hypothesized to be functionally related with various socio-demographic variables.

Cox's semi-parametric model or so called proportional hazard (PH) model explores the risks of attaining sterility after marriage. It is easy to fit the data and require hardly any assumptions about the shape of the hazards rate since it varies according to the duration since marriage (Teachman, 2002). The PH model is one of the most cited regression models (Cox, 1972) in survival analysis. The life time is defined here to be the effective reproductive span, the time interval between marriage and menopause or sterilisation. Its simplified form may be given by

$$\lambda(t;\underline{x}) = \lambda_0(t)\ \varphi(\underline{x})$$

where $\lambda_0(t)$ is the baseline hazard function, defined to be the hazard function when all x's equal zero and $\varphi(\underline{x})$ is a parametric link function bringing in the covariates. It satisfies $\varphi(0) = 1$ and $\varphi(\underline{x}) \geq 0$ for all $\underline{x}$. The commonly used form of φ is $\varphi(\underline{x}) = \varphi(\underline{x},\underline{\beta}) = \exp(\underline{\beta}'\underline{x})$, known as the log linear form. Thus, for the woman with covariate vector $\underline{x}$, the hazard function $\lambda(t;\underline{x})$ can be represented as:

$\lambda(t;\underline{x}) = \lambda_0(t) \exp(\underline{\beta}'\underline{x})$,

so that the ratio, $\frac{\lambda(t;\underline{x})}{\lambda_0(t)} = \exp(\underline{\beta}'\underline{x})$ represents the 'risk of exposure' within the effective reproductive span. Further, $\text{Log}\frac{\lambda(t;\underline{x})}{\lambda_0(t)} = \underline{\beta}'\underline{x}$ is the usual form of linear regression model and hence the name 'log linear model'. In this model, regression coefficients are constants and the covariates are fixed. Therefore, the hazards $\lambda(t;\underline{x})$ and $\lambda_0(t)$ are proportional, hence the name proportional hazard. The Cox's PH model is also known as semi-parametric model as the base line hazard function, $\lambda_0(t)$ is a completely unknown and unspecified function. It assumes that the effects of the different covariates on the reproductive period are constant over time and are additive in a particular scale.

The covariates considered here are current age, number of live birth ever born, number of living son, number of living daughter, ever experienced of fetal loss, ever experienced of infant and child death (yes=1, otherwise=0), use of effective contraceptives (used=1, otherwise=0), sex of first child (male=1, female=0), place of residence(rural=1, urban=0), type of family (joint=1, nuclear=0), educational level, social marital status at survey (currently married=1, otherwise – widow, divorce, separated etc. =0), hardship experienced in pre-marital life (yes=1, otherwise=0), couple's desire number of son and daughter. Here, the educational level is defined by illiterate under matric, undergraduate, and graduate and above as quantified in ordinal scale by 0, 5, 10 and 15 respectively.

3. Results and Discussion

In the study population of 973 eligible women aged 35-55 years of their age, 418(43.3%) women reach their median menopausal age of 48 years with 95% confidence interval (CI) of 47.4-48.6. The present analysis is based on 554 (57%) women with 136 censored cases. The average fertility is observed to be 3.45 of the eligible women marrying at 22 years (median). As terminal event of the reproductive span, the women under study undergo sterilization at their median age of 35 years. As such the effective reproductive span of the women is found to be 29 years, 15 years, and 17 years according to natural menopause, sterilization, and hysterectomy respectively while their overall median duration is 26 years with 95%CI is 23.1-26.9. The variation in the reproductive span is also found to be significant (χ^2=162, P<0.001). The reproductive span of the women is also observed to be negatively related with their age at marriage ranging from 30 years to 13 years according to their marriage age classes from below 20 years to at least 30 years depicted in Table-1.

Utilizing the hazard ratios, the risk of exposure in the reproductive period with respect to some interested variables have been explored in Table -2. Apart from the level of risk, regression coefficients of only 3 variables out of 15 are found to be significant on the dynamics of reproductive span. They are use of effective contraceptives (P<0.05), educational level achieved (P<0.05), and hardship experienced in their pre-marital life (P<0.01) while adjusted the joint effects of other variables under study. The women who used effective contraceptives have 40% longer reproductive period than those of women who did not used any contraceptives in the population (e^{β}=0.60 with 95%CI: 0.39-0.91). When an advancement of educational level the women can compress 40% risk of exposure in their reproductive period. Besides, the women who experienced hardship during their pre-marital life are facing of 66% shorter period than that of women who did not. However, only five variables can be detected to be determinants of the reproductive span in the population in stepwise regression. These are number of live birth ever born (P<0.05), use of effective contraceptives (P<0.01), type of family (P<0.05), educational level (P<0.05), and hardship experienced in pre-marital life (P<0.01) shown in Table - 3.

In the last model, women who experienced hardship in their pre-marital life tend to have shorter reproductive span. When adjusted the joint effects of four variables – number of live birth, contraceptive use, type of family and educational level. The shorter significant shorter reproductive span may be due to early menopause. The effects of hardship on early menopause is supported by the empirical findings of Gold (2001), Rick-Edwards (2002), wise (2002) etc. Hardy and Kuh (2005) also highlighted that a cumulative effect of socio-economic circumstances in childhood, but not in adulthood on the age at menopause. They opined that the influence could not be explained by adult socio-economic status, behavior and life style or by psychological health and stress, but was somewhat attenuated by early life factors. It also suggested that childhood nutrition and cognition are possible mechanisms underlying the social gradient. But Rick-Edwards suggested that the variation in age at menopause by socio-economic

factors is due to cumulative hardship experienced throughout the life course leading to premature aging of the reproductive system.

From this interpretative analysis, it may be suggested that in order to manage the women's reproductive span leading to reduction in fertility level in the state, the future researchers may view the measures – couples be aware to use the effective contraceptives; to increase the educational level specially for girls and serious attempt also be made to improve the economic status of general public resulting into better way of life. The study population having joint family behavior is still nowhere near a satisfactory solution despite so much emphasis given on Family Welfare Programmes. The large number of couples practice contraceptive devices specifically permanent methods achieving their desire number of children which is against the small family norm of India when couples are expected to adopt permanent methods while they have no more than two children. Besides, we have a long way to go to ensure the effective implementation of Reproductive and Child Health (RCH) programmes and National Rural Health Mission (NRHM-2005) in the State in order to achieve the basic standard for higher quality family planning. The term standard includes not only technical quality but informed consent, a range of contraceptive choice in early part of reproductive span, health services in addition to contraception and accurate communication between clients and providers.

4. Acknowledgement

The first author is indebted to UGC (NERO) for financial assistance under MRP scheme vide sanctioned letter No.F-5-160/2012-13 (MRP/NERO)/ 22318 dated the 28th March, 2013.

References

[1] Brambilla DJ, McKinlay SM, Johhanes CB. Defining the perimenopause for application in epidemiologic investigations. *American Journal of Epidemiology* 1994; 140: 1091-1095.

[2] Brambilla DJ, McKinlay SM. A prospective study of factors affecting age at menopause. *Journal of Clinical Epidemiology* 1989; 42: 1031-1039.

[3] Cox DR. Regression models and life tables (with discussion). *Journal of Royal Statistical Society, Series B* 1972; 34: 187-220

[4] Kour D, Kapoor BH, Sharma S, Mahajan A, Khajuria V. Comparative effects of raloxifence and HRT on serum lipids and fibrinogen in healthy postmenopausal women. *The Journal of Obstetrics and Gynecology of India* 2005; 55(3): 261-264.

[5] NFHS (National Family Health Survey-3). Key Findings. International Institute of Population Sciences, Mumbai, 2007.

[6] Odalia MH. The socio economic determinants of the age at first marriage among women in Hong Kong. Available at *http://sprinerlink.com/content/721673604u28632t/* 11th Nov. 2006.

[7] Odemir O, Col M. The age at menopause and associated factors at the center area in Ankara, Turkey. *Maturitus* 2004; 49: 211-219.

[8] Registrar General, India, Compendium of India's Fertility and Mortality Indicators, 1971-1997, Sample Registration System, New Delhi: Government of India, 1999.

[9] Porter M, Penney GC, Russel D. A population based survey of women's experience of the menopause. *British Journal of Obstetric Gynecology* 1996; 103: 1025-1028.

[10] Sabu S, Padmadas, Inge H, Frans W. Compression of women's reproductive spans in Andhra Pradesh, India. *International Family Planning Perspectives* 2004; 30(1): 12-19.

[11] Topcuoglu A, Uzum H, Aydin S, Kahraman N, Vehid S, Zeybek G. The effect of hormone replacement therapy on oxidized low density lipoprotein levels and paraoxonase activity in postmenopausal women. *Tohoku Journal of Experimental Medicine* 2005; 205: 79-86

[12] WHO. Research on the menopause. WHO Technical Report Series, 866. World Health Organization, Geneva 1996.

Table 1: Average statistics of fertility, initial and terminal events of women's effective reproductive span (in yrs)

Variable	Mean (95%CI)	Median (95%CI)	
Fertility for women			
<40 yr	2.70 (2.46-2.94)		
40 yr+	3.61 (3.47-3.76)		
Total	3.45 (3.33-3.58)		
Age at marriage (yrs)	23.42 (22.72-24.11)	22 (20.95-23.05)	
Age at menopause (yrs)	47.94 (47.38-48.49)	48 (47.39-48.61)	
Age at sterilization (yrs)	34.40 (33.20-35.59)	35 (33.96-36.04)	
Age at hysterectomy (yrs)	40.82 (37.87-43.77)	42 (38.20-45.79)	
Reproductive span due to:			
Natural menopause	27.51 (26.54-28.48)	29 (27.55-30.45)	Log Rank-χ^2= 162.39; P<0.001
Sterilization	14.99 (13.80-16.18)	15 (13.40-16.60)	
Hysterectomy	17.26 (14.08-20.44)	17 (6.82-27.18)	
Overall	24.34 (23.38-25.33)	26 (24.07-27.93)	
Reproductive span due to age at marriage of: <20 yr	28.10 (26.75-29.46)	31 (29.99-32.01)	Log Rank-χ^2= 99.01;
20-25 yr	23.08 (21.41-24.74)	26 (23.11-28.89)	

25-30 yr	19.52 (18.03-21.01)	21 (18.89-23.11)	P<0.001
30 yr +	14.81 (13.16-16.45)	14 (12.15-15.85)	
Overall	24.34 (23.38-25.33)	26 (24.07-27.93)	

Study subject=973; Event=418(43.3%); Censored=136(13.9%); Cases in analysis=554(57.2)

Table 2: Risk of exposure (hazard ratios) on effective reproductive span for independent variables

Characteristics		Risk of exposure (e^{β})	95%CI for e^{β}		P-value for β
			Lower	Upper	
Demographic	Current age	0.983	0.950	1.018	0.346
	No. of live birth ever born	0.986	0.797	1.218	0.893
	No. of living son	0.974	0.776	1.223	0.819
	No. of living daughter	0.937	0.747	1.175	0.571
	Ever-experience of fetal loss No Yes	 1.000 0.932	 0.717	 1.212	 0.598
	Ever-experience of infant and child death No Yes	 1.000 0.845	 0.563	 1.269	 0.417
	Use of effective contraceptives No Yes	 1.000 0.599	 0.393	 0.914	 0.017
	Sex of first child Female Male	 1.000 0.914	 0.699	 1.197	 0.515
Social	Place of residence Urban Rural	 1.000 0.851	 0.649	 1.117	 0.246
	Type of family Nuclear Joint	 1.000 1.293	 0.999	 1.674	 0.051
	Educational level	1.399	1.060	1.846	0.018
	Social marital-status at survey Widow/Divorce/Separated Currently married	 1.000 0.388	 0.088	 1.717	 0.212
	Hardship experienced in pre-marital life No Yes	 1.000 1.656	 1.171	 2.343	 0.004
Reproductive attitude	Couple's desire number of son	0.909	0.751	1.101	0.331
	Couple's desire number of daughter	1.041	0.782	1.387	0.782

-2Log Likelihood=2897.782; Model-χ^2 = 43.103 (P<0.001)

Table 3: Risk of exposure (hazard ratios) on effective reproductive span for independent variables by stepwise method

Step	Characteristics	Risk of exposure (e^{β})	95%CI for e^{β}		P-value for β
			Lower	Upper	
1	Educational level	1.510	1.169	1.951	0.002
2	Use of effective contraceptives No Yes	 1.000 0.570	 0.394	 0.825	 0.003
	Educational level	1.505	1.165	1.944	0.002
3	Use of effective contraceptives No Yes	 0.581	 0.401	 0.841	 0.004
	Educational level	1.533	1.186	1.982	0.001
	Hardship experienced in pre-marital life No Yes	 1.000 1.596	 1.144	 2.225	 0.006

4	Use of effective contraceptives No Yes	 1.000 0.578	 0.399	 0.837	 0.004
	Type of family Nuclear Joint	 1.000 1.299	 1.024	 1.648	 0.031
	Educational level	1.484	1.147	1.921	0.003
	Hardship experienced in pre-marital life No Yes	 1.000 1.630	 1.168	 2.276	 0.004
5	No. of live birth ever born	.916	.847	0.989	0.026
	Use of effective contraceptives No Yes	 1.000 0.573	 0.396	 0.829	 0.003
	Type of family Nuclear Joint	 1.000 1.336	 1.052	 1.698	 0.018
	Educational level	1.380	1.058	1.798	0.017
	Hardship experienced in pre-marital life No Yes	 1.000 1.610	 1.153	 2.249	 0.005

Table 3a: Tests of Model coefficients in stepwise method

Step	-2 Log Likelihood	χ^2	P-value
1	2931.784	10.106	.001
2	2921.577	19.145	.000
3	2914.778	26.494	.000
4	2910.144	31.345	.000
5	2905.045	35.556	.000