Iranian Women's Preferred Birth Interval: Non-Parametric Survival Analysis

Arezoo Bagheri[1], Mahsa Saadati[2],

[1,2] National Population Studies & Comprehensive Management Institute, Tehran, Iran
[1] Email: abagheri_000@yahoo.com, [2] Corresponding author's Email: mahsa.saadati@gmail.com

Abstract

The duration of birth intervals has received attention in demography and public health research because of its implication for fertility, maternal and child health. Spacing preferences also have potential effects on the level of fertility. In a cross-sectional study, a structured questioner was used to collect childbearing attitudes and its social, economical and cultural factors of 6177, 15-49 Iranian married women in 2014, by multi-stage stratified sampling. The main aim of this article is to compare the birth interval lengths that women would prefer to have in confronting some influential factors by Kaplan-Meier estimate and Log-Rank test as non-parametric survival analysis tools. The mean and median of preferred birth intervals were 4.323 and 4.000 years, respectively. The results presented that Kaplan-Meier estimates were significantly different between levels of woman's place of residence, educational level, activity, number of ever born children and family income (p-value<0.05).

Keywords: Preferred Birth Intervals, Kaplan-Meier Estimate, Log-Rank Test, Women, Iran.

1. Introduction

Fertility is an important component of population dynamics which plays a major role in changing the size and structure of a given population (Yohannes et al., 2011). Fertility analysis is very important for policy makers to get guidance for population control and also the evaluation of family planning programs (Kamal, Pervaiz, 2012). Knodel (1987) presented the idea of three fertility inhibiting behaviors during early transitional period of fertility. These are starting, spacing and stopping behavior of fertility.

Birth interval (spacing) is the length of time between two successive live births (CSA Ethiopia, 2006). Birth interval analysis is more susceptible technique for measuring fertility than other conservative methods such as Total Fertility Rate (TFR) (Nath et al., 2000). Pattern of birth intervals not only provides pace of child bearing but also chances of transition to higher parity (Pillai, 2010). Intentional long birth spacing limits child bearing which is known as 'spacing behavior' of fertility. Chakraborty et al. (1996) mentioned that health education message have focused not only on small family size but also on longer spacing between births. Short birth intervals have been associated with adverse health outcomes, including infant, child and maternal mortality. Many researchers have shown that inter-pregnancy interval is a risk factor for pre-term delivery and neonatal death (Smith et al., 2003). An optimal birth interval has not been agreed upon universally (Zhu et al., 1999; Fallahzadeh et al., 2013).Based on Zhu et al. (1999) to prevent the adverse prenatal outcomes the best interval between births is 18-23 months. While according to Clayton (1974) the optimal interval to ensure survival through childhood is 3 years and 9 months. Martin (1979) deduced that a minimum of 2 years spacing is necessary between births for the best physical and mental development, while three years spacing would be even better.

Different studies have identified different risk factors contributing to the length of birth intervals. Results of a Demographic Health Survey (DHS) studies and meta-analysis showed that previous birth intervals of 36-59 months are optimal for reducing risk of neonatal mortality, although some studies have found significant relation only with shorter spacing births (Rutstein, 2005; Conde-Agudelo et al., 2006; Marston, 2006). In rural Saudi Arabia, Al-Nahedh (1999) and Bella and Al-Almaie (2005) showed that there were significant relation between socio-demographic variables and birth interval. Woman's education and age at marriage are the most widely used determinants of birth intervals. Woman's age at marriage is considered to be an important variable in the fertility process which is negatively associated with the length of birth interval (Al Nahedh, 1999; Clegg, 2001; Nahar, Rahman, 2006). Age at marriage may have a varied effect on different birth intervals. West (1987) found that the younger a woman is at first birth, the higher the transition probability. Moreover, education has always been an important variable in the sociological and economical literature of fertility (Shayan et al., 2014). In Iran, many researches were conducted to study determinants of birth intervals; Hajian-Tilaki et al. (2009) showed that there were significant correlation between birth interval and maternal age, duration of breast feeding, sex of previous child, history of alive births, history of infant mortality of the previous child, type of contraception used, regular attendance at a family planning clinics and parity Fallahian et al. (1993) also found the duration of breast-feeding and the method of contraceptive used were factors significantly associated with child intervals. Rasekh and Momtaz (2007) stated that the encouraging women for higher education and giving opportunity to them to get employed may be the influential ways of slowing down fertility in Ahvaz, Iran.

Birth spacing has become a main strategy of the health promotion program for mothers and children over the past two decades in Iran (Fallahzadeh et al., 2013). Although there are many studies about birth interval and its influential factors, little is known about preferred birth interval in different cultural settings and at different stages of fertility transition, the contribution of interval goals to the fertility transition, their covariates, and their interaction with family size goals. Interval preferences often are ignored in studies of fertility transition (Pritchett, 1994). A first step in understanding this aspect of reproductive motivations is to measure people's goals on birth interval. Not only there is a lack of data on the birth interval preferences in Iran, but also not much is known about the perception of Iranian women regarding to it. This study, therefore, aimed to identify the determinants of birth interval preferences among women in their reproductive age in Iran by introducing data and statistical analysis in following section. Results are presented in section (3) and conclusions are displayed in section (4).

2. Materials and Methods

In this section, data and statistical analysis which is used to study preferred birth interval are described.

2.1. Data

In a cross- sectional study, the structured questionnaire was filled from 6177 married women aged 15-49 years in 31 provinces in Iran to collect women's demographic, fertility history and socio-economic characteristics in 2014. These women were selected by multi-stage stratified random sampling from those who were referred to public health centers to vaccinate their children. In first stage, 31 provinces were selected, then, in second stage, 3 Shahrestan (subprovince) of each province based on size and distribution of population by Probability Proportional to Size (PPS) sampling were collected. Minimum (105) and maximum (777) samples were collected from Ilam and Tehran province, respectively. The randomly selected women answered a self-report questionnaire with careful monitoring system (Kazemipour, 2014).

2.2. Statistical Analysis

In this study, Kaplan-Meier survival analysis was applied to describe fertility events, such as transition to first, second, third, and fourth births. Life table and Kaplan-Meier techniques are useful tools to analyze the time of accrued events, such as death, marriage and birth intervals. In addition, these techniques can produce correct estimates of the proportion of women who have a subsequent birth at a successive duration of exposure. If the observation duration is long enough, the proportion of women who have a subsequent birth after a given duration is similar to the parity progression ratio from one parity to the next (Feeney, Yu, 1987; Rodriguez, Hobcraft,1980; Eryurt, Koç, 2012). Thus, these techniques are more sensitive to measure changes in reproductive behavior compared with conventional fertility measures, such as the TFR. These techniques may provide more detailed information about the cause of fertility decline. Using these techniques, it can be learnt whether fertility change is due to the spacing of births or due to a change in the proportion of women reaching high parities. In sum, life table analyses of parity orders may provide information both on quantum and tempo of fertility.

In this article, Kaplan-Meier technique is preferred to use, because it is more advantageous compared with ordinary life table technique. In the Kaplan-Meier approach, it is not necessary to group episode durations according to arbitrarily defined time intervals. Instead, it is based on the calculation of a risk set at every point in time where at least one event occurred (Blossfeld et al., 2007). In this way, the information contained in a set of episodes is optimally used. Another difference between life table and Kaplan-Meier methods is related to the contribution of censored cases to the exposure. Kaplan-Meier technique can cope with the right censoring issue better than ordinary life table technique (Kaplan, Meier, 1958). If no censoring occurs, two methods give the same results as the life table method. In the life table method, it is assumed that censoring occurs in the middle of the time interval. However, in the Kaplan-Meier method censoring is assumed to occur after the time point for which the survival function is estimated, and, thus, censored cases contribute more to the exposure. The only disadvantage of this approach is that all episodes must be sorted according to their ending and starting times. Advanced statistical programs can easily overcome this problem with efficient sorting algorithms (Blossfeld et al., 2007).

The Kaplan-Meier method estimates for all "event times", t_l, can be calculated according to formula (1):

$$S(t_i) = \prod_{l=1}^{i} \frac{n_l - d_l}{n_l} \qquad (1)$$

Where n is the number of individuals at risk at time t_l, and d_l is number of events at time t_l.

The simplest way of comparing the survival times obtained from two (or more) groups of individuals is to plot the corresponding estimates of the two survivor functions on the same axes. The resulting plot can be quite informative, but if the number of groups increases, interpretation will be complicated. The alternative way is hypothesis test. In the comparison of two (or more) groups of survival data, there are a number of methods that can be used to quantify of between-group differences such as Log-Rank and Wilcoxon tests. For the two groups, Hypotheses are given as:

$$H_0: S_1(t) = S_2(t)$$
$$H_1: S_1(t) > S_2(t) \qquad (2)$$

Where S_l (t) is the survival function at time t_l.

In this article the log-rank test is used which is a nonparametric and more appropriate test to use when the data are right censored. The log-rank test compares the hazard function estimates of the two (or more) groups at each observed event time. It is constructed by computing the observed and expected number of events in one of the groups at each observed event time and then adding these to obtain an overall summary across all time points where there is an event (Mantel, 1966; Schoenfeld, 1981; Harrington, 2005).

3. Results

Mean age of 6177 15-49 years old women was 29.9±6.06 years and mean age of women's marriage was 21.43±4.68. In this article, we consider place of residence, marriage duration, educational level, activity, number of ever born children and family income of women as covariates which can affect "preferred birth interval" response variable. Table (1) shows frequency and percentage of covariates in this study. About 72 percent of women lived in urban areas and nearly 14 percent of them were employed. Most of the respondents (34.1 percent) were in 5-9 marriage duration years. 85 percent of women had 1 or 2 children, and only 1.3 percent of women lived in a reach family (Family Income>=3 million IRR).

Table 1. Demographic and Socio-Economic Characteristics of Women 15-49 Years Old

Variable	Categories	Frequency	Percent
Place of Residence	Urban	4466	71.7
	Rural	1765	28.3
Marriage Duration	<=4	1879	30.2
	5-9	2123	34.1
	10-14	1324	21.2
	15-19	582	9.3
	20-24	222	3.6
	>=25	101	1.6
Educational level	Under secondary	1130	18.3
	High school & Diploma	3390	54.9
	Associate/BA/BS	1492	24.2
	Master/PhD & above	159	2.6
	Religious degree	6	0.1
Activity	Employed	845	13.7
	Unemployed	5332	86.3
Ever Born Children	0	12	0.2
	1-2	5252	85.0
	3-4	830	13.4
	>=5	83	1.3
Family Income	<=1 Million IRR	4428	71.7
	1-2 Million IRR	1345	21.8
	2-3 Million IRR	322	5.2
	>=3 Million IRR	82	1.3
Total		6177	100

Kaplan-Meier survival estimates are computed for women's preferred birth intervals and survival curve of those is shown in Figure (1). As this figure displays, most of the women's (about 80 percent) preferred birth interval were less than 5 years. Mean and median of Kaplan-Meier estimates are 4.3 and 4.0, respectively. The median equals to 4 years means that half of the women prefer to have 4 years birth intervals between their children. Kaplan-Meier estimates for mean, median and 95 percent confidence interval for preferred birth interval of covariates are given in Table (2). Furthermore, the results of Log-Rank test and its p-value for covariate in this study are presented in this table. These indicators help us to understand the average and median length of preferred birth intervals various categories of covariates. Moreover, Figure (2) presents Kaplan-Meier survival curve of preferred birth interval by covariate in this study.

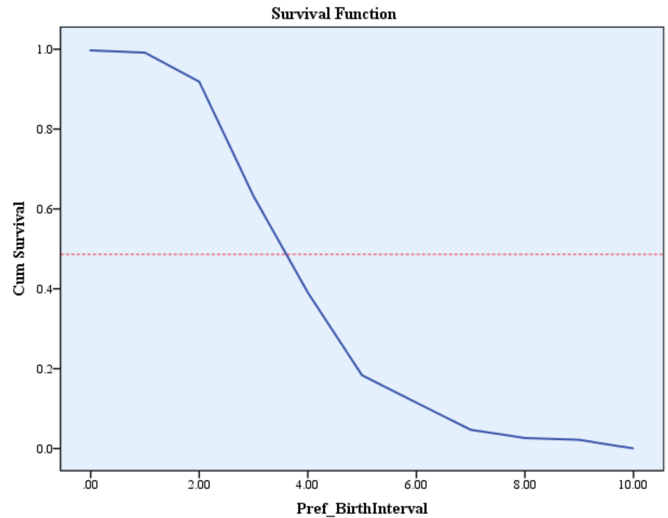

Figure 1. Kaplan-Meier Survival Curve of Preferred Birth Interval

Table 2. Kaplan-Meier Estimates of Preferred Birth Interval by Covariates

Variable	Categories	Mean		Median		Log-Rank Test (P-value)
		Estimate	95% confidence interval	Estimate	95% confidence interval	
Place of Residence	Urban	4.277	(4.228, 4.326)	4.000	(3.941, 4.059)	11.107
	Rural	4.438	(4.356, 4.521)	4.000	(3.902, 4.098)	(0.001)
Marriage Duration	<=4	4.290	(4.210, 4.369)	4.000	(3.905, 4.095)	
	5-9	4.289	(4.218, 4.359)	4.000	(3.915, 4.085)	
	10-14	4.401	(4.309, 4.494)	4.000	(3.897, 4.103)	1.197
	15-19	4.337	(4.201, 4.473)	4.000	(3.829, 4.171)	(0.274)
	20-24	4.541	(4.304, 4.777)	4.000	(3.714, 4.286)	
	>=25	4.060	(3.796, 4.324)	4.000	(3.950, 4.050)	
Educational level	Under secondary	4.428	(4.324, 4.533)	4.000	(3.861, 4.139)	
	High school & Diploma	4.372	(4.313, 4.430)	4.000	(3.930, 4.070)	
	Associate/BA/BS	4.173	(4.094, 4.252)	4.000	(3.913, 4.087)	27.776
	Master/PhD & above	3.969	(3.739, 4.198)	4.000	(3.725, 4.275)	(<0.001)
	Religious degree	3.333	(2.364, 4.302)	3.000	(1.400, 4.600)	
Activity	Employed	4.129	(4.024, 4.234)	4.000	(3.877, 4.123)	13.962
	Unemployed	4.353	(4.307, 4.400)	4.000	(3.945, 4.055)	(<0.001)
Ever Born Children	0	3.833	(3.077, 4.590)	4.000	(3.265, 4.735)	
	1-2	4.342	(4.295, 4.388)	4.000	(3.946, 4.054)	4.894
	3-4	4.251	(4.140, 4.361)	4.000	(3.857, 4.143)	(0.027)
	>=5	3.916	(3.508, 4.323)	4.000	(3.619, 4.381)	
Family Income	<=1 Million IRR	4.352	(4.301, 4.402)	4.000	(3.939, 4.061)	
	1-2 Million IRR	4.257	(4.169, 4.346)	4.000	(3.895, 4.105)	4.402
	2-3 Million IRR	4.220	(4.036, 4.405)	4.000	(3.803, 4.197)	(0.036)
	>=3 Million IRR	4.220	(3.902, 4.537)	4.000	(3.644, 4.356)	
Total		4.323	(4.280,4.365)	4.000	(3.950,4.050)	

Following results can be obtained from table and Figure (2):

- Women who lived in rural areas had greater mean (4.438 years) of preferred birth intervals compared to urban areas (4.277 years). So in average, rural women preferred to space more between their children's birth. But the median of both groups is the same and equal to 4 years. Figure (2.a) shows the survival curves of women's preferred birth intervals according to their resistance area that displays differences between two curves. These differences are proved by Log-Rank test which is computed in table (2) and significant at 0.01 level (p-value=0.001).
- There is not obvious pattern which indicates the trend of preferred birth interval's means among marriage duration categories. The maximum and minimum preferred birth interval's mean are 4.541 and 4.060 years which belong to 20-24 and ≥25 years marriage duration categories, respectively. The median of six marriage duration groups is the same and equal to 4 years. Regarding to the pattern of the survival curves, Figure (2. b), it can be concluded that the timing of preferred birth interval does not differentiate according to women's marriage duration. The result of Log-Rank test also shows that survival curves by marriage duration are not different (p-value=0.274). Since the patterns of all survival curves resemble each other.
- Considering the pattern of the survival curves by educational levels, Figure (2.c), it is seen that more than 80 percent of women who have religious educational level, preferred to space 4 years interval between their children. This percentage decreases to 70 and 60 percent among university educated (Associate/BA/BS, Master/PhD & above) and under diploma (Under secondary, High school & Diploma) women, respectively. These variations also proved by very significant Log-Rank test p-value (<0.001). Median of preferred birth interval for religious educated women is 3 years which is one year less compared to the other educational levels.
- Unemployed women have greater mean (4.353 years) of preferred birth intervals than employed women (4.129 years). But the median of both groups is the same and equal to 4 years. Figure (2.d) shows the survival curves of women's preferred birth intervals according to their job status that displays differences between two curves. These differences are proved by Log-Rank test which is computed in table (2) and it is significant at 0.001 level (p-value<0.001).
- Women who were childless or born more than 5 children preferred less birth interval mean (3.833 or 3.916 years) than women who had 1 to 4 children (4.342 or 4.251 years). But the median of both groups is the same and equal to 4 years. Regarding to the pattern of the survival curves, Figure (2. e), it can be stated that the timing of preferred birth intervals differed according to women's children ever born. The result of Log-Rank test also proved these differences (p-value=0.027).

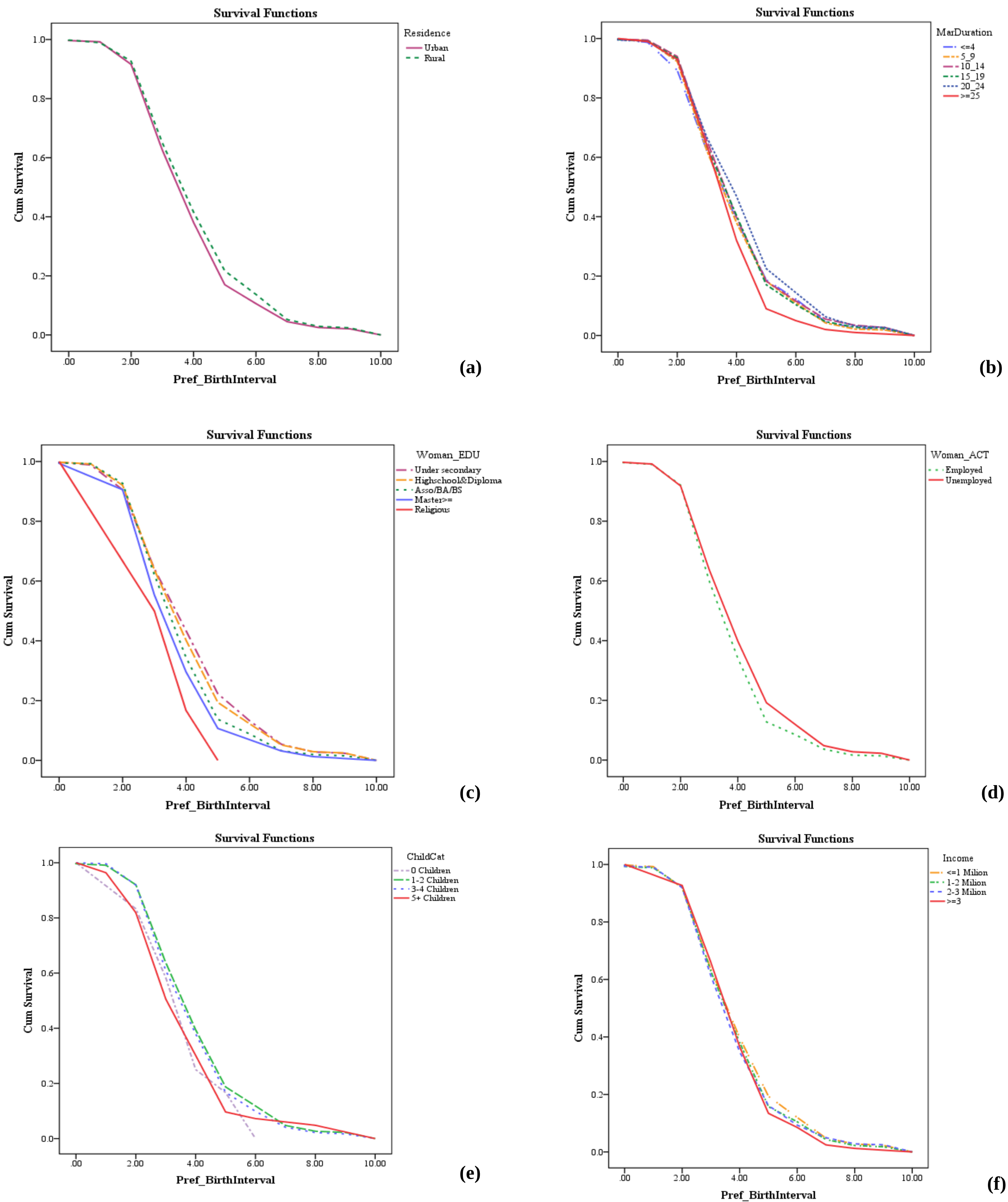

Figure 2. Kaplan-Meier Survival Curve of Preferred Birth Interval by Covariates

(a) Place of Resistance, (b) Marriage Duration, (c) Educational level, (d) Activity, (e) Ever Born Children, (f) Family Income

- Pattern of average preferred birth interval is decreasing from law (4.352 years) to high (4.220 years) family incomes. Figure (2.f) displays the survival in each family income group curves. As this figure shows there are differences between curves pattern of each family income group. These variations also proved by significant Log-Rank test p-value (0.036).

4. *Conclusion*

The study of timing and spacing dynamics of births is important for several reasons, including an understanding of completed family size as well as maternal and child mortality (Gyimah, 2002). Modeling fertility data is one of the greatest interests in population economic studies. Socio-economic factors such as women's place of residence, educational level and activity have been correlated with birth spacing although the mechanisms by which these background variables influence birth spacing is less clear. In some settings, maternal education is associated with shorter spacing; in Korea, for example, one study reported that better educated women had shorter second birth intervals than those less educated (Bumpass et al., 1986). However by studding DHS data, in 38 of 51 countries with, women with no education were more likely than educated women to have shorter birth intervals (Setty-Venugopal, Upadhyay, 2002). The reason for such diversity is uncertain. It can be conjectured that better educated women wish to compress childbearing into fewer years and participate in non-childbearing activities and hence have shorter spacing. Rural women are also associated with short intervals in 51 of 55 countries by studding DHS data (Setty-Venugopal, Upadhyay, 2002). For example, in Tanzania, urban women were 18 percent less likely to have conceived and closed an interval than rural women (Mturi, 1997). The effect of maternal employment on spacing is less clear; in some settings it appears to be associated with shorter spacing. The nature of work is perhaps more important. Employments in the formal and modern sectors have been found to be related to longer spacing (Mturi, 1997; Setty-Venugopal, Upadhyay, 2002). Maternal age at the birth of the index child is also associated with birth intervals. In general, older mothers tend to have longer subsequent intervals (Chakraborty et al., 1996; Mturi, 1997; Setty-Venugopal, Upadhyay, 2002). This could be due to two reasons: older women are late in their childbearing process and are likely to achieve their desired family size and hence likely to have long subsequent spacing; they are also likely to be less fertile leading to long spacing.

The social influence theory suggests that preferences with respect to the length of the birth interval may be influenced by significant advise that people receive from others. Those who receive advice are more likely to prefer longer birth intervals than those who do not (Kim et al., 1998). The motivational forces that drive the fertility transition in developing countries may include both the desire to stop childbearing after couples reach their preferred family size and the desire to lengthen birth intervals, either as a goal by itself or as a means to achieve small family sizes (Kamal, Pervaiz, 2012). But very few studies have investigated the various aspects of preferred spacing or birth intervals in all over the world. The objective of this study was to investigate the effect of selected factors on preferred duration for child spacing or birth interval among 15-49 year old women in Iran.

In this article preferred birth intervals and factors which are affect on its variability among 15-49 years old married women in Iran were analyzed by Kaplan-Meier survival estimates and Log-Rank test. Median and mean of preferred birth interval were 4 and 4.323 years, respectively which were in the recommended range (3, 5) years set by the Ministry of Health in Iran (Fallahzadeh et al., 2013). These values indicate that Iranian women in the fecund ability age are aware of their optimum birth interval. According to information from 55 countries, median birth interval in developing countries was about 32 months. The median birth-to-conception interval among women in less developed countries who breastfeed their infants was approximately three years (Rasheed, Al-Dabal, 2007). Therefore women whose ideals conformed to family planning norms had fewer children and longer child spacing intervals.

The result of this article showed that, there are significant variations in preferred birth interval among different categories of woman's place of residence, educational level, activity, ever born children and family income. It means that significant variability exists among preferred birth intervals and various categories of these factors. There was not a significant association between preferred birth interval and marriage duration.

Social and cultural norms are one reason of differences between preferred birth interval in rural and urban areas and the others may be awareness and access to health facilities. Certain trends are expected, for instance, long exclusive breastfeeding in rural area lead to widens of birth interval (Kamal, Parviz, 2012).

Higher education level is usually linked to better health awareness and longer birth intervals (Al-Nahedh,1999; Fallahzadeh et al., 2013; Sakait, Ansari;1996). This study has demonstrated that women with higher educational level have shorter preferred birth intervals. Similar results have been reported by Fallahzadeh et al. (2013) and Al-Nahedh (1999). Ramarao et al. (2006) had called the reason of short interval for highly educated women as 'compressing the child bearing'. In this study, employed women had shorter preferred birth interval compared to unemployed women.

Employed women had shown short interval in some of the countries. On the other side, Mturi (1997) and Setty-Venugopal and Upadhyay (2002) had reported long interval for employed women.

Quantity and Quality theory of fertility may also affect spacing behavior similarly as it affects stopping behavior. Usually birth intervals are expected to be short for lower income group than higher income group (Van Bavel , Kok, 2004). This result is as the same as our findings.

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