (HR=0.88, 95% CI: 0.84-0.93) and 20% respectively

251 compared to a shortened FBI in South East (10%) and South West (17%) than in the North
 252 Central. The risk of first birth after marriage decreased as women delayed marriage (HR=1.21,
 253 95% CI:1.17-1.25). Addition of the husbands' characteristics in Model 2 did not improve the
 254 fitness of Model 1. Based on GG model, we found family types and age differences between
 255 husbands and wives to be insignificant (Table 3).

256 Table 3: Multiple Survival analysis Regression Model of FBI using the CPH and GG

Characteristics	Model 1				Model 2			
	Cox Regression		Generalized Gamma		Cox Regression		Generalized Gamma	
	HR	95% CI	TR	95% CI	HR	95% CI	TR	95% CI
Age at 1st marriage								
<15	*1.21	1.17-1.25	*0.94	0.93-0.95	*1.20	1.16-1.25	*0.93	0.92-0.95
15-19	*1.28	1.23-1.35	*0.93	0.91-0.94	*1.29	1.23-1.35	*0.92	0.90-0.94
20-24	1.05	0.98-1.12	*0.94	0.92-0.97	1.07	1.00-1.14	*0.94	0.92-0.97
25+	Ref							
Zone								
North Central	Ref							
North East	*0.88	0.84-0.93	*1.04	1.02-1.06	*0.91	0.87-0.96	*1.03	1.01-1.06
North West	*0.80	0.76-0.84	*1.13	1.11-1.15	*0.82	0.78-0.86	*1.12	1.10-1.15
South East	*1.10	1.04-1.17	*0.97	0.95-0.99	*1.10	1.03-1.17	*0.97	0.94-1.01
South South	1.01	0.95-1.07	1.00	0.98-1.02	0.98	0.93-1.05	1.00	0.98-1.03
South West	*1.17	1.10-1.23	*0.95	0.93-0.98	*1.16	1.09-1.23	*0.95	0.93-0.97
Residence								
Urban	*1.03	1.01-1.05	*0.98	0.97-0.99	1.03	0.99-1.07	*0.98	0.97-0.99
Rural	Ref							
Wife Education								
No education	Ref							
Primary	*1.16	1.12-1.21	*0.95	0.94-0.97	*1.12	1.07-1.17	*0.96	0.95-0.98
Secondary	*1.12	1.08-1.18	*0.96	0.94-0.98	*1.07	1.02-1.13	*0.97	0.95-0.99
Higher	1.03	0.97-1.10	*0.95	0.93-0.98	1.01	0.94-1.10	*0.97	0.93-0.99
Religion								
Catholics	Ref							
Other Christian	1.03	0.98-1.07	1.00	0.98-1.02	1.02	0.98-1.07	0.99	0.98-1.01
Islam	*0.67	0.65-0.72	1.13	1.11-1.16	*0.65	0.65-0.72	1.10	1.11-1.15
Others	*0.81	0.72-0.91	1.06	1.01-1.11	*0.80	0.72-0.91	1.05	1.01-1.11
Wealth Status								
Poorest	Ref							
Middle	*1.24	1.29-1.39	0.90	0.90-0.92	*1.34	1.29-1.38	0.91	0.90-0.93
Richest	*1.37	1.42-1.52	0.87	0.88-0.90	*1.47	1.42-1.52	0.89	0.88-0.90
Ever PP								
No	Ref							
Yes	*1.32	1.27-1.37	*0.96	0.95-0.98	*1.31	1.26-1.36	*0.96	0.94-0.97
Ever HPT								
No	*1.22	1.17-1.27	*0.97	0.95-0.98	*1.23	1.18-1.28	*0.96	0.94-0.98
Yes	Ref							
HW age Difference								
Same					1.00	0.87-1.15	0.97	0.92-1.03
Wife Older					*0.82	0.70-0.95	0.97	0.91-1.03
Husband older 1-10yr					*1.05	1.02-1.08	0.99	0.98-1.00
Husband older 11+yr					Ref			
Husband Education								

No education			Ref	
Primary			*1.09	1.04-1.14 0.98 0.96-1.00
Secondary			*1.10	1.05-1.16 0.97 0.95-1.00
Higher			1.04	0.99-1.11 0.97 0.95-1.00
Family type				
Monogamy			*1.07	1.03-1.10 1.00 0.98-1.01
Polygamy			Ref	
2loglikelihood	373512	41738	344822	38606

*Significant at 5%. HW Husband-Wife HPT Had pregnancy terminated PP Used something to prevent pregnancy

257 The chi square test of hypothesis of no association between FBI and children ever born was
258 statistically significant at all ages of women except at age 15. Also the Pearson's correlation
259 coefficient showed that the longer the FBI the lower the fertility level and vice versa except for
260 women aged 15-19 years, who seemed to have higher fertility with delayed FBI (Table 4). We
261 found association with correlation coefficient of -0.3185 and -0.3414 between number of
262 children ever born and FBI among women aged 40-44 years and 45-49 years respectively. These
263 categories of women were likely to have completed their family sizes.

264 Table 4: Relationship between womens' first birth interval and number of children ever born
265 according to current age of women

Age of Ever Married Women (year)	Correlation Coefficient*	Chi-square (χ^2) p-value**
15	0.1478	>0.005
16	0.2600	<0.001
17	0.0337	<0.001
18	0.0513	<0.001
19	0.0223	<0.001
15-19	0.1357	<0.001
20	-0.1609	<0.001
21	-0.1376	<0.001
22	-0.0897	<0.001
23	-0.1756	<0.001
24	-0.0897	<0.001
20-24	-0.1304	<0.001
25	-0.2269	<0.001
26	-0.0687	<0.001
27	-0.1037	<0.001
28	-0.1998	<0.001
29	-0.0985	<0.001
25-29	-0.1592	<0.001
30	-0.3470	<0.001
31	-0.2131	<0.001
32	-0.2241	<0.001
33	-0.2404	<0.001
34	-0.2687	<0.001

30-34	-0.2871	
35	-0.3259	<0.001
36	-0.3407	<0.001
37	-0.2811	<0.001
38	-0.1509	<0.001
39	-0.2470	<0.001
35-39	-0.3259	<0.001
40	-0.3799	<0.001
41	-0.3287	<0.001
42	-0.2572	<0.001
43	-0.2268	<0.001
44	-0.2598	<0.001
40-44	-0.3185	<0.001
45	-0.3456	<0.001
46	-0.3548	<0.001
47	-0.3692	<0.001
48	-0.3392	<0.001
49	-0.3125	<0.001
45-49	-0.3414	<0.001
Total	-0.1017	<0.001

*Pearson's correlation coefficient of relationship between women's normalised FBI and children ever born

**Chi-square significance of association between grouped FBI (<1.5, 1.5-2.9 & 3+ year) and number of children ever born (0, 1-2, 3-4 & 5+ births)

266

267 Discussion

268 We found that Nigerian women have first birth after marriage in the average of 1.75 years (20
269 months). The determinants of first birth interval in Nigeria are women related and include
270 background, social and reproductive characteristics. Most significant among the characteristics
271 were age at first marriage, place of residence and geographical zones of residence, women
272 education, ever use of something to prevent having pregnancy and haven terminated a
273 pregnancy. We also found that some women have waited for 25.5years to have a first birth while
274 some married women have waited for 37 years expecting a first birth and are still counting. Also,
275 the longer the FBI the lower the fertility level and vice versa. Relationship between FBI and
276 fertility was strongest among women who are likely to have completed their family size.

277 While our study have been strengthened by use of large nationally representative data, it might
278 be limited by its cross-sectional nature. Data were self-reported and this could be potentially
279 affected by recall bias.

280 The average FBI of 1.75 years found in this study was similar to 1.65 years reported in a similar
281 study in India(1) but much higher than 1.5years in 1980s and 1.4 years in 1985 among women of
282 reproductive age in China(5). The Chinese study had attributed the falling FBI to declined
283 fertility which was as a result of sharp delayed age at first marriage. There were significant
284 differences in median FBI across the respondents' characteristics. The median FBI after marriage
285 decreased with the increasing age at marriage. This was in concordance with reports of previous
286 Iranian study(2) and a Chinese study (5). Average FBI was higher in rural areas than urban areas.
287 This finding agreed with findings of Chinese study(5) which found that average FBI was about
288 0.7 years longer for rural and coastal women as compared with upland and urban women. FBI
289 was higher among those with low or no education than among respondents with higher education
290 and mostly higher in the Northern regions than in the Southern regions of Nigeria.

291 We found women who married before attaining age 20 years to have a likelihood of longer FBI
292 than those who delayed marriage. Women who married before age 15 years had 30% higher
293 hazard of delayed first birth than a woman marrying at age 25 or thereafter. This is in
294 concurrence with findings elsewhere(5). In particular, a Chinese study had hypothesized an
295 indirect association between FBI and the age at marriage(5). This implied that women often rush
296 their first and consecutive births soon after marriage so as to make up for the late entry into child
297 bearing.

298 Women with no education had a longer FBI than others with better education. The generalized
299 gamma model showed higher time ratio of FBI among women with no education compared with
300 women with primary, secondary and higher education. This is in agreement with previous reports
301 that found less educated women to have waited longer than those with higher education to have
302 first birth after marriage (1,5,17,24).

303 The FBI is much longer among rural women than urban women. This could be due to the fact
304 that some husbands lives in urban cities looking for better livelihood while their wives remained
305 in the rural area. In the same line, we found geographical differences in the likelihood of women
306 to have her first birth after marriage. Women from the North East and North West are likely to
307 wait 20-30% longer than women in Southern axis of Nigeria waited. The finding agreed with
308 outcome of previous studies elsewhere(1,5,24).

309 Women in monogamy family have higher risk of early first birth after marriage than those in
310 polygamous family. This could be as a result of the husband having alternative woman in his life.
311 In Nigeria setting, husbands with multiple wives rarely keep them in the same household thereby
312 making the men to have divided attention towards the wives. This finding is at variance with an
313 India study which found average FBI of 1.3 years among women from extended families
314 compared to a higher 1.58 years among women from nuclear families(1). Similarly, women who
315 are of the same age with their husbands had a likelihood earlier first birth after marriage than
316 women younger or older than their husbands (1).

317 Respondents who had ever used contraceptives had a shorter first birth interval than those who
318 did not. On the contrary, women who had ever experienced pregnancy termination had
319 likelihood of longer FBI. This is understandable since most contraceptives are used to

320 temporarily prevent pregnancy and does not cause any permanent blockage while pregnancy
321 termination could have hindered the chance and health of another child since they are at higher
322 risk complications resulting from medical abortion(25,26).

323 We recommend that education and social empowerment should be used as a weapon to improve
324 social status of women so that age at marriage could be postponed. Since fertility is indirectly
325 associated to FBI, delaying first birth as fertility reduction strategy should be embraced by the
326 policy makers considering the differentials in socio-demographic and reproductive dynamics of
327 Nigerian women.

328 **Conclusion**

329 This study showed that socio-demographic and reproductive characteristics of a woman are the
330 main determinants of marriage to FBI dynamics in Nigeria. The delayed first births in rural areas
331 among women who married at a younger age and uneducated could be ascribed to high loss of
332 pregnancy which is commoner among this class of respondents as a result of poor antenatal care
333 (27,28). This is intuitive because antenatal care use has been reported to be lower among less
334 educated, poorer, younger and rural women from Northern part of Nigeria (17–20,29,30). Also,
335 shorter FBI among women with higher education, urban dwellers and within highest wealth
336 status could be due to the fact that these categories of women are those who usually delay
337 marriage (18,22). They are thereby well prepared and ready for childbearing as soon as they get
338 married both financially and otherwise than other women.

339 **Recommendation**

340 Age at marriage is major determinant of fertility. The fertility of women who delayed marriage
341 will be low irrespective of their first birth interval. Education and social empowerment should be

342 used as a weapon to improve social status of women so that age at marriage could be postponed.
343 Delaying first birth as fertility reduction strategy should be embraced by the policy makers
344 considering the differentials in socio-demographic and reproductive dynamics of Nigerian
345 women.

346 **Contribution of Authors**

347 AFF conceived the study, designed the study, extracted, analysed the data and wrote the results
348 of the analyses and discussion. ESI facilitated publication of the manuscript and both authors
349 reviewed the manuscript.

350 **Conflict of Interest**

351 Authors declared no conflict of interest

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355

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