Prognostic factors in birth time: A Survival Analysis

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ABSTRACT

The waiting time between children births are called tempo. This phenomenon plays a crucial role in the child and mother health. The purpose of the present study is determination of factors which influence this variable of interest. A significance level of 5% and power of 80% considered to calculate the required sample size for this cross sectional study. The sample size of 124 women determined using PASS software (ver. 11.0.4). These women randomly selected of married women between 15-45 years old with at least two children, living in Irin village. We consider the waiting time between the first and the second birth in women randomly sampled from Irin village of Tehran province of Iran.The selected mothers had 364 children at the time of study. The average and standard error for the number of children were 2.940 and 1.102 respectively. 59% of the children were girl and the rest were boy.Tempo variable as an index estimated using Toki method. The lowest tempo is for 5th to 6th births (28.5) and highest is for 6th to 7th (60). Cox regression model was used to determine the significant explanatory factors.Birth of child was considered as an event and time between the first and the second event was considered as outcome in this model.According to the fitted Cox regression model, only maternal education and father's occupation were statistically significant at 5% on time to second birth.

Key words: Fertility; Cox model; Hazard; Tempo.

INTRODUCTION

Currently more than 6.9 billion human beings live on earth.Experts believe that within 7 years the population of the world will pass 7 billion and it should be considered that 86% of this population belongs to the under-developed countries. This increase in the population may lead to blatant educational as well as health problems [1].

The Islamic Republic of Iran hasexperienced dramatic changes in fertilityand population growth rates during the past30years. A change in population policyimmediately after the revolution resultedin the suspension of the family planningprogram and led to a huge rise in fertilityand population growth rates. Following therevival of this program in1989, the fertilityrate declined significantly and by late 2000 there were indications that the fertility ratehad dropped to around replacement level (a total fertility rate of 2.1per woman) in allurban areas as well as some rural districts. During 1975 – 2000, the growth rate was high enough which led into a doubled population. The hugecohort of 31 million children was born during 1991 – 1997 which have made many problems for Iran. The proportion of the elderly(age group 65+) has risen to 5% and maysoon pose major challenges for the socialsecurity system.The past 30years have also seen asignificant rise in the urbanization rate of thepopulation. In 2006, 71%of the population(just above52million) lived in urban areas.

After Pakistan, the Islamic Republic ofIran isthe second largest host country for refugeesin the world. As estimated in January 2007, there are 968registered refugees (and approximately 2 million unregistered) in Iran, equivalent to 14refugees for every 1000 persons [2]. The flood of immigrants toward the city of Tehran has led to the extremely high growth in population of this

city. The civil experts believe that the population of Tehran will grow twice within 7 years and will reach 14 million [1].

The main purpose of this study is fitting Cox proportional hazards (PH) model for determining the factors influencing the birth of second child. We also calculate the acceleration of fertility (Tempo) on second to eighth children in women of Irin village.

MATERIALS AND METHODS

The appropriate sample size calculated 124 mothers given the significant level of 5% and the power of 80%. This cross-sectional study held in the Irin village of the Eslamshahr township in Tehran province.

The studypopulation was all the married women between 15 – 49 years old who are fertile and have at least 2 children. Eslamshahr is located about 15 kmapart of south west of Tehran.This township has been under attention for many years due to its good and fertile farmlands, Karaj River and vicinity to Tehran [1].It is one of the main villages in this townshipwhich has a population of 1770 according to the 2011 Iranian Population and Housing Census. The main occupation of the people is self – employment jobs, because of its closeness to Tehran.

The covariates are the age difference of the parents, the gender of the first child (boy=1, girl=0), mother's occupation (housewife=0, employed=1), father's and mother's education (illiterate, primary school, guidance school, high school, academic studies), father's occupation (jobless, worker, employee). Survival analysis is a collection of statisticalprocedures for data analysis for which theoutcome variable of interest is time until anevent occurs. This time is referred as survival or failure time. In the current study the birth of each child is considered as an event and time between successive births as survival time. In this analysis, Cox regression model (proportional hazards model) is appropriate for evaluating the effect of explanatory variables on survivor or hazard function [3,4,5,6,7,8].

The Cox PH model is usually written in terms of the hazard model. This model for n observations can be written as

$$\lambda_i(t) = \lambda_0(t)\exp(\beta_1 z_{1i} + \cdots + \beta_k z_{ki}) \qquad i = 1,2,\dots,n$$

Where, $z_i = (z_{1i}, \dots, z_{ki})$, is a vector of explanatory variables and $\lambda_0(t)$ is called the baseline hazard function [9,10,11,12,13,14].

There are two main important questions we shall answer them through this investigation. The first was about the calculation of the value of acceleration of fertility (Tempo) between the births and the second was about determining the significant explanatory variables which affect the Tempo as the outcome.The tempo calculated using Toki method and the Cox model was used for determining explanatory variables.

Tempo is the average waiting time to next birth for a woman. If this time is short, it results a high tempo and vice versa. There are different ways to calculate tempo and all of them use the time gap between the two births. In this study the Toki methodis used and it is calculated separately for each birth [15]. According to this method, three averages are used for estimating tempo. These three averages are like $\frac{q_1+2q_2+q_3}{4}$where q1, q2 and q3 are first, second and third quarters of the time birth distribution.

RESULTS

A total of 124 mothers studied who had364 children at the time of study. The average and standard error for the number of children respectively are 2.940 and 1.102.

59% of these children were girl and the rest were boy. Only one mother had 7 children and others had less than 7. Approximately 72.3% of the mothers were literate and for fathers were79.3%. About 1.7% of fathers were jobless and the majority of the mothers (97.5%) were housewife.

Table 1 shows some information about fertility rate in Irin village comparing to Eslamshahr township. Children gender distribution according to the birth order is another crucial descriptive statistics (Table 2). As you can see the percentage of boys are more than girls.

Table 1. The fertility indices in Eslamshahrtownship and Irin village of Iran, 2011

Indexes	Rural areas of Eslamshahr	Irin Village
Crude birth rate	13.90	17.53
General fertility 15-49 years	71.92	89.26
General fertility 10-49	71.91	89.26
Total fertility 10-49	2.87	3.57
Gross reproduction rate	1.37	1.34

Resource: Population information of health houses of Eslamshahr Health Network, 2011

Table 2. Children's gender distribution in each birth order of 124 mothers selected from Irin village of Iran, 2011

Birth order	Number of children	Percentage of boys	Percentage of girls
1st	124	67.7	32.3
2nd	124	53.2	46.8
3rd	69	55.1	44.9
4th	30	60	40
5th	14	42.9	57.1
6th	3	66.7	33.3
7th	1	100	-
Total	364	41.0	59.0

Table 3. Estimation of tempo index in each birth order of 124 mothers selected from Irin village of Iran using Toki method, 2011

Birth order	1^{st} quarter	2^{nd} quarter	3^{rd} quarter	Tempo
2^{nd} birth	25.03	39.21	64.81	42.07
3^{rd}	26.25	45.00	77.00	48.31
4	26.18	44.57	58.80	43.53
5	18.86	28.00	42.00	29.21
6	24.00	28.00	34.00	28.50
7	60.00	60.00	60.00	60.00

Table 4. Estimation of Cox model coefficients for significant explanatory variables of Irin village data, 2011

Variable	categories	coefficient	Exp of coef.
Mother's education	**Primary School**	0.230	1.259
	Guidance	-0.413	0.662
	High School	-0.950	0.387
	University	0.223	1.250
	Illiterate	Reference	-
Father's occupation	**Governmental**	1.042	2.835
	Self	0.389	1.476
	Unemployed	Reference	-

The acceleration of fertility (Tempo)

According to table 3, the lowest estimated tempo is for 5th to 6th births (28.5) and the highest is for 6th to 7th (60).Since, there is only one mother with seven children, it doesn't sound reasonable to consider the last birth order group as the highest estimation for tempo. Thus, the second highest of estimated tempo is for the2nd to 3rd birth order group and is considered as the highest (48.31).

Estimation of hazard function for the birth of 2nd child

Proportional hazard assumption for Cox model was checked. The results have shown in table 4. Backward elimination method was used for effective explanatory variable selection in model.Finally, the mother's education and father's occupation were selected as the significant explanatory variables (P<0.05).This means mothers with higher education have lower risk of pregnancy than mothers withlower education level.

DISCUSSION

According to table 1, it can be seen all reproductive indices of Irin's sample are higher than the rural areas of Eslamshahr. However, GRR, number of girls born per woman in the reproductive period, regardless of mortality, in Irin's sample is fewer than the rural areas of Eslamshahr. The reason is TFR in Irin's sample is much higher than the rural area of Eslamshahr. Thus, it can be concluded that the percentage of male birth in the Irin's mothers are higher (P<0.05).

The value of GRR is more than one, so, there is not a particular problem in reproduction demographically.

The average and standard error of tempo is respectively 50.39 and 38.72.This shows a gap of 4.2 years for the birth of each child. Of course, considering the fact that the average number of children for these women are 3 and also due to its closeness to Tehran and having urban occupations, then having the city habitof life is expected in this village having the gap of 4.2.

As was observed in the fitted Cox regression model, only maternal education and father's occupation at 5% significant level effect tempo. The hazard of having guidance and high school education compared to being illiterate have a negative impact on fertility hazard and it can be removed because these mothers usually have more demands for education and thus have less fertile.

The father's occupation, as can be seen in table 4, in both cases of governmental and self-job compared to unemployed has increased the hazard of fertility.This means that employed fathers apply more children, andthis increase in governmental is more than self.

In the simulation study, all coefficients except the maternal academic education are closely to the coefficients of final model and conform that.

In a general glance, we can conclude from the represented results that the high number and priority of boy children has resulted as a kind of decrement in birthing children. Therefore it can be said that in bearing children they are following the city habit of life, while the contrary is seen in other villages.

A study in2005 shows that the significant explanatory variables on the gap between pregnancies are: the age at the time of marriage, the age at the time of child delivery, duration of breast feeding and the mother's education [16].

In another study done by Faghihzadeh and others [17] the significant factors were considered to be the age at the time of first marriage and the mother's educational level.Other studies which are not as comprehensive as the recent work and has studied less variables, but they have reached the same results. One of the studies in 1974 about the gap between births was held in England and Wales during 1951 until 1966, by S.M.Farid. This study showed that the relation between the age of marriage and the gap between the marriage and the birth of the first child in England and Wales are like the image of a capsized U. i.e. as the age of marriage is increased the gap between the birth of the first child and marriage is also increased [18]. The reason that this relation holds true is that the marriage in upper ages for women results in decreasing their fertility period and therefore the average of the gap between their births is less than the women who are getting married at lower age.

Also numerous studies have been implemented in America regarding the gap between giving births.The most comprehensive of them has been done in 1974 by K. Ford.This study has shown more fertility between the marriage time and the first birth for the women who has got married in lower ages comparing to women who has got married older ages [19]. In 2009 in Netherland the most important factors are considered to be the behavior taken after the parents and also the economic situation of the society [20]. In this field another study has been done in Europe

which considers all 27 countries analyzed had adjusted TFR in 1995-2000 above1.4. However, substantial regional differences in fertility level across Europe persist even when the differential pace of fertility postponement is taken into account and then they have been concluded that Europe start to terms of the potential long-term pace of population decline[16].

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