



Determinants of different birth intervals of ever married women: Evidence from Bangladesh

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ABSTRACT

Introduction: The analysis of factors affecting birth interval helps to reveal the mechanism and dynamics of fertility behavior which changes the population structure of a country.

This study aims to examine the association among different socioeconomic and demographic factors with birth intervals and to identify the statistically significant factors of birth intervals.

Material and methods: This study has been used latest Bangladesh Demographic and Health Survey 2014 data based on two stage stratified sample of households. Different birth intervals have been analyzed using various statistical techniques such as Kaplan Meier estimator, log rank test, Cox proportional hazard model and Frailty model.

Results: Among the ever married women, 92.40%, 76.80% and 61.60% have experienced live birth for first, second and third times, and the estimated median duration of birth intervals are 26, 46, and 58 months, respectively. Using the log rank test, this study found that region, place of residence, mothers education, partners education, contraceptive use, and mothers age are significantly associated with birth intervals. This study also considered mothers age and working status at first birth interval; mothers education, age, working status and survival status of previous child at second birth interval; mothers education, sex of household head, working status, mass media exposure, age, contraceptive use, religion, and survival status of previous child at third birth interval are protective factors in next births.

Conclusions: Overall, mothers age, working status and mass media exposure are protective factors in birth intervals. To fulfill the target, government should pay attention to significant protective factors.

1. Introduction

Nowadays over population is the most alarming problem. Excess population growth is a big and challenging problem in Bangladesh and this growth varies significantly due to social, regional and educational factors. One of the important determinants of population growth is fertility, that plays the most important role in changing the size and structure of population¹ and it is identified as the main cause of increasing the growth of population.^{2,3} Fertility analysis is essential for policy makers to get guidance for population control and evaluation of family planning programs.⁴ Fertility depends on the couple's decisions, effective reproductive period, duration of the length of birth intervals, socioeconomic, health related, and emotional factors. The intrinsic growth rate as well as the mean generational length of any population may get affected by the birth interval.⁵ This is the main evidence that the birth interval is the key factor in population growth. Furthermore,

information on birth interval provides an insight into birth spacing patterns, which affect fertility as well as maternal, infant, and childhood mortality.

A birth interval is defined as the time between two successive live births.⁶ The duration of birth intervals has received attention in demography and public health research because of its influential implication on fertility and hazardous impact on both maternal and child health. Several maternal and child health problems may occur due to birth interval of less than 17 months or more than 5 years. Different studies have been shown that short birth interval is associated with high risk of both mother and baby death, particularly when the birth interval is less than 18 months.⁷ It is evidence that there is no universally accepted optimal birth interval.^{8,9} Zhu et al. suggests that the first birth interval should be 18–23 months to avoid the adverse prenatal outcomes.⁸ According to Clayton, the optimal interval to ensure survival through childhood is 3 years and 9 months.¹⁰ Martin deduced that a

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Table 1
The category of demographic and socio-economic characteristics with identification code.

Demographic and socio-economic characteristics	Categories (code)
Region/Division	Barisal (1), Chittagong (2), Dhaka (3), Khulna (4), Rajshahi (5), Rangpur (6), Sylhet (7)
Place of residence	Urban (1), Rural (2)
Mothers education	No education (0), Primary (1), Secondary (2), Higher education (3)
Partners education	No education (0), Primary (1), Secondary (2), Higher education (3)
Mothers age	≤ 20 years (1), 21–30 years (2), ≥ 31 years (3)
Mothers working status	No (0), Yes (1)
Contraceptive use status	No (0), Yes (1)
Sex of household head	Male (1), Female (2)
Religion	Muslim (0), Non-Muslim (1)
Wealth index	Poor (0), Middle (1), Rich (2)
Mass media exposure	No (0), Yes (1)
Sex of previous child	Boy (1), Girl (2)
Survival status of previous child	Dead (0), Alive (1)
Previous birth interval	< 24 months (1), 24–48 months (2), > 48 months (3)

minimum of 2 years spacing is necessary between births for the best physical and mental development, but three years spacing would be even better.¹¹

Generally, birth intervals are higher in Bangladesh and increasing day by day. Lengthy breastfeeding and a long period of postpartum amenorrhea are the main factors of high percentage of births occurring after an interval of 24 months or more. Bangladesh has been achieved a remarkable demographic transition over the last two decades. The aim of the health sector programs those were conducted in Bangladesh is to reach a fertility level of two births per woman within 2016.¹²

Total fertility rate significantly declined from 1970 to 2014.¹² However, birth interval is affected by several factors. Some women are experienced very short birth interval whereas some too long and the rest just normal. This study intends to identify the factors affecting first, second and third birth intervals separately and assess their impacts on birth intervals.

2. Methods

2.1. Data sources

The current study uses the nationally representative secondary data extracted from Bangladesh Demographic and Health Survey (BDHS) 2014. The survey is intended to serve as a source of population and health data for policy makers and the research communities in Bangladesh. The survey was implemented by a Bangladeshi research firm “Mitra and Associates” under the authority of the National Institute for Population Research and Training. Financial and technical supports were provided by the U.S. Agency for International Development and the ICF International of Rockville, respectively.

2.2. Sample design

The survey is based on a two stage stratified sample of households. In the first stage, 600 enumeration areas were selected with probability proportional to the enumeration area size, with 207 clusters in urban areas and 393 in rural areas. In the second stage of sampling, a systematic sample of 30 households on average from complete list of household was selected per enumeration area to provide statistically reliable estimates of key demographic and health variables for the country. With this design, the survey selected 18,000 residential households, which were expected to result in completed interviews with about 18,000 ever married women. All ever married women aged 15–49 years who stayed at the selected households the night before the survey were eligible for the survey.

2.3. Variables of interest

The identification of determinants of birth interval is a big challenge in the real world. In rural area there was significant relation between socio demographic variables and birth interval.^{13,14} In Iran, there was significant association between birth interval with maternal age, duration of breast feeding, sex of child, history of still births, and regular attendance at family planning clinics.¹⁵ Fallahian et al. showed that the duration of breastfeeding and the method of contraceptive used were significantly associated factors with birth intervals.¹⁶ Mothers age at marriage is measured to be an important variable in the fertility process and it is negatively associated with birth interval.^{17,18} Education has always been an important variable in birth.¹⁹

In general, birth interval depends on two successive live births. The duration between first live birth and first cohabitation of married couple is considered first birth interval. Other intervals are calculated by the difference between two successive live births. This study considered the approximate determinants of first birth interval as region, place of residence, mothers education, partners education, mothers age, mothers working status, contraceptive use, sex of household head, religion, wealth index and mass media exposure. But for the other birth intervals the approximate determinants as sex of previous child, survival status of previous child, duration of previous birth interval and all the determinants of first birth interval. The necessary and required categories for demographic and socio-economic factors have been presented in Table 1.

The response variable for this study is birth interval. Successful birth is considered as success event and otherwise censored. The event time is defined as the interval between date of marriage and a live birth or censoring. Women who gave first birth but not second birth or those who were not even impregnated during the survey period are considered as censored for second birth interval analysis and this is the same for third birth interval. Pregnancy is the time during which one or more offspring develops inside a woman. Childbirth occurs just over nine lunar months, where each month is about 29½ days. Women having birth interval time bellow nine months, sterilized women and no dejure residence of women are excluded from this study.

2.4. Cox proportional hazard model and its extension

In general, survival analysis examines the relationship between survival status and covariates. Cox proportional hazard model is the most important model for survival analysis because it investigates the effects of the covariates on survival.²⁰

Let Y_i denotes the observed time (either censoring time or event time) for subject i . Let C_i be the indicator that the time corresponds to an event (i.e. if $C_i = 1$ the event occurred and if $C_i = 0$ the time is a censoring time). Let $X_i = \{X_{i1}, X_{i2}, \dots, X_{ip}\}$ be the realized values of the

covariates for subject, i . The mathematical form of hazard function for the Cox proportional hazard model is:

$$h(t/X_i) = h_0(t) \exp(\beta_1 X_{i1} + \beta_2 X_{i2} + \dots + \beta_p X_{ip})$$

$$\text{Or, } h(t/X_i) = h_0(t) \exp(X_i \beta)$$

This expression gives the hazard rate at time t for the subject i with covariate vector (explanatory variables) X_i .

The usual Cox proportional hazard model requires time-to-event data to be independent.²¹ Frailty is an unobserved random proportionality factor that changes the hazard function of an individual or a group of related individuals. In Cox proportional hazard model, it is assumed that the correlations are due to the unobservable group specific covariates and one approach to adjust all the unobservable covariates is to include a non-negative valued random term, known as frailty. Such extension of Cox proportional hazard model is known as frailty model. Frailty model is becoming more and more popular in the area of survival analysis and commonly used for analyzing correlated time-to-event data.²²

One key problem in frailty model is choice of the frailty distribution. The most frequently used frailty distributions are gamma distribution, positive stable distribution, power variance function (PVF) distribution, inverse Gaussian distribution, compound Poisson distribution and log-normal distribution.²³ Among them the most common and important frailty distribution is the gamma distribution. From a computational and analytical point of view the gamma distribution fits very well to failure data, because it is easy to derive the closed form expressions of survival, density and the hazard function.²³

2.5. Statistical analysis

Since this study includes censored data, the survival analysis methods have been used to assess the significant impacts of different variables on the birth interval that leads to visualize the dominant factors affecting fertility in Bangladesh. Descriptive statistics served to illustrate the general characteristics of the variables. Kaplan-Meier estimator is used to find out the estimated mean with standard error and median value of different categories of the considered covariates and log rank test is used to test the significance of different categorical factors under this study. The Cox proportional hazard model is used to determine the effects of various factors on first birth interval. The extension of Cox proportional hazard model known as frailty model which is used to determine the effects of various factors on second and third birth intervals because of heterogeneity in birth intervals due to mother. The exponent of the coefficients of Cox proportional hazard model and frailty model is hazard ratio and have been used to calculate the factors change in the hazard rate associated with the changes of covariates. In this study p -value less than 0.05 is considered to be statistically significant. All statistical analyses are performed by SPSS version 15.0 and R.3.3.3.

3. Results

There were 13370, 11952 and 8871 women in this study among whom 92.40%, 76.80% and 61.60% had experienced of live birth and the rest 7.60%, 23.20% and 38.40% were censored for first, second and third birth, respectively. The average (\pm SD) age of the ever married women for first, second and third births are 19.10 (\pm 03.89), 23.13 (\pm 05.12) and 27.78 (\pm 06.50) years, respectively. For the ever married women the estimated average (\pm SE) duration of first, second and third births are 39.05 (\pm 0.47), 76.38 (\pm 1.13) and 135.27 (\pm 1.93) months, respectively, but the estimated median duration of births for first, second and third births are 26, 46 and 58 months, respectively.

Table 2 provides descriptive statistics of the selected covariates for different birth intervals. The result shows that the percentage of

families increased with an increasing number of birth in Rangpur, but decreased in Dhaka division. Among the ever married women, 64.61% gives at least one birth live in rural area. The percentages of rural people are increasing with respect to number of birth compared to urban people. The percentage of illiterate and primary educated mothers' birth significantly increased from 23.64% to 30.54% and 28.15% to 31.60% but secondary and higher educated mothers' birth significantly decreased from 37.94% to 31.45% and 10.28% to 6.41% for first birth to third birth respectively. The same scenario is discernible for partners education. In this study the majorities (88.37%) of the household head are male, and 90.30% are Muslim. For some women whose families were not connected with any mass media and their numbers of birth increased from 39.45% to 51.62%. The births increased from 35.75% to 38.77% in poor family but this scenario is different for rich family and the number of births decreased from 44.38% to 41.24%. Around 74.24% women had first birth at the age of less than 21 years, 59.26% women had second birth and also 65.02% women had third birth at the age 21–30 years. Overall, both sexes of the child are equal for each birth and for all births the survival status of child is around 92%. In case of duration of the birth interval, maximum 45.65% have less than 24 months for first birth, 39.57% had 24–48 months for second birth, and 47.58% had more than 48 months for third birth.

Table 2 also shows mean and median duration of birth according to the different covariates. With the rising of wealth index, mothers and their partners education level, the birth interval significantly increased for two or more births, but it had no effect on first birth.

Table 3 presents the different values of hazard ratio of Cox proportional hazard model and frailty model. Rural women are significantly more likely to have experienced first, second and third birth intervals in comparison to urban women.

Highly educated mothers are significantly more likely to have experienced live birth in case of first birth interval (HR: 1.86; C.I.: 1.70–2.03) and significantly less likely to have experienced live birth in case of third birth interval (HR: 0.47; C.I.: 0.39–0.58) if compared to others. More generally, mothers with primary, secondary and higher education are less likely to experience the live birth than uneducated mother for second and third birth interval. Partners education (primary and secondary level) is a protective factor for the next live birth for second and third birth interval. Higher education of partners is more likely to experience to the live birth in case of first, second and third birth intervals in comparison to uneducated partners.

Female household head is more likely to experience the next live birth in comparison to male household head for first and second birth interval but less likely to experience the next live birth and significantly protective factor for third birth intervals (HR: 0.86; C.I.: 0.78–0.95). Mothers working status for first, second and third birth interval is less likely to the experience in comparison to non-working women and it is also a significantly protective factor for third birth intervals (HR: 0.94; C.I.: 0.88–1.00). Mass media plays an important role in protecting different birth intervals. Non-Muslim family is also significantly more likely to experience the next live birth in comparison to Muslim family for first birth interval (HR: 1.12; C.I.: 1.06–1.19) but less likely to experience the next live birth for third birth interval (HR: 0.88; C.I.: 0.79–0.97). Contraceptive use is a significant protective factor for third birth interval (HR: 0.90; C.I.: 0.85–0.96) and contraceptive use for first and second birth intervals are significantly more practiced compared to the non-users of contraceptive. Wealth index (rich and middle class family) is approximately equally likely to the experience in comparison to poor family. In case of first birth interval, previous birth interval is not used. But women with more than 48 months birth interval are significantly more likely to experience the next live birth for second birth interval (HR: 1.92; C.I.: 1.79–2.06).

Table 2
Estimated mean and median duration of first, second and third birth interval according to different categorical covariates.

Factor	Mean and median duration of first birth interval				Mean and median duration of second birth interval				Mean and median duration of third birth interval			
	Number (%)	Mean ± SE	Med	Sig.	Number (%)	Mean ± SE	Med	Sig.	Number (%)	Mean ± SE	Med	Sig.
Region/Division												
Bairisal	1571 (11.75%)	37.55 ± 1.05	28	< 0.001	1387 (11.60%)	69.68 ± 2.77	46	< 0.001	1048 (11.81%)	107.46 ± 4.35	53	< 0.001
Chittagong	2084 (15.59%)	32.35 ± 0.77	22		1853 (15.50%)	61.72 ± 2.39	40		1435 (16.18%)	87.54 ± 3.14	46	
Dhaka	2353 (17.60%)	39.75 ± 1.04	27		2083 (17.43%)	76.07 ± 2.37	50		1484 (16.73%)	140.97 ± 4.54	68	
Khulna	2000 (14.96%)	41.88 ± 1.28	28		1815 (15.19%)	86.72 ± 2.82	54		1326 (14.95%)	169.54 ± 5.35	81	
Rajshahi	1906 (14.26%)	43.21 ± 1.45	28		1700 (14.22%)	85.31 ± 2.97	55		1210 (13.64%)	156.93 ± 5.03	78	
Rangpur	1930 (14.44%)	37.42 ± 0.92	27		1769 (14.80%)	76.39 ± 2.86	46		1326 (14.95%)	138.94 ± 4.51	66	
Sylhet	1526 (11.41%)	38.92 ± 1.50	23		1345 (11.25%)	54.60 ± 2.12	36		1042 (11.75%)	72.53 ± 3.37	39	
Place of residence												
Urban	4731 (35.39%)	40.39 ± 0.81	27	< 0.001	4162 (34.82%)	90.52 ± 2.22	51	< 0.001	2931 (33.04%)	149.79 ± 3.24	72	< 0.001
Rural	8639 (64.61%)	38.24 ± 0.56	26		7790 (65.18%)	68.05 ± 1.21	43		5940 (66.96%)	124.06 ± 2.27	53	
Mothers education												
No education	3160 (23.64%)	45.50 ± 1.01	30	< 0.001	3023 (25.29%)	63.52 ± 1.73	36	< 0.001	2709 (30.54%)	101.14 ± 2.69	42	< 0.001
Primary	3764 (28.15%)	37.21 ± 0.76	25		3465 (28.99%)	62.94 ± 1.51	41		2803 (31.60%)	111.58 ± 2.71	52	
Secondary	5072 (37.94%)	35.65 ± 0.76	25		4370 (36.56%)	84.70 ± 2.06	55		2790 (31.45%)	159.47 ± 3.66	81	
Higher	1374 (10.28%)	37.96 ± 0.95	29		1094 (9.15%)	105.29 ± 4.50	66		569 (6.41%)	240.91 ± 8.55	.	
Partners education												
No education	3727 (27.88%)	41.55 ± 0.82	28	< 0.001	3528 (29.52%)	62.47 ± 1.56	38	< 0.001	3010 (33.93%)	102.78 ± 2.59	47	< 0.001
Primary	3549 (26.54%)	36.07 ± 0.84	24		3185 (26.65%)	64.46 ± 1.66	43		2409 (27.16%)	114.39 ± 3.15	52	
Secondary	3938 (29.45%)	38.39 ± 0.89	26		3390 (28.36%)	84.68 ± 2.37	51		2283 (25.74%)	157.90 ± 4.15	70	
Higher	2156 (16.13%)	39.51 ± 1.15	28		1849 (15.47%)	99.47 ± 3.15	60		1169 (13.18%)	190.61 ± 5.54	102	
Sex of household head												
Male	11815 (88.37%)	39.03 ± 0.51	26	0.122	10532 (88.12%)	74.14 ± 1.17	46	0.022	7810 (88.04%)	133.77 ± 2.05	58	0.137
Female	1555 (11.63%)	39.21 ± 1.14	27		1420 (11.88%)	88.57 ± 3.58	46		1061 (11.96%)	133.05 ± 4.79	59	
Mothers working status												
No	8996 (67.28%)	37.98 ± 0.55	26	< 0.001	7880 (65.93%)	72.81 ± 1.31	46	0.092	5673 (63.95%)	124.75 ± 2.22	57	0.001
Yes	4374 (32.72%)	40.90 ± 0.81	28		4072 (34.07%)	80.83 ± 1.99	46		3198 (36.05%)	144.55 ± 3.23	61	
Mass media exposure												
No	6642 (49.68%)	39.45 ± 0.66	26	0.498	5968 (49.93%)	68.37 ± 1.44	41	< 0.001	4579 (51.62%)	110.23 ± 2.30	50	< 0.001
Yes	6728 (50.32%)	38.55 ± 0.65	26		5984 (50.07%)	82.44 ± 1.62	51	< 0.001	4292 (48.38%)	157.71 ± 2.95	71	< 0.001
Religion												
Muslim	12073 (90.30%)	39.09 ± 0.49	26	0.768	10792 (90.29%)	74.92 ± 1.17	46	< 0.001	8040 (90.63%)	131.35 ± 1.99	57	< 0.001
Non-Muslim	1297 (9.70%)	37.64 ± 1.19	26		1160 (9.71%)	86.94 ± 3.84	51	< 0.001	831 (9.37%)	153.88 ± 5.74	74	< 0.001
Wealth index												
Poor	4780 (35.75%)	39.31 ± 0.73	27	< 0.001	4359 (36.47%)	63.90 ± 1.50	40	< 0.001	3439 (38.77%)	104.82 ± 2.58	48	< 0.001
Middle	2657 (19.87%)	37.89 ± 1.03	26		2362 (19.76%)	70.56 ± 2.10	45		1774 (20.00%)	115.33 ± 3.62	54	
Rich	5933 (44.38%)	39.14 ± 0.71	26		5231 (43.77%)	87.78 ± 1.95	52		3658 (41.24%)	166.64 ± 3.26	77	
Contraceptive use status												
No	5451 (40.77%)	52.04 ± 1.17	24	< 0.001	4442 (37.17%)	96.93 ± 2.23	46	< 0.001	3122 (35.19%)	127.73 ± 3.01	47	< 0.001
Yes	7919 (59.23%)	31.58 ± 0.28	30		7510 (62.83%)	62.48 ± 1.04	46		5749 (64.81%)	132.42 ± 2.33	64	
Mothers age												
≤20 years	9927 (74.24)	27.35 ± 0.17	23	< 0.001	3946 (33.02%)	27.35 ± 0.17	23	< 0.001	NA	NA	NA	NA
21–30 years	3219 (24.08)	56.22 ± 0.75	45		7083 (59.26%)	56.22 ± 0.75	45		NA	NA	NA	
≥31 years	224 (01.68)	248.54 ± 11.42	234		923 (7.72%)	248.54 ± 11.42	234		NA	NA	NA	
Duration of birth												
< 24 Months	6104 (45.65%)	15.61 ± 0.06	15	< 0.001	2517 (21.06%)	18.35 ± 0.09	19	< 0.001	1540 (17.36%)	18.70 ± 0.11	20	< 0.001
24–48 Months	4738 (35.44%)	33.95 ± 0.11	33		4730 (39.57%)	33.75 ± 0.11	36		3110 (35.06%)	36.23 ± 0.14	36	
> 48 Months	2528 (18.91)	96.89 ± 1.78	70		4705 (39.37%)	129.30 ± 2.19	78		4221 (47.58%)	215.85 ± 2.87	123	
Sex of previous child												
Male					6110 (51.12%)	81.28 ± 1.67	48	< 0.001	4465 (50.33%)	148.12 ± 2.82	64	< 0.001
Female					5842 (48.88%)	70.39 ± 1.45	44		4406 (49.67%)	115.95 ± 2.36	53	

(continued on next page)

Table 2 (continued)

Factor	Mean and median duration of first birth interval			Mean and median duration of second birth interval			Mean and median duration of third birth interval					
	Number (%)	Mean ± SE	Med	Sig.	Number (%)	Mean ± SE	Med	Sig.	Number (%)	Mean ± SE	Med	Sig.
Survival status of previous child												
Died												
Alive	1174 (9.82%)	38.07 ± 1.68	25	< 0.001	10778 (90.18%)	80.77 ± 1.24	49	< 0.001	659 (7.43%)	48.21 ± 2.86	28	< 0.001
Previous birth interval												
< 24 Months	5482 (45.87%)	69.19 ± 1.52	46	< 0.001	4301 (35.99%)	72.99 ± 1.64	46	< 0.001	1540 (17.36%)	18.70 ± 0.11	20	< 0.001
24–48 Months	4301 (35.99%)	72.99 ± 1.64	46		2169 (18.15%)	86.90 ± 2.60	47		3110 (35.06%)	36.23 ± 0.14	36	
> 48 Months	2169 (18.15%)	86.90 ± 2.60	47						4221 (47.58%)	215.85 ± 2.87	123	
Overall		39.05 ± 0.47	26			76.38 ± 1.13	46			135.27 ± 1.93	58	

Med, Median; SE, Standard Error; Sig, Significance.

4. Discussion

As far as we know, there is not yet any study done on different birth intervals using BDHS 2014 data. To analyze the birth intervals, different statistical techniques and models are developed and carried out. Therefore, there is no scope for compares the developed statistical techniques and models in the present study with those reported in other studies. But it is important to compare this study with studies carried out in other countries.

Bangladesh is the world's eighth most populous country with 160 million people.²⁴ The controlling of population growth encourages the people to longer births intervals.²⁵ The estimated average duration of first two live births are 39 and 76 months, however, it is higher than the average child spacing period of Saudi Arabian children.^{14,26} This study also found that the estimated median intervals of first two live births are 26 and 46 months but the median birth interval of 55 developing countries was about 32 months.²⁷ Higher education of mother is a significant protective factors for the third birth interval in comparison to first and second birth interval but Singh et al., Rajaram et al. and Gandotra et al. found that higher education of woman was a protective factor for first birth interval.^{28–30} Mass media is a protective impact on higher order birth interval. This finding is supported by Singh et al. and Gandotra et al.^{28,30}

Findings of this study indicate that without any doubt the mothers working status is a more significant protective factor for the first and third birth intervals. This finding is supported by Singh et al. but not by Trussell et al. and Richter et al., who identified that employed women were significantly less likely to go for the next birth.^{28,31,32} The covariates contraceptive use is a significant protective factor for third birth interval but not protective factor for first and second birth interval. The result of third birth interval is supported by Singh et al.²⁸ Mothers in rural area are not protective for all birth intervals and this result is supported by Singh et al., and Swenson & Thang for first and second birth interval.^{28,33} Mothers age is a significant protective factor for all birth intervals and is supported by Swenson & Thang.³³ Rich families are also more protective for third birth interval and this is supported by Yohannes et al.¹ However, previous female child is not a protective factor for the second and third birth intervals. The present study does not indicate the likelihood of it being a protective factor at any birth interval. Survival status of previous child emerged as a significant protective factor for the second and third birth intervals. This finding is in line with many other studies like Oheneba Sakyi & Heaton, Ojha and Palloni & Hantamala.^{34–36} If the number of birth increases, mothers education (primary, secondary and higher education), partners education (primary and secondary) and contraceptive use also decrease.

5. Conclusion

In this study, all analysis has been used to investigate the association and figure out the potential determinants of first, second and third birth interval in Bangladesh using BDHS-2014 data. This study shows that some important covariates, which have been used in the models and varied among the birth intervals. Using log rank test we have found that the covariates division, place of residence, mothers education, partners education, contraceptive use, mothers age, sex of the previous child, duration of previous birth are significantly associated with all considered number of births. The covariates place of residence, contraceptive use status and mothers age have significant impact on all birth intervals. Mothers education, sex of household head, mothers working status, and religion are significant factors for first and third birth intervals. Previous sex of the child, previous survival status of child and previous duration of birth are also significant factors for second and third birth intervals. However, partners education and wealth index have no significant impact on any birth intervals. This study emphasizes the importance of increasing the partners education, regional and religion studies, role of household head and mass media

Table 3

Estimates of Hazard Ratio (95% CI) and p-value of Cox proportional hazard model for first birth interval and Frailty model for second and third birth intervals according to different categorical variables.

	First birth interval		Second birth interval		Third birth interval	
	HR (95% CI)	p-value	HR (95% CI)	p-value	HR (95% CI)	p-value
Region/Division						
Barisal	1.00		1.00		1.00	
Chittagong	1.30 (1.21,1.39)	< 0.001	1.38 (1.26,1.51)	< 0.001	1.16 (1.04,1.29)	0.006
Dhaka	1.07 (1.00,1.15)	0.055	0.93 (0.85,1.02)	0.100	0.85 (0.76,0.95)	0.003
Khulna	0.96 (0.89,1.03)	0.238	0.77 (0.70,0.85)	< 0.001	0.74 (0.66,0.83)	< 0.001
Rajshahi	0.97 (0.90,1.04)	0.342	0.77 (0.70,0.84)	< 0.001	0.72 (0.64,0.81)	< 0.001
Rangpur	1.00 (0.93,1.07)	0.983	0.87 (0.80,0.96)	0.003	0.72 (0.65,0.81)	< 0.001
Sylhet	1.47 (1.36,1.59)	< 0.001	1.62 (1.47,1.79)	< 0.001	1.41 (1.26,1.58)	< 0.001
Place of residence						
Urban	1.00		1.00		1.00	
Rural	1.05 (1.01,1.09)	0.024	1.10 (1.04,1.16)	0.001	1.10 (1.03,1.18)	0.005
Mothers education						
No education	1.00		1.00		1.00	
Primary	1.16 (1.11,1.22)	< 0.001	0.89 (0.83,0.95)	< 0.001	0.75 (0.70,0.81)	< 0.001
Secondary	1.32 (1.25,1.40)	< 0.001	0.72 (0.67,0.78)	< 0.001	0.53 (0.48,0.58)	< 0.001
Higher	1.86 (1.70,2.03)	< 0.001	0.89 (0.79,1.01)	0.070	0.47 (0.39,0.58)	< 0.001
Partners education						
No education	1.00		1.00		1.00	
Primary	1.10 (1.04,1.15)	< 0.001	0.95 (0.89,1.02)	0.140	0.98 (0.91,1.06)	0.640
Secondary	1.05 (0.99,1.11)	0.112	0.92 (0.86,0.99)	0.024	0.99 (0.90,1.08)	0.780
Higher	1.07 (0.99,1.15)	0.076	1.10 (0.99,1.21)	0.066	1.15 (1.01,1.32)	0.033
Sex of household head						
Male	1.00		1.00		1.00	
Female	1.07 (1.01,1.13)	0.033	1.03 (0.95,1.11)	0.520	0.86 (0.78,0.95)	0.002
Mothers working status						
No	1.00		1.00		1.00	
Yes	0.95 (0.91,0.99)	0.007	0.95 (0.91,1.00)	0.052	0.94 (0.88,1.00)	0.035
Mass media exposure						
No	1.00		1.00		1.00	
Yes	0.99 (0.94,1.04)	0.622	0.98 (0.91,1.04)	0.400	0.97 (0.89,1.04)	0.380
Religion						
Muslim	1.00		1.00		1.00	
Non-Muslim	1.12 (1.06,1.19)	< 0.001	1.05 (0.97,1.14)	0.260	0.88 (0.79,0.97)	0.014
Wealth index						
Poor	1.00		1.00		1.00	
Middle	1.00 (0.95,1.06)	0.941	0.98 (0.92,1.06)	0.660	1.04 (0.96,1.14)	0.330
Rich	1.00 (0.94,1.06)	0.921	1.01 (0.93,1.09)	0.890	1.02 (0.92,1.12)	0.720
Contraceptive use status						
No	1.00		1.00		1.00	
Yes	1.36 (1.31,1.41)	< 0.001	1.27 (1.21,1.34)	< 0.001	0.90 (0.85,0.96)	0.002
Mothers age						
≤ 20 years	1.00		1.00		1.00	
21–30 years	0.31 (0.30,0.33)	< 0.001	0.20 (0.19,0.21)	< 0.001	0.22 (0.20,0.25)	< 0.001
≥ 31 years	0.04 (0.03,0.05)	< 0.001	0.02 (0.01,0.03)	< 0.001	0.02 (0.01,0.03)	< 0.001
Sex of previous child						
Male			1.00		1.00	
Female			1.15 (1.10,1.20)	< 0.001	1.24 (1.17,1.32)	< 0.001
Survival status of previous child						
Died			1.00		1.00	
Alive			0.41 (0.38,0.45)	< 0.001	0.50 (0.45,0.55)	< 0.001
Previous birth interval						
< 24 months			1.00		1.00	
24–48 months			1.23 (1.17,1.30)	< 0.001	1.06 (0.99,1.14)	0.120
> 48 months			1.92 (1.79,2.06)	< 0.001	0.99 (0.91,1.08)	0.840

HR, Hazard Ratio; 95% CI, 95% confidence interval.

exposure, and awareness of contraceptive use.

Ethics approval

We have used secondary dataset taken from the Demographic and Health Surveys (DHS) Program website (<https://dhsprogram.com/data/>). No ethics approval is required for this dataset.

Conflicts of interest

None declared.

Claiming interest

Authors are not interested to face any claim about their study.

Author's contributions

Benojir Ahammed have designed the study and involved in data analysis and interpreted the result of the study and finally drafted the main manuscript. Md. Rasel Kabir and Md. Menhazul Abedin have contributed in statistical analyses and provided overall help to prepare the manuscript. All authors have read and approved the final version of the manuscript.

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