Demography India (2016) ISSN: 0970-454X
Vol.45, Issue: 1&2, pp: 77-88

Research Article

Heterogeneity in Waiting Time to First Conception in Uttar Pradesh: A Parametric Regression Analysis

Brijesh P. Singh[1], Gunjan Singh[2,*] & K. K. Singh[3]

Abstract

An important problem in the study of fertility is the estimation of the fecundability of the population. Fecundability is the rate at which a sexually active non-contraceptive ovulating female conceives. The waiting time to first conception plays an important role in determination of level of fecundability of a female. The objective of the study is to observe factors affecting the duration of waiting time to first conception through Cox's proportional hazards model (semi-parametric regression) and Weibull regression (a parametric regression). The data has been used for the analysis is taken from NFHS-III for the females of Uttar Pradesh.

Introduction

Fertility analysis has the central importance in demographic analysis as births are a vital component of population growth. The study of fertility also provides important information about female's reproductive behavior and her attitude. Many studies have been carried out to look at the fertility variations across states and the factors which are influencing fertility level time to time (Kalan &Udry 1986, Rao 1987, Rao & Balakrishnan 1988, Singh et al. 1992, Nath et al. 1993, 1995, Mukherjee et al. 1996, Hoque et al. 2012). It is worthwhile to mention here that socio-economic and cultural factors affect fertility mainly through biological factors. To determine these factors as well as tempo and quantum of the fertility in the society, different type of birth intervals such as first birth interval, last closed birth interval, most recent closed birth interval, straddling birth interval, interior birth interval and forward birth interval offer an interesting and fruitful area for scientific research.

Among these, first birth interval, plays an important role in determination of fertility level of the society because the length of first birth interval can be considered as start of parenthood, i.e. with the couple starts their reproductive process. This interval has important place for analysis of fertility pattern because it is free from PPA and the females usually do not use any type of contraception before giving first birth.

In traditional society of India the use of contraception is very rare, prior to first conception. Therefore, the timing of first birth can be considered an actual measure of fertility if the female is adequately mature at the time of marriage. There is a need to determine how different factors influence the duration of the first birth interval in different Indian social contexts for these days. Few studies (Nath et al. 1994, 1999) have estimated the net effect of each explanatory variable using multivariate hazards regression techniques.

The concept of fecundability derives its importance for the study of human fertility from the fact that it is one of the principal determinants of fertility and by which the impact of fertility regulation can be assessed. Fecundability affects fertility through its relationship with the average time required for a conception. The level of fecundability in a population has been a focus of research interest ever since, Gini (1924), who first defined fecundability as “the probability of conception to a female during a menstrual cycle”.

[1]Associate Professor, Department of Statistics, Institute of Science, Banaras Hindu University, Varanasi
[2]Assistant Professor (Statistics), Amity School of Applied Sciences, Amity University, Lucknow
[3]Professor, Department of Statistics, Institute of Science, Banaras Hindu University, Varanasi
*Corresponding author: Gunjan Singh, Email: gunjan.stat@gmail.com

In homogeneous population, fecundability can be measured as the reciprocal of the first birth interval but in reality, fecundability is not same for all females because of the different biological and social characteristics. In such a heterogeneous population it is expected that the average length of first birth interval is longer than that in homogeneous case, females with the higher fecundability conceive quicker, in comparison to the lower fecundable female**s**. Gini (1924) proposed a model to estimate fecundability from data on the first live births based on some assumptions. Henry et al. (1964) used this estimate of fecundability to make inferences about the presence of feotal loss. Further, Henry et al. (1964) and Sheps et al. (1965) have studied the biases in the estimates of Gini (1924).

Lachenbruch et al. (1967) estimated fecundability based on coital frequency and the viability of the ovum and sperm. Further, Brass (1958), Singh (1963), Sheps (1965) and Singh (1969) fitted probability models under some assumptions to the distribution of birth intervals and number of births attained within a certain period of time for a group of females to estimate the fecundability. Mujumdar (1970) have studied the fecundability based on observation on first birth intervals with censoring at higher values, assuming that they introduce systematic bias into the estimates. Goldman et al. (1985) examined interval between marriage to first birth using the data of World Fertility Survey for number of countries and observed that in addition to several methodological problems there are other sources of bias. Islam et al. (1997) estimated levels and trend of fecundability using Singh et al. (1971). Further, in 2012 Hoque et al. estimated level and trends of fecundability using regression and life table technique.

To estimate level and trend of fecundability waiting time to first conception, which is generally taken as nine months smaller than the interval between marriage and first birth plays an important role in determination of fertility. Therefore, in this paper the waiting time to first conception in place of first birth interval has been analyzed under different combinations of explanatory variables to know the current situations of fertility pattern. The main objective of this paper is to observe factors affecting the duration of waiting time to first conception through Cox's proportional hazards model (semi-parametric regression) and Weibull model (parametric regression).

Data and Methodology

Data has been taken from NFHS-III for currently married females aged 15-49 years of the state Uttar Pradesh. To avoid recall bias, only those females who have given first births in last 10 years have been considered, i.e., 10 year prior to the survey date as well as data in this study restrict the waiting time to first conception up to 120 months. Here total sample size obtained were 1898, out of which 310 cases are censored with the complete information on factors such as place of residence, religion, caste, education, age at first marriage, family type, spousal age difference and standard of living, which have been considered to have an influence on waiting time to first conception.

Analysis is done to observe the factors which are affecting the duration of waiting time to first conception using Cox's proportional hazards regression technique and Weibull regression technique. Data on first birth intervals collected under retrospective surveys are considered to be useful for determining tempo and quantum aspects of fertility. The incompleteness of the fertility histories of females, except for the older cohort, is main obstacle in the study of birth interval data obtained from retrospective survey. In this type of study, analyst has to face two types of problem, namely sample selectivity and censoring (Yamaguchi, 1991). In such a situation, the survival models, which encompass both the complete (having at least one birth at the time of survey date) as well as censored observations (childless females at the time of survey date), are considered to be an appropriate technique for analyzing such data. Thus, the problem of censoring can be overcome through the application of life table techniques (Namboodiri & Suchindran, 1987) or by using Life table technique in combination with multivariate procedures (Cox, 1972).

The length of the waiting time to first conception depends on many factors. It is analytically useful to supplement life table analysis with multivariate procedures. Further, it is believed that the hazard of first conception is age dependent and it is increasing with age. Thus, in order to get the net effect of each explanatory variable; Weibull regression techniques has been used as an alternative

technique instead of Cox's proportional hazards regression technique. Weibull regression captures the heterogeneity in the phenomenon having increasing hazard better than a non-parametric regression such as Cox's proportional hazard regression. A brief description of these methods and the notations are given below:

Cox's Proportional Hazards Regression

The hazards regression model (Cox, 1972) combines the merits of both life table and regression techniques. The hazard or instantaneous-risk function of first conception at time t due to the hazard regression function is given by

$$h(t, z) = h(t)exp(\beta z)$$

where $h(t,z)$ is the instantaneous risk of having a first conception at time t (given that there is no prior conception for a female with a vector of covariates z), $h(t)$ is an arbitrary non-negative unspecified baseline hazard function not dependent on the covariates and is a vector of unknown regression co-efficient to be estimated. Here the exponentiated value of the regression coefficient, $exp(\beta)$, represents the relative risk of other groups in relation to specified baseline group. It becomes unity when no covariate is present, with values greater (or less) than unity indicating the relative risk of having first conception is greater (or less) for this group than that of the reference group.

Weibull Regression

Weibull regression is suitable for analyzing survival data. This is an alternative method to Cox's proportional hazards model and it offers following advantages which are as follows:

- The analyst can estimate survival probabilities for individuals, together with confidence intervals.
- A single parameter describes whether individuals have decreasing, stable, or increasing risk (hazard) functions. This helps to test the theoretical predictions about rising or falling risks.
- The method is an M-estimate (from robustness theory), which makes available several practical results.

The classical Weibull regression model assumes that the subpopulation defined by the observed covariates is homogeneous. Since it is not practical to measure all important environmental, physiological, and behavioral differences the assumption of homogeneity is most likely invalid. In many situations individuals with the same values for all observed covariates will have important differences which cannot be measured or which were not measured during study. These unknown or unmeasured differences make the subpopulations defined by the observable covariates heterogeneous Trussell et al. (1990). Assuming that the subpopulations are homogeneous when they are heterogeneous potentially creates misleading statistical inference, because unobserved heterogeneity can lead to systematic changes in the composition of the population over time and the changes which may create the illusion of effects that are not really present Trussell et al. (1990).

Let Z be a random variable, termed frailty, and let $\mu(y|Z = z)$ be the force of first conception at time y for an individual with frailty $Z=z$. Let $\mu_Y|1(y|1)$ be a standard hazard for a standard individual whose value of risk of first conception is one. The "standard individual" may or may not be an individual in the population of interest. The frailty modifies multiplicatively the standard hazard, such that an individual's hazard is related to the standard hazard by multiplying the standard hazard by the realization of $Z=z$. Thus,

$$\mu(t|Z = z) = z*\mu_Y\ |1(y|1)$$

An individual with value of Z equal to two is twice more likely to get first conception than the standard individual. Implicit in the definition of Z is that the range of Z is $(0, \infty)$ Vaupel et al. (1979). Each individual has a value of frailty, Z=z, which can be thought of as a nuisance parameter. These nuisance parameters, are treated as a sequence of identical and independent observations from an unknown distribution. The Weibull hazard for an individual with frailty Z=z is of the form,

$$\mu_Y|Z(y|z) = z\alpha y^{(\alpha-1)} \quad z>0,\ \alpha>0$$

Where α is a shape parameter. In this study Weibull regression analysis using a conditional proportional hazards model, in combination with the gamma frailty, a whole new model is introduced to observe the heterogeneity among females. By taking a gamma frailty model, our objective is to find an appropriate model for the baseline hazard function and to compare with a standard Weibull model.

Results

Table 1 present the percentage distribution of females in the sample by some socio demographic characteristics and summary of the descriptive measure. From panel 1,it is observed that 42 percent females in the sample comes from urban areas and the rest 58 percent from rural areas. Tri-mean for waiting time to first conception is found to be 10.0 months for urban females, whereas, it is very high, i.e., 18.0 months for the females belong to rural area. It clearly gives us the impression that urban females are more likely to conceive earlier (after marriage) in comparison to rural females.

Value of spread of waiting time to first conception is 16.0 months among urban females, however, it is 24.0 months among rural females. It means that there is less variation in the waiting time to first conception among urban females than that of rural females. In the sample more than 80 percent females belong to Hindu religion and remaining are from Muslim religion. Tri-mean for waiting time is observed 11.25 months for Muslim females, whereas, it is found high for Hindu females (15.0 months).

Thus, it can be inferred that Muslim females are more likely to get first conception after marriage earlier than Hindu females. Spread is found to be 22.0 months for Hindu females and 17.0 months for Muslim females. If the analysis is done caste wise then 24.1, 47.0 and 28.9 percent females belong to SC/ST, OBC and others caste groups respectively.

Value of tri-mean for waiting time is 15.25, 15.0 and 11.75 months for SC/ST, OBC, and others caste respectively. From panel 4 of Table 1, it is observed that about 60 percent females are educated up to primary level, 29.5 percent females have education more than primary but up to secondary education and 12.8 percent females are having education more than secondary level. Here the females who have no formal education and the females whose education is up to primary level have been merged due to the fact that the characteristics under study are almost same for these two groups. Also the number of observations in the group who have formal education and her education is up to primary level is small.

Tri-mean for waiting time to first conception is observed as 17.25, 11.31 and 9.0 months among the females up to primary, secondary and highly educated (more than secondary level) respectively. From the result it is clear that as education is increasing the interval between marriage to first conception is decreasing. Also, spread is observed as 23.0, 16.75 and 16.0 months for the females with education up to primary, secondary as well as for highly educated females. It shows that variation in waiting time to first conception is very high among primary educated females, whereas, it very low among the females whose education is higher than primary level.

From the Table it is observed that in the sample the percent of females whose age at marriage is below 16 years is 23.4. Similarly the percent of females whose age at marriage is 16-18 years and above 18 years are 29.2 and 47.4 respectively. From the result it is clear that more than 50 percent females are married before 18 years. Value of tri-mean for waiting time is found very high, i.e., 22.75 months for the females whose age at first marriage is below 16 years as compared to females whose age at first marriage is 16-18 years and above 18 years and for these it is 15.25 months and 10.0 months respectively. Negative relationship between age at marriage group and waiting time to first conception is observed from the data. As age at marriage group is increasing the duration between marriage and first conception is decreasing. Variation is also found very high among females whose age at first marriage is below 16 years as compared to females whose age at first marriage is 16-18 years and above 18 years as spread is found 29.00 months for the females whose age at first marriage is below 16 years and for rest it is 21.00 months and 16.00 months respectively.

It is found that two-fifth of the females belong to nuclear family and the rest three-fifth of the females belong to extended family. Also value of tri-mean for waiting time to first conception is observed as 15.50 months for nuclear family and 12.75 months for extended family and spread value is 22.00 for nuclear family and 19.00 months for extended family.

It is found from the results that 21.7, 34.3 and 44.0 percent females belong to the household with low, medium and high standard of living respectively. Tri-mean for waiting time is observed 18.25 months for females who belong to low SLI households, whereas, its value is very less for the females who belong to high SLI households which is observed as 16.50 months. Spread is found 22.0, 24.0 and 16.0 months for the females who belong to low, medium and high SLI households respectively. It is worthwhile to mention that females who belong to high SLI households are more likely to get first conception earlier than females belong to low SLI households as well as medium SLI households.

Among all the females 6.2 percent females are those whose age at time of survey is greater than or equal to her husband's age, whereas, 53.3 percent females are those who are 1-4 years younger than her husband and 40.5 percent females are those who are more than 4 years younger than her husband. The value of tri-mean for waiting time to first conception is observed high for the females whose husband's age is less than equal to her husband, i.e., 15.50 months as compared to females whose husband is 1-4 years elder and husband is more than 4 years elder, i.e., 14.25 months and 13.75 months respectively. Following this, the value of spread is also showing the same results in the same direction, as it is 26.0, 21.0 and 19.0 months for the females whose husband is equal or younger, husband is 1-4years elder and husband is more than 4 years elder respectively. Here it is to be noted thatboth tri-mean and spread is calculated only for the females having at least one birth and censored cases are excluded from the analysis.

Table 2 shows the results of univariate Cox's proportional hazard analysis to assess the influence of some socio demographic characteristics on waiting time to first conception. From Table 2 it can be observed that urban females are 51 percent more risk to get first conception as compared to rural females and the difference is highly significant. Also Hindu females are 19 percent less risk to get first conception as compared to Muslim females. If we consider the educational status of female then it is observed that as the educational level group is increasing the risk to get first conception among the females is also increasing. It can be also observed that as the age at first marriage group increases the risk to get first conception increases significantly. Further, the females who belong to medium and high standard of living the chance to get first conception is 3 percent and 34 percent higher as compared to females who belong to the household with low standard of living. According to spousal age difference it is observed that female whose husband is equal or younger has 27 percent less likely chance to get first conception as compared to female whose husband is 1-4 years elder and the difference is significant. On the other hand female whose husbands are more than 4 years elder has 9 percent more likely to get first conception as compared to female whose husband is 1-4 years elder. The result clearly show that there is no difference in waiting time to first conception whether the female lives in nuclear family or she is living in joint family system.

Table 3 shows the results of two multivariate logistic regression models to assess the variables which have effect on waiting time to first conception after controlling other socio-demographic variables. In these models, only the variables which are significant in the univariate model have been considered. According to Model-I urban females have 36 percent more chance to get first conception in comparison of females who belong to rural area and the difference is highly significant. Also Hindu females have 18 percent less likely to get first conception as compared to Muslim females. A positive correlation is observed between education of female and waiting time to first conception. As the education of female is increasing the waiting time to first conception is increasing significantly. It is also observed that as the age at first marriage increases the waiting time to get first conception increases significantly. There is no effect of standard of living on waiting time to first conception.

Model-II includes are new variable i.e. spousal age difference. By introducing this variable in the model slight changes in the hazards of other covariates on the waiting time to first conception are

observed. The variable spousal age difference which was introducing in the Model-II affects the waiting time to first conception significantly. It is observed that females whose husband is equal or younger are 25 percent less likely to get first conception as compared to females whose husband are 1-4 years elder. On the other hand females whose husbands are more than 4 years elder are 14 percent more likely to get first conception as compare to females whose husband are 1-4 years older. It is also evident that -2loglikelihood of Model-II is smaller than -2log likelihood of Model-I, which indicates that Model-II, gives better explanation of the data.

Table 4 shows the Weibull regression analysis (homogeneous model) to assess the influence of some socio-demographic characteristics on waiting time to first conception. Almost similar risk of first conception is observed by using Weibull distribution as it was observed using Cox's proportional hazards model for each independent variables. According to homogeneous model urban females are 34 percent more likely to get first conception.

Hindu females are 19 percent less likely to get first conception soon after marriage as compared to Muslim females and it is significant. If we consider the risk of getting first conception after marriage according to educational level it is observed that as the educational level of female is increasing risk is also increasing. Furthermore, it is observed that as the age at first marriage of females increases the risk to get first conception increases significantly. It is also observed that females whose husbands are equal or younger are 28 percent less likely to get first conception as compared to the females whose husband are 1-4 years elder. On the other hand females whose husbands are > 4 years elder those females are 15 percent more likely to get first conception as compared to the females whose husbands are 1-4 years elder.

Discussion

Study of interval between marriage to first conception is significant because they signal the entry of female into the state of motherhood. Results presented here show that, in the absence of contraception the females of Uttar Pradesh, India experience usually longer waiting time to first conception. Abstinence from coitus is a cultural practice scrupulously observed for various reasons by most couple in rural India and other traditional (Mahadevan, 1979, Santow, 1978). In recent study Hoque et al. (2012) have shown that fecundability is high among urban females as compared to rural females. He has also shown that if it is compared religion-wise then Muslim females are more fecund than Hindus. Similar result is observed in the present analysis. The interval between marriage to first birth is longer as fecundability is found low among Hindu females because in Hindu religion many social custom and taboos practices are present (Nath et al., 1993) and due to which this interval become longer and thus lower fecundability is observed among Hindus than Muslims. Regarding the role of education and timing of first conception, it appears much that much of the influence of education in timing of first conception is through a delay in entry into marriage rather than a delay in entry into motherhood after marriage.

Age at marriage is the most important factor explaining fecundability of the study population. A negative relationship is observed between the age at marriage of the females and the average waiting time to first conception which were also observed in the studies Bumpass (1969), Hoque et al. (2012), Freedman (1975), Jolly (1981) and Vaidyanathan (1989). Most of the marriages are arranged by parents or elderly member of the household. Usually couple starts their conjugal life in a joint family, only in later years after becoming self-supporting they separate from the parental household. The custom of frequent visits to parents in early years of marriage is even more frequent for brides marrying at younger ages.

Also if the females are married at younger ages they attain menarche during the period of observation and thus lengthening the period between marriages to first conception. Some females whose age is low at the time of marriage may be in the period of adolescent sub fecundity (Henry, 1966). In this study first time spousal age difference is taken as a factor which may affect waiting time to first conception. Results shows that when a female is elder or equal to her husband’s age, then there is less chance to get first conception as compared to those whose husbands are 1-4 years elder. On the

other hand when a female is more than 4 years younger to her husband's age then there is more chance to get first conception as compared to those whose husbands are 1-4 years elder. It can be explained with the fact that for a couple as the age of male partner is increasing and female partner is decreasing male partner domination increases in order to take decision about first birth as well as biologically male partner become more mature.

Table 1: Descriptive measures and percentage distribution of females in the sample by some socio demographic characteristics

Characteristics	Definition	Percent	Waiting time to first conception*	
			Tri-mean	Spread
Place of residence				
Urban	Residence in the urban area	42.0	10.00	16.00
Rural	Residence in the rural area	58.0	18.00	24.00
Religion				
Hindu	Females belonging to Hindu religion	81.9	15.00	22.00
Muslim	Females belonging to Muslim religion	18.1	11.25	17.00
Caste				
SC/ST	Female belonging to SC/ST caste	24.1	15.25	19.00
OBC	Female belonging to OBC caste	47.0	15.00	20.00
Others	Female belonging to others caste	28.9	11.75	21.00
Education				
Primary	Female is primary educated	57.7	17.25	23.00
Secondary	Female is secondary educated	29.5	11.31	16.75
Higher	Female is highly educated	12.8	9.00	16.00
Age at first marriage				
Below 16	Female's age at first marriage < 16 years	23.4	22.75	29.00
16-18	Female's age at first marriage 16-18 years	29.2	15.25	21.00
Above 18	Female's age at first marriage > 18 years	47.4	10.00	16.00
Type of family				
Nuclear	Female belonging to nuclear family	40.3	15.50	22.00
Extended	Female belonging to extended family	59.7	12.75	19.00
Standard of living				
Low	Female belonging to low SLI household	21.7	18.25	22.00
Medium	Female belonging to medium SLI household	34.3	16.50	24.00
High	Female belonging to high SLI household	44.0	11.00	16.00
Spousal age difference				
Husband ≤ wife	Female elder than or equal to her husband	6.2	15.50	26.00
Husband ≥ 1-4 yrs wife	Female 1-4 years younger than her husband	53.3	14.25	21.00
Husband > 4 yrs wife	Female more than 4 years younger than her husband	40.5	13.75	19.00
Total	Total females in the sample (1898)	100.0	14.00	20.00

*Calculated only for the females having at least one birth (excluded censored case)

Table 2: Univariate Cox's proportional hazards analysis to assess the influence of some socio demographic characteristics on waiting time to first conception

Variables	Hazard Ratio	p-value	95% Confidence interval	
			Lower	Upper
Place of residence[1]				
Urban	1.513	0.000	1.366	1.677
Religion[2]				
Hindu	0.809	0.001	0.709	0.922
Caste[3]				
OBC	1.025	0.700	0.904	1.163
Others	1.130	0.086	0.983	1.299
Education[4]				
Secondary	1.289	0.000	1.150	1.447
Higher	1.469	0.000	1.256	1.720
Age of first marriage[5]				
16-18	1.282	0.000	1.118	1.470
Above 18	1.433	0.000	1.264	1.625
Type of family[6]				
Nuclear	1.053	0.321	0.951	1.165
Standard of living[7]				
Medium	1.038	0.597	0.905	1.189
High	1.343	0.000	1.178	1.531
Spousal age difference[8]				
Husband ≤ wife	0.734	0.007	0.586	0.919
Husband 4 years > wife	1.095	0.090	0.986	1.215

Reference category: 1: Rural, 2: Muslim 3: SC/ST, 4: Primary, 5: Below 16, 6: Extended, 7: Low, 8: Husband 1-4 years ≥ wife

Table 3: Multivariate Cox's proportional hazards analysis to assess the influence of some socio demographic characteristics on waiting time to first conception

Variables	Hazard ratio	p-value	95 % confidence interval		Hazard ratio	p-value	95 % confidence interval	
			Upper	Lower			Upper	Lower
	Model-I				Model-II			
Place of residence[1]								
Urban	1.356	0.000	1.199	1.533	1.337	0.000	1.182	1.512
Religion[2]								
Hindu	0.815	0.003	0.711	0.933	0.827	0.006	0.721	0.947
Education[3]								
Secondary	1.180	0.012	1.038	1.342	1.156	0.027	1.016	1.315
Higher	1.187	0.082	0.979	1.439	1.177	0.096	0.971	1.426
Age of first marriage[4]								
16-18	1.204	0.010	1.046	1.385	1.242	0.003	1.078	1.430
Above 18	1.200	0.010	1.045	1.379	1.262	0.001	1.096	1.454
Standard of living[5]								
Medium	0.963	0.599	0.838	1.107	0.975	0.720	0.848	1.121
High	0.987	0.875	0.841	1.159	1.001	0.987	0.853	1.176
Spousal age diference[6]								
Husband ≤ wife	–	–	–	–	0.751	0.013	0.599	0.941
Husband 4 years > wife	–	–	–	–	1.141	0.015	1.026	1.269
-2 Log Likelihood	20008.38				19992.62			

Reference category: 1: Rural, 2: Muslim, 3: Primary, 4: Below 16, 5: Low, 6: Husband 1-4yrs ≥ wife

Table 4: Weibull regression analysis to assess the influence of some socio demographic characteristics on waiting time to first conception

Variables	Hazard Ratio	p-value	95 % confidence interval	
			Lower	Upper
Place of residence[1]				
Urban	1.342	0.000	1.186	1.518
Religion[2]				
Hindu	0.809	0.002	0.706	0.926
Education[3]				
Secondary	1.178	0.012	1.036	1.340
Higher	1.196	0.068	0.987	1.449
Age of first marriage[4]				
16-18	1.277	0.001	1.109	1.470
Above 18	1.292	0.000	1.121	1.488
Standard of living[5]				
Medium	0.982	0.797	0.854	1.129
High	1.007	0.936	0.858	1.181
Spousal age diference[6]				
Husband ≤ wife	0.722	0.005	0.577	0.905
Husband 4 years > wife	1.152	0.009	1.035	1.281

Reference category: 1: Rural, 2: Muslim, 3: Primary, 4: Below 16, 5: Low, 6: Husband 1-4yrs ≥ wife

References

Amin, S. & Bajracharya, A. (2011) 'Marriage and First Birth Intervals in Early and Late Marrying Societies: An Exploration of Determinants', *Population Council*.

Bhattacharya, B. N. & Singh, K. K. (1983) 'On A Modification of Life Table Technique for Analysis of Birth Interval Data and Its Application', *Janasamkhya*, 1(2), 99.

Bhattacharya, B. N., Pandey, C. M. & Singh, K. K. (1988) 'Model for First Birth Interval and Some Social Factors', *Mathematical Biosciences*, 92, 17.

Bongaarts, J. (1975) 'Why High Birth Rates Are So High, Population and Development', 1(2),pp. 289-296, *Population council*.

Brass, W. (1958) 'The Distribution of Births in Human Population', *Population Studies*, 12, 51.

Bumpass, L. (1969) 'Age at Marriage as A Variable in Socio-economic Differentials in Fertility', *Demography*, 6, pp. 45-54.

Chiang, C. L. (1968) 'Introduction to Stochastic Process in Biostatistics', *John Wiley and Sons, New York*.

Cox, D. R. (1972) 'Regression Models and Life Tables (with discussion)', *Journal of Royal Statistical Society (Series B)*, 34, pp. 184-220.

Freedman, R. (1975) 'The Sociology of Human Fertility', *John Wiley and Sons,New York*.

Goldman, N., Westo, C. F. & Paul, L. E. (1985) 'Estimation of Fecundability from Survey Data', *Studies in Family Planning*. 16,pp. 232-259.

Gini, C. (1924) 'Premieres recherches sur la fecondabilite de la femme', *Proceedings of the International Mathematics Congress*, Toronto, 889.

Henry, L. (1964a) 'Mesure de temps mort enfecondite naturel le', *Population*, 19, pp. 485-514.

Henry, L. (1964b) 'Morta1ite intra - uterine et fecondabilite', *Population*, 19,pp. 899-940.

Hoque, F., Khan, M. S. H. & Haque, A. (2012) 'Levels, Trends and Determinants of Fecundability in Bangladesh: A Comparative Study Using Bangladesh Health and Demographic Survey (BDHS) Data', DOI: 10.4236/ojpm.2012.23055, pp. 379-389.

Islam, M. M. & Yadava, R. C. (1997) 'Estimation of Fecundability: Levels and Trends in Bangladesh', *The Journal of family Welfare*. Sep. 1997. 43(3), pp. 13-20.

Jolly, K. G. (1981) 'Differential Fertility Performance by Education, Age at Marriage and Work Status in Delhi Metropolis', *Demography India*, 10,pp. 118-125.

Kalan, J. & Udry, J. R. (1986) 'The Determinant of Effective Fecundability Based on the First Birth Interval', *Demography*, 23(1),pp. 53-66.

Lachenbruch,P. A. (1967) 'Frequency and Timing of Intercourse and the Probability of Conception', *Population Studies*, 21, pp. 23-31.

Majumdar, H. & Sheps, M. C. (1970) 'Estimators of A Type I Geometric Distribution from Observations on Conception Times', *Demography*, 7,pp. 349-360.

Mahadevan, K. (1979) 'Sociology of Fertility', *Sterling*, New Delhi.

Marini, M. M. (1981) 'The Effects of the Timing of Marriage and First Birth. J.Marriage Fam', 43, pp. 27-46.

Marini, M. M. & Hodsdon, P. J. (1981) 'Effect of the Timing of Marriage and First Birth of the Spacing of Subsequent Births', *Demography*, 18,pp. 529-548.

Mukherjee, S., Bhattacharya, B. N. & Singh, K. K. (1994) 'Distribution of Time of First Birth in Presence of Social Customs Regulating Physical Separation and Coital Frequency', *Mathematical Biosciences*, 31,pp. 1-21.

Mukerjee, R. (1976) 'Family Planning in India', *Orient Longman*, New Delhi.

Namboodiri, K. & Suchindran, C. M. (1987) 'Life Table Techniques and Their Applications', *Orlando, FL: Academic Press*.

Nath, D. C. (1995) 'Family Planning and Assamese Women', *The North East Times*. VI(55).

Nath, D. C., Singh, K. K., Land, K. C. & Talukdar, P. K.(1993) 'Age of Marriage and Length of the First Birth Interval in a Traditional Society: Life Table and Hazards Model Analysis', *Human Biology*, 65, pp. 783-797.

Nath, D. C., Singh, K. K., Land, K. C. & Talukdar, P. K. (1993) 'Breastfeeding and Postpartum Amenorrhoea in A Traditional Society: A Hazards Model Analysis,' *Social Biology*, 40,pp. 74-86.

Nath, D. C.,Singh, K. K.&Talukdar, P. K. (1994) 'Most Recent Birth Intervals in A Traditional Society: A Life Table and Hazards Regression Analysis', *Canadian Studies in Population*, 21(2), pp. 149-164.

Nath, D. C., Land, K. C. & Goswami G. (1999) 'Effect of the Status of Women on the First Birth Interval in Indian Urban Society', *J. Biosoc. Sci.*, 31,pp. 55-59.

Rao, K. V. (1987) 'Demographic Models for Age at First Marriage and First Birth: An application of Canadian data,' *Ph.D. thesis, University of Western Ontario, London, Canada*.

Rao, K. V. & Balakrishnan, T. R. (1988) 'Age at First Birth in Canada: A Hazard Model Analysis', *Genus*, 44(1), pp. 55-72.

Rindfun, R. R. (1983) 'Marriage, Sex and the First Birth Interval: The Quite Revolution in Asia', *Population and Development Review*, 9, pp. 259-278.

Santow, G. (1978) 'A Simulation Approach to the Study of Human Fertility', *MartinusNijhoSocial Science Division, Leiden/Boston.*

Sheps, M. C. (1965) 'Application of Probability Models to the Study of Human Reproduction', In Sheps, M. C. and Ridley, J. C. (eds.), *Public Health and Population Change, University of Pittsburg Press, Pittsburg*.

Singh, K. K., Suchindran, C. M., Singh, V. & Ramakumar, R. (1992) 'Age at ReturnMarriage and Timing of First Birth in India's Uttar Pradesh and Kerala States', *Soc.Biol.*, 39, 292-298.

Singh, S. N. & Singh, K. K. (1989) 'Life table Analysis on Censored Data of Post-Partum Amenorrhoea Period', *Demography India*, 18, pp. 27-38.

Singh, S. N. & Bhaduri, T. (1971) 'On the Pattern of Post-Partum Amenorrhoea', In Proceedings of all India Seminar on Demography and Statistics (edited by S.N. Singh) *Banaras Hindu University*, India, 284.

Singh, S. N. (1969) 'Low Estimates of Fecundability', *Paper presented at the IUSSP General conference*, London, England, October.

Singh, S. N. (1963) 'Probability Models for the Variation in the Number of Births for Couple', *Journal of American Statistical Association*, 58, pp. 721.

Srinivasan, K. (1967) 'Analytical Models for Two Types of Birth Intervals with Application to Indian Population', *Ph.D. thesis, India*, University of Kerala.

Trussell, J., Hatcher, R. A., Cates, W., Stewart, F. H. & Kost K. (1990) 'A Guide to Interpreting Contraceptive Efficacy Studies', *Obstetrics and Gynaecology*, 76 (32), pp. 558-567.

Trussell, J. & Menken, J. (1978) 'Early Childbearing and Subsequent Fertility', *Fam. Plann. Persp*., 10(4),pp. 209-218.

Vaidyanathan, K. E. (1989) 'Status of Women and Family Planning the Indian case', *Asia pacific population*, J 4(2),pp. 3-18.

Vaupel, J. W., Manten, K. G. & Stallard, E. (1979) 'The Impact of Heterogeneity in Individual Frailty on the Dynamics of Mortality', *Demography*, 16, 3.

Yamaguchi, K. (1991) 'Event History Analysis', *SAGE publication, London, UK*.