DETERMINANTS OF INFANT MORTALITY IN TURKEY

Authors: Nutiye Seckin*, Murat G. Kirdar*
* Department of Economics, Middle East Technical University, 06531, Ankara, Turkey
e-mail: e128091@metu.edu.tr

ABSTRACT

The infant mortality rate in Turkey has dropped from 67 to 21 per 1000 live births in 17 years from 1990 to 2007; however, it remains much higher than those in developed countries. Moreover, the high rate of infant mortality conflicts with certain other demographic and socio-economic indicators of the country. This paper examines the regional, household and individual level characteristics that are associated with infant mortality in Turkey. The data come from 2003 Turkish Demographic and Health Survey. In the estimation, duration analysis methodology is used. The results of the study show that breastfeeding, maternal age-at-birth, place of delivery, and prenatal care are strongly correlated with infant mortality risk. At the same time, the association of these variables with infant mortality exhibit important differences according to family wealth and the child's age in months.

1. INTRODUCTION

The rate of infant mortality is an important indicator of nations' socioeconomic welfare. Despite the tremendous reduction in infant mortality rate (IMR) since 1900s it is still a concern especially of the less developed countries. IMR – expressed as the number of children dying before reaching age one per 1000 live births – was 5 for developed regions whereas it was 51 for the developing countries in 2007 [1].

Like most developing countries, Turkey has experienced a reduction in the IMR in the recent decades. The IMR in Turkey has dropped from 67 to 21 per 1000 live births in 17 years from 1990 to 2007. Moreover, according to the results of a survey conducted by the Hacettepe University Institute of Population Studies the IMR in the 2003-2008 period was 17.6 per 1000 live births in Turkey. This implies a substantial progress in terms of IMR. However, the IMR in Turkey remains much higher than those in developed countries. The significance of IMR as an indicator of nations' welfare and the high levels that had been experienced in the country make it important to find out the determinants of infant mortality in Turkey.

The main aim of this study is to examine the factors that are correlated with the mortality among children under the age one in Turkey. The effects of certain variables would depend on the economic resources available to the family. For instance, a longer preceding birth interval is claimed to improve the health of the infants whose families' resources are scarce more than the health of the other infants. Therefore, in order to observe the potentially varying effects of the determinants of infant mortality across families from different socioeconomic groups, the interactions of wealth with those variables are used. In addition, the variables whose effects on infant's health would be expected to vary by the infants' age are interacted with the age of the infant.

The Turkish Demographic and Health Survey (TDHS) conducted by Hacettepe University Institute of Population Studies in 2003-2004 is used in this study. In addition to the birth histories of the women, information on a rich set of individual-level – on the mothers and children – as well as family-level characteristics is gathered in the data set.

This paper examines the regional, household and individual level characteristics that are associated with the infant mortality in Turkey. In the estimation, survival analysis is used.

The results of the study show that breastfeeding, maternal age at birth, place of delivery, and prenatal care are correlated with infant mortality risk. At the same time, the association of these variables with infant mortality exhibit important differences according to family wealth and the child's age in months.

The study will be organized as follows. In the subsequent section the literature on the determinants of infant mortality is summarized. In Section 3 the data used in this study are described and descriptive statistics are provided. In Section 4 the econometric model is presented. In Section 5 the results are discussed. Finally Section 6 summarizes and concludes this paper.

2. LITERATURE REVIEW

Determinants of infant mortality received considerable attention from researchers of different fields like biomedical, demography and economy for a long while. Due to the difficulties in determining the variables to be included to the models and due to the data limitations a very large scale of variables was investigated by these researchers [2]. Yet, there exists a set of variables prevalently included in these studies. These variables are breastfeeding, prenatal care, inter-birth intervals, maternal age-at-birth, mother's education level, gender of the infant, financial resources of the family, and health policies.

Breastfeeding is claimed to improve infant health thanks to three characteristics it has. First, it is nutritious; it can provide all the nutritional requirements for an infant up to six months. None of its substitutes is as rich or as complete as mother's milk. Second, breast milk provides immunity to infections. And third, breast milk is clean and hygienic since the substances it includes prevent the growth of bacteria [3, 4]. Despite the fact that there is a tendency to include breastfeeding as a determinant of infant mortality, there are some problems arising when measuring the effects of breastfeeding on infant health. First, in some cases breastfeeding do not start at all due to the death of the infant immediately after birth. This is the case of reverse causality; death is the reason for no breastfeeding, not the outcome of it. Second, breastfeeding may be truncated. Truncation occurs because the duration of breastfeeding cannot be longer than the duration of life. If the child dies before he/she is weaned, the observed duration of breastfeeding will be shorter than the case where the child lives. Truncation may lead to the effect of breastfeeding to be underestimated [2].

One of the methods used to subdue the mismeasurement of the impact of breastfeeding on infant health was to predict the chance of survival of the index child in small age segments (x, x+n) as a function of whether or not the child is breastfed up to age x. By doing so, survival chances of children only living up to certain age (x) as a function of breastfeeding is compared [4-6]. Taking breastfeeding as a time-varying variable helps to deal not only with truncation but also with reverse causality problem.

The literature on the determinants of infant mortality indicates a positive correlation between the cessation of breastfeeding and infant mortality risk [4-10]. However, Wolfe and Behrman (1982) could not find a stable relationship between breastfeeding and child health which they measure using child mortality, standardized weight, standardized height and standardized biceps circumference.

Empirical studies indicate that increased use of prenatal care is associated with healthier infants. In the estimation of the effects of prenatal care, problems similar to those of breastfeeding arise. As the breastfeeding is truncated by the length of the infant's life the prenatal care is truncated above by the duration of gestation [2]. Taking the length of the gestation equal for all the infants – nine months – prevents the truncation problem that arises from shorter or longer durations of gestations.

Another variable that is expected to be in correlation with infant survival is the interval between the birth of the previous child and the index child. There is a general thought that longer birth intervals improve the survival chance of the following infant [3, 5, 7-10]. Short preceding birth interval influences infant mortality through three mechanisms. First, closely spaced births cause depletion of the mother. Second mechanism is through sibling competition and the third is the transition of infectious diseases between the closely spaced children [8, 9].

Short subsequent birth interval is found to influence child survival adversely in various studies. Explanations about the ways it affect child mortality are similar to those given for the short previous birth interval except maternal depletion. Competition mechanism operates since some of the resources including parental care go to the new born child and less is left for the index child. Also mother may decide to stop breastfeeding because of the beginning of a pregnancy; this would imply an indirect competition [9].

Measuring the impact of subsequent birth interval may also be problematic. There may be spurious relation between death of the index child and following birth interval. Cut of breastfeeding or replacement and hoaring effects after the death of a child may lead to fertility. In case of the index child's dead, the shorter following birth interval will not be the reason of the death, but the outcome of it. In order to deal with reserve causality problem some studies take only the subsequent births that occur before the beginning of an age interval. Survival of the child in a small age interval (x, x+n) is estimated as a function of whether conception occurred before the child entered to that age segment [4, 5].

The impact of maternal age at birth draws attention of many researchers studying the determinants of infant mortality. Most of the studies investigate a curvilinear relationship between the maternal age at birth and infant mortality; this means that compared to the infants of women who gave birth at very young or old ages, the infants of women who gave birth at middle ages face a lower infant mortality risk [7, 11, 12].

Maternal education is expected to be an important determinant of infant mortality and is mostly used as a proxy for socio-economic status of mother. Less educated mothers are found to experience more child mortality cases [10].

3. DATA AND DESCRIPTIVE STATISTICS

In an attempt to find out the determinants of infant mortality in Turkey, data coming from Turkey Demographic and Health Survey (TDHS) conducted by Hacettepe University Institute of Population Studies in 2003-2004 is used in this study. Throughout this study infant mortality implies the mortality of the babies between the ages 0-11 months.

TDHS-2003 is a survey of 11,517 women, from 10,836 households, between the ages 15 and 49. 8,075 of these women are married at least once. TDHS is thought as the appropriate data set to be utilized in this study due to the fact that the data contain detailed information on the fertility histories of all mothers as well as a rich set of individual and household level characteristics on these women. 7,360 women of 8,075 are mothers and they gave birth to 22,443 children. Of these 22,443 children 1,456 died before their first birthday. Multiple births are excluded from the data due to the higher mortality risk they contain, that may be due to factors that cannot be controlled in the model. Therefore, we end up with 21,985 children and 1,350 infant mortality cases.

In this study, we restrict the sample to 4,576 children who were born after 1998, five years before the date of the survey. The main reason for this elimination is that; data for children born before that date is missing. Information about breastfeeding, antenatal check during pregnancy, place where the delivery took place does not exist for those children. Therefore, in order to find the correlation between these health inputs and infant mortality risk in Turkey the limitation of the data is required.

Children in the entire data are born between 1968 and 2004. However, there are fewer observations for children born earlier because data is restricted to women that are under the age 50. Moreover, these few children are not randomly selected from the sample. Maternal age at birth is very low for those children. To give an example, women who gave birth in 1968 and were older than 14 years old then, are not included in the sample. Restricting data to last five years prevents this selection bias.

Information on household characteristics such as wealth of the family, region and province they live in is present only for the date of the survey. It is assumed that these variables do not change rapidly and stays stable for a while. Hence, these variables are thought as they were alike when the child was born. In addition to handling with missing data and selection bias problems using data of children who were born after 1998 also makes this assumption more reliable. Finally, during 37 years parameters of the specification might have changed. Assumption of constant parameters during this period might not be realistic. Restricting the data to children born five years before the survey allows us to eliminate this assumption.

Of the 4,576 children who were born after 1998, 128 infants died before reaching their first birthday. The age composition of 128 infants that died before their first birthday is presented in Table 1. It can be seen from the table that, nearly twenty percent of the infant mortality cases occurred at the very first day of the infants' lives.

Table 1 Distribution of infant mortality cases at each month (%)

Age of the infant (in months)	**All**	**Male**	**Female**
00	19.530	17.650	21.670
0	41.410	47.060	35.000
1	8.590	8.820	8.330
2	3.130	1.470	5.000
3	10.160	7.350	13.330
4	2.340	4.410	0.000
5	3.910	1.470	6.670
6	3.130	5.880	0.000
7	2.340	0.000	5.000
8	2.340	1.470	3.330
9	0.780	1.470	0.000
10	1.560	1.470	1.670
11	0.780	1.470	0.000

The regional dummy variables indicating the place where the family lives are included to the model. The families are grouped into five categories according to the region they live; south, north, east, west and central. In addition to the regional groups the families are also grouped according to the type of the residence they live. Table 2 presents the IMR according to the regions and the gender of the child. Infant mortality rate is worse for the eastern part of the Turkey, which is considered as less developed and poorer than the other parts of the country. In Table 3 IMR is presented for urban and rural areas. For rural areas the IMR is higher than the IMR for urban areas, 35.5 and 24.3 respectively.

Table 2 IMR (‰) according to the region

Region	All	Male	Female
West	18.9	20.5	17.1
South	23.9	36.5	10.5
Central	20.4	26.8	13.2
North	29.6	25.4	34.3
East	35.5	32.4	38.7

Table 3 IMR (‰) according to the type of place of residence

Type of Place of Residence	All	Male	Female
Urban	24.3	24.3	24.3
Rural	35.5	39.3	31.7

As well as region and place of the residence, ethnicity is a community level factor that is thought to be associated with infant mortality. The mother tongue of the infant's mother is used to reflect the ethnicity of the infant. The most populated ethnic groups living in Turkey are the Turkish, the Kurdish and the Arabic. Figure 1 shows that better outcomes are observed for the ethnic Turkish babies than for the ethnic Kurdish and ethnic Arabian babies.

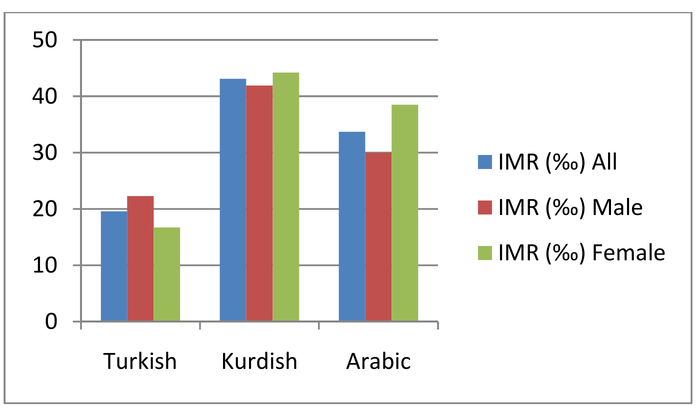

Figure 1 IMR (‰) according to ethnicity

In addition to the community level characteristics, there are also individual and household level characteristics that are thought to have influence on infants' health. One of those factors is the age of the mother when the infant was born. This variable takes values between 13 and 47 and it is grouped into six intervals. IMR by the maternal age at birth is shown in Table 4. IMR for the mothers below the age 20 is 38.5 per 1000 live births. Beyond that age, a gradual decline in the IMR takes place and IMR reaches to minimum for the mothers at the ages between 25 and 29. The IMR rises moderately for the women who gave birth after that age. Among these groups IMR is the highest for the women who gave birth above the age 39.

Table 4 IMR (‰) according to the maternal age at birth

Mother's age at birth	All	Male	Female
<20	38.5	51.3	24.2
20-24	30.7	29	32.7
25-29	17.8	16.1	19.6
30-34	26.9	32.6	21
35-39	38.6	33.7	43.2
>39	42.7	56.6	31.3

Table 5 presents IMR by education level of mother and sex of the child. Note that education groups refer the highest educational level the mother received; which means that it is not necessarily the mother completed the referred level. Increasing levels of education is associated with decreasing levels of IMR. The only exception of this is the higher level of IMR for the male children of mothers with higher education than for the male children of mothers with secondary education.

Table 5 IMR (‰) according to the education level of the mother

Educational Level of Mother	All	Male	Female
No education	46.5	56.5	36.7
Primary	24.5	22.2	26.8
Secondary	13	9.2	17.1
Higher	15.3	26.5	0

In this study wealth index is used in order to take into account the resources available to the household. Wealth index variable is presented by TDHS, and takes values between -2402770 and 2857500 for the restricted sample. For simplicity this variable is fitted to the interval 0-1. By normalizing this variable it will be easier to interpret the impact of explanatory variables interacted with wealth indices of the families. Another variable formed by TDHS classifies families according to their wealth indices into five groups from the poorest to the richest. IMR by this classified wealth index and sex of the child is displayed in Table 6. Children of families with higher wealth indices are observed to have lower IMR.

Table 6 IMR (‰) according to the wealth indices of the families

Wealth Index	All	Female	Male
Poorest	41.2	45.2	37.4
Poorer	33.3	34.4	32.1
Middle	23.9	25.4	22.5
Richer	20.3	20	20.6
Richest	9.3	8.5	10.3

Water source in this analysis stands for hygienic conditions of the family. Water source is classified into twelve groups by TDHS. However, we have joined some of the similar groups in this study in order to simplify the results; we end up with five groups of households in terms of water source. The IMR by water source and gender is given in Table 7. The IMR is the lowest for the families using water from the tanker, water station, bottled water or from the sources other than the sources mentioned in the other groups. The worst group in terms of infant mortality is the group consisting of the families using water from public well.

Table 7 IMR (‰) according to the water source

Water source	All	Male	Female
Piped water	26.3	24.2	28.6
Public well	108.4	175	46.5
Well in house/garden	23	23.3	22.7
Piped surface water/spring/public fountain/ river/ stream/ pond/ lake/ dam/rain water	32.7	32.5	32.9
Tanker/bottled/water station/other	14.9	24.5	3.6

The interval between the observed child and child preceded her/him is calculated simply by the birth dates of the children. For our restricted sample preceding birth interval takes values between 9 and 250 months. Preceding birth interval is taken as 250 months, the largest value of the sample, for the first children who are not preceded by any other child. A dummy variable is created for the short preceding birth interval. 5% of the children have preceding birth interval shorter than or equal to 13 months. Therefore cutoff point for short preceding birth interval is determined to be 13 months. Table 8 provides information of IMR by preceding birth interval and gender of the child. According to the table babies with preceding birth interval shorter than 14 months are subject to higher risk of mortality than other babies; this claim is true both for female and male babies.

Table 8 IMR (‰) according to the preceding birth interval

Preceding birth interval	All	Male	Female
>13 or first child	25.7	28.4	22.8
<14	85.2	47.1	120.9

Instead of succeeding birth interval a dummy variable which takes value 1 when the conception of the succeeding sibling occurs is included to the model. The interval between the birth of the index child and conception of the succeeding sibling is computed by subtracting 9 – assumed length of gestation – from the succeeding inter-birth interval. In Table 9 descriptive statistics for succeeding conception at each age interval of infants' lives are given. According to this table 0.1 percent of the mothers became pregnant until the index child was 1 month old. As expected, the ratio rises as the infant ages. 10% of the women become pregnant within a year after giving birth to the index child. Moreover, it can be seen from the table that women bearing a female child are more likely to become pregnant shortly after they gave birth than women bearing a male child.

Table 9 Descriptive statistics for succeeding conception at each age interval

Age of the infant (in months)	**All**	**Female**	**Male**
0	0.001	0.000	0.001
	(0.026)	(0.021)	(0.029)
1	0.003	0.003	0.002
	(0.052)	(0.057)	(0.047)
2	0.008	0.010	0.007
	(0.092)	(0.101)	(0.082)
3	0.016	0.020	0.013
	(0.127)	(0.140)	(0.112)
4	0.028	0.032	0.024
	(0.165)	(0.176)	(0.153)
5	0.037	0.045	0.029
	(0.189)	(0.207)	(0.169)
6	0.048	0.055	0.041
	(0.214)	(0.228)	(0.198)
7	0.059	0.068	0.051
	(0.236)	(0.251)	(0.220)
8	0.070	0.078	0.063
	(0.256)	(0.268)	(0.243)
9	0.079	0.086	0.072
	(0.270)	(0.280)	(0.259)
10	0.090	0.099	0.082
	(0.287)	(0.299)	(0.274)
11	0.101	0.111	0.090
	(0.301)	(0.315)	(0.286)

Note: Numbers in parenthesis are standard deviations.

Table 10 presents IMR by the sex of the child and by prenatal care received by the mother. TDHS-2003 included information of the month of the pregnancy the mother started receiving prenatal care. Duration of prenatal care is calculated by subtracting the month of initiation of prenatal care from 9, which is taken as the duration of the pregnancy for all women. It can be seen from the table that IMR is highest for the children that did not receive any prenatal care.

Table 10 IMR (‰) according to the duration of prenatal care

Duration of prenatal care (in months)	All	Male	Female
0	50.6	51.4	49.7
1	26.3	45.5	0
2	35.3	54.1	20.8
3	15.9	15.2	16.7
4	14.6	9.1	20.8
5	9.4	9.7	9.2
6	22.8	20.3	25.3
7	25.1	28.9	20.7
8	13.1	14.2	11.9
9	14.4	10	19.2

Table 11 present infant mortality rates by the sex of the infants and by the place of delivery. This table implies that children who were delivered at home are more likely to die than the children that were delivered in a hospital, health center or in a clinic. The most favorable group consists of babies that were delivered in a private hospital, clinic or in a private doctor's office.

Table 11 IMR (‰) according to the place of delivery

Place of delivery	All	Male	Female
Home	46.7	46.4	47
Government hospital	22.7	22.8	22.7
Health centre	30.1	30.6	29.6
MCHFP centre/ other public	7	3.5	10.5
Private hospital/clinic/doctor	5.9	7.3	4.3
Other	272.7	333.3	0

Finally, duration of breastfeeding is included as an explanatory variable in this analysis. Due to the truncation problem duration of breastfeeding is not included to the model. Instead, a dummy variable is created that takes value 1 if the child is breastfed before the he/she enters a certain age interval, and 0 otherwise. Moreover, this variable is taken as 0 for all the children at the very first day of their lives. This method is similar to the method used to account for the birth of the next child and the method used to observe the impact of breastfeeding on infant mortality by Palloni and Tienda [4].

In Table 12 descriptive statistics for breastfeeding at ach age interval are presented. This table implies that 90% of the infants were breastfed at their first month. This ratio declines as the infant ages. Among the infants who are at the twelfth month of their lives 44% were breastfed.

Table 12 Descriptive statistics for breastfeeding at each age interval

Age of the infant (in months)	All	Female	Male
0	0.902	0.910	0.894
	(0.297)	(0.286)	(0.308)
1	0.859	0.863	0.856
	(0.348)	(0.344)	(0.351)
2	0.805	0.805	0.806
	(0.396)	(0.396)	(0.396)
3	0.767	0.770	0.765
	(0.422)	(0.421)	(0.424)
4	0.733	0.740	0.726
	(0.443)	(0.439)	(0.446)
5	0.661	0.675	0.648
	(0.473)	(0.469)	(0.478)
6	0.636	0.642	0.630
	(0.481)	(0.479)	(0.483)
7	0.614	0.613	0.615
	(0.487)	(0.487)	(0.487)
8	0.585	0.586	0.583
	(0.493)	(0.493)	(0.493)
9	0.564	0.568	0.561
	(0.496)	(0.495)	(0.496)
10	0.549	0.548	0.550
	(0.498)	(0.498)	(0.498)
11	0.444	0.434	0.454
	(0.497)	(0.496)	(0.498)

Note: Numbers in parenthesis are standard deviations.

4. METHODOLOGY

In this study, survival analysis is conducted to find out what socioeconomic factors are associated the most with infant mortality in Turkey. Infant mortality is referred to the mortality of the children at ages 0-11 months. Survival analysis is particularly appropriate in this context because it is formed to model time to event data. Unlike a linear regression or probit model, it can handle observations with a censored structure. In our study, a child enters the risk set when he/she is born and exists when he is dead (failure) or reaches the age of one (no failure) or exits the sample before reaching age one because he/she is younger than age one at the time of the survey (right-censored outcomes). In survival analysis, the probability that an infant who has lived t months dies until t+1 months is modeled as a function of age of the infant and explanatory variables that are expected to determine infant mortality.

It is important to distinguish weather duration of life of the infant is modeled as a continuous or discrete outcome. The survival time of an infant – length of time infant is alive – is intrinsically continuous. However, the information on the exact length of infants' lives is not available in the data; survival times of the infants are reported in months. This grouped structure of the duration data prevents an analysis using continuous time specifications. Hence, a discrete time specification is used in this study for survival analysis. Waiting time is grouped into intervals. Except for the first interval, all intervals are one-month long. The first interval is the first day in the infant's life. The second interval starts at the second day of life and lasts until the infant is one-month-old. The thirteenth interval starts at the beginning of the twelfth month and ends at the 365th day of the infants' life.

In forming the data, for each infant who has lived n months, (n+1) data columns are generated. The variable indicating the survival status of the child will be 0 for the months the infant is alive and 1 if the child is dead. For infants who live more than 12 months, 13 columns will be formed and this variable will take value 0 at all of the intervals. For infants who die in their nth month, the survival status variable takes the value 1 only at the last column and 0 at the first n columns. Finally, for children who are alive but have not reached age one at the date of the survey (censored outcomes), this variable will take value 0 at all the columns.

Failure is defined as the death of the infant. Therefore, hazard rate is equal to the probability of dying at a specific age interval conditional on the survival of the infant up to that age interval. It is defined as; $\lambda j = Pr (T = tj \mid T \geq tj)$ where t denotes some specific time, and T denotes the age of the infant at death. We choose a logistic functional form for the hazard function in the estimation.

The hazard rate of the child i of mother j at time t is assumed to be as;

$$\boldsymbol{\lambda_{ijt} = \lambda\,(X_{ij,}\, X_{ij}(t))} \tag{1}$$

In equation (1) X_{ij} refers to the time invariant covariates included in the specification for the i^{th} child of the j^{th} family, and $X_{ij}(t)$ refers to the time varying covariates of the same child. In particular, a logistic form is chosen for the hazard rate given by;

$$\boldsymbol{log\left[\frac{\lambda_{ijt}}{1-\lambda_{ijt}}\right] = \alpha_0 + \sum_{i=1}^{k_1} \beta_i X_{ij} + \sum_{i=k_1}^{k_2} \beta_i X_{ij}(t) + u_{ij}} \tag{2}$$

The time varying covariates that are used in this study are the duration of breastfeeding of the child and the occurrence of conception of his/her succeeding sibling. As explained before the method employed to deal with the problem of reverse selection for breastfeeding and succeeding birth interval is to create dummy variables that can take different values for each age interval. In case of breastfeeding the variable takes value 1 until the infant is weaned, then it becomes 0 for the same child. The variable for the conception of the succeeding birth interval takes value 0 until the mother of the index infant becomes pregnant, and then it becomes 1.

The place of delivery, prenatal care received by mother, preceding birth interval, wealth index, maternal age at birth, education level of the mother, gender of the child, source of water, region and type of place of residence where the family lives, ethnicity of the child, birth order and birth year of the infant are time invariant variables used in this analysis. These variables take a constant value at every age interval.

Forty-five percent of the infant mortality cases in our sample occur immediately after the infant is born. Hence, the effects of the socioeconomic factors that are expected to be correlated with infant mortality are allowed to vary by the waiting time concept (age of the child) in the model. Interactions of the variables-of-interest with wealth of the families are also included in the study to see any differential impact of the variables-of-interest by wealth.

5. RESULTS

The results of our discrete time logit estimation of equation (2) are given in Table 13. The first column presents the coefficients of the estimation and the second column presents the odds ratios.

Table 13 Logit estimate results for infant mortality

	Coefficient	Odds Ratio
Breastfeed	-6.674***	0.001***
	[1.023]	[0.001]
Place of delivery (Base category: Government hospital)		
Home	0.363	1.437
	[0.284]	[0.409]
Health centre/Health house/ Maternity house	0.283	1.327
	[0.301]	[0.400]
MCHFP centre/ other public	-0.776	0.460
	[0.611]	[0.281]
Private hospital/clinic/doctor	-1.383*	0.251*
	[0.792]	[0.198]
Other	3.419***	30.549***
	[0.526]	[16.067]
Prenatal care (Base category: No prenatal care)		
Take prenatal care * age(00)	-1.590	0.204
	[1.221]	[0.249]
Take prenatal care * age(0 - 11)	-0.456	0.634
	[0.642]	[0.407]
Duration of prenatal care * age(00)	0.263*	1.301*
	[0.158]	[0.205]
Duration of prenatal care * age(0 - 11)	-0.047	0.954
	[0.086]	[0.082]
Inter-birth intervals		
Short preceding birth interval	1.162	3.198
	[0.970]	[3.101]
Short preceding birth interval * wealth	-2.982	0.051
	[3.763]	[0.191]
Occurrence of conception	0.135	1.144
	[0.586]	[0.670]
Occurrence of conception * wealth	1.994	7.343
	[1.511]	[11.094]
Wealth index (Base category: Poorest)		
Wealth index : Poorer	0.133	1.142
	[0.338]	[0.387]
Wealth index : Middle	0.252	1.286
	[0.383]	[0.493]
Wealth index : Richer	-0.062	0.940
	[0.463]	[0.435]
Wealth index : Richest	-0.507	0.602
	[0.722]	[0.435]

Table 5-2 (continued)

Maternal age at child's birth (Base category : 25-29)		
Mother's age< 20	1.470***	4.351***
	[0.406]	[1.765]
Mother's age : 20-24	0.902***	2.464***
	[0.337]	[0.831]
Mother's age : 30-34	0.447	1.564
	[0.372]	[0.582]
Mother's age : 35-39	1.176**	3.241**
	[0.476]	[1.543]
Mother's age>39	0.045	1.046
	[0.621]	[0.649]
Maternal education level (Base category: No education)		
Primary * age(00)	0.339	1.404
	[0.445]	[0.625]
Primary * age(0-11)	-0.100	0.905
	[0.300]	[0.271]
Secondary * age(00)	-0.363	0.695
	[1.035]	[0.720]
Secondary* age(0-11)	-0.067	0.935
	[0.548]	[0.512]
Higher* age(00)	1.050	2.858
	[1.351]	[3.861]
Higher* age(0-11)	0.573	1.773
	[1.131]	[2.006]
Gender of the index child (Base category: Male)		
Female* age(00)	0.156	1.169
	[0.479]	[0.560]
Female* age(0-11)	-0.159	0.853
	[0.249]	[0.212]
Water Source (Base category: piped into house/garden or outside house/garden)		
Public well	0.693	2.001
	[0.591]	[1.182]
Well in house/garden	-0.639	0.528
	[0.654]	[0.345]
Piped surface water/spring/public fountain/ river/ stream/ pond/ lake/ dam	0.058	1.059
	[0.383]	[0.405]
Tanker/bottled/water station/other	0.378	1.459
	[0.550]	[0.803]
Region (Base category: West)		
Region: Central	-0.254	0.776
	[0.401]	[0.311]
Region: East	0.457	1.580
	[0.405]	[0.639]
Region: South	0.000	1.000
	[0.484]	[0.483]
Region: North	0.161	1.174
	[0.522]	[0.613]

Table 5-2 (continued)

Type of place of residence		
Rural	-0.099	0.905
	[0.425]	[0.385]
Large city	0.235	1.266
	[0.453]	[0.573]
Small city	-0.048	0.954
	[0.396]	[0.377]
Ethnicity (Base category: Turkish)		
Kurdish	0.351	1.420
	[0.296]	[0.421]
Arabic	0.084	1.087
	[0.619]	[0.673]
Child order (Base category: 1)		
2	0.247	1.280
	[0.331]	[0.423]
3	0.111	1.117
	[0.411]	[0.459]
4	0.395	1.485
	[0.493]	[0.732]
> 5	0.496	1.641
	[0.475]	[0.780]
Age interval in months (Base category: 00)		
0	4.392***	80.787***
	[0.631]	[51.001]
1	2.564***	12.986***
	[0.726]	[9.429]
2	0.843	2.324
	[0.838]	[1.948]
3	1.876***	6.527***
	[0.656]	[4.283]
4	0.059	1.061
	[0.850]	[0.902]
5	0.384	1.468
	[0.801]	[1.176]
6	0.632	1.881
	[0.787]	[1.480]
7	-0.812	0.444
	[0.934]	[0.414]
8	-0.436	0.647
	[0.837]	[0.542]
9	-2.385**	0.092**
	[1.178]	[0.109]
(10 + 11)	-1.783**	0.168**
	[0.906]	[0.152]

Table 5-2 (continued)

Birth year (Base category: 1999)		
Birth year : 2000	0.045	1.046
	[0.375]	[0.392]
Birth year : 2001	-0.028	0.972
	[0.401]	[0.390]
Birth year : 2002	-0.040	0.961
	[0.394]	[0.379]
Birth year : 2003	-0.050	0.951
	[0.383]	[0.365]
Birth year : 2004	-2.225**	0.108**
	[0.982]	[0.106]
Pseudo-R^2	0.3762	0.3762

Note: The number of observations is 52,892. Robust and clustered at household level standard errors are in brackets beneath regression coefficient and odds ratio. The level of statistical significance of each estimate is indicated by ***, ** and * for the one, five and ten percent levels, respectively.

We will discuss the estimated impact of the variables of interest on infant mortality in groups.

5.1. Breastfeeding

In order to overcome the truncation and reverse causality problems, the length of infant's life is split into intervals and breastfeeding is taken as a dummy variable taking value 1 if the child is breastfed during that interval and 0 otherwise. Breastfeeding is taken as 0 for all the infants at the first day of their lives.

The results of the model presented in Table 13 imply that breastfeeding is associated with the infant mortality risk. The odds of an infant dying is 0.001 times smaller if he/she is breastfed relative to infants that are not breastfed, holding other variables constant. (The coefficient is statistically significant at the 1 percent level.) This finding that breastfeeding is positively related with infants' survival chances is consistent with the previous literature on the determinants of infant mortality [4, 6, 10, 13].

5.2. Prenatal Care

In addition to the dummy variable indicating whether the child receives any prenatal care, the duration of prenatal care is also included to the model. Both of these variables are interacted with the age of the infant. The interacted terms of prenatal care shows the impact of prenatal care at the first day of the infant and when the infant is between the ages 0 and 11 months.

Table 14 presents the impact of prenatal care on infant mortality for selected durations of prenatal care. As shown in the table impact of prenatal care changes according to the distinctive duration of prenatal care. Moreover, the impact of prenatal care on infant mortality varies according to the age of infants'. There is no evidence for an impact of prenatal care on infant mortality risk at the very first day of an infant's life, and this fact is true for all durations of prenatal care received. However, prenatal care that is longer than 3 months is associated with a lower infant mortality risk for infants between the ages 0-11 months. The risk of dying is negatively correlated with prenatal care among the children at ages 0-11 months, after the first day of their lives. For instance, a full 9-month long prenatal care is associated with 59 percent drop in the odds ratio.

Table 14 Impact of prenatal care for selected durations of prenatal care

Duration of Prenatal Care	Prenatal Care * age(00)		Prenatal Care * age(0-11)	
	Coefficient	**Odds Ratio**	**Coefficient**	**Odds Ratio**
1	-1.326	0.265	-0.504	0.604
	[1.080]	[0.287]	[0.569]	[0.344]
2	-1.063	0.345	-0.551	0.576
	[0.944]	[0.326]	[0.501]	[0.288]
3	-0.800	0.449	-0.598	0.550
	[0.816]	[0.367]	[0.438]	[0.241]
4	-0.536	0.585	-0.646*	0.524*
	[0.700]	[0.410]	[0.385]	[0.202]
5	-0.273	0.761	-0.693**	0.500**
	[0.604]	[0.460]	[0.346]	[0.173]
6	-0.010	0.990	-0.741**	0.477**
	[0.537]	[0.532]	[0.325]	[0.155]
7	0.253	1.289	-0.788**	0.455**
	[0.512]	[0.659]	[0.326]	[0.148]
8	0.517	1.677	-0.835**	0.434**
	[0.534]	[0.895]	[0.349]	[0.151]
9	0.780	2.182	-0.883**	0.414**
	[0.598]	[1.304]	[0.391]	[0.162]

Notes: These estimates are based on the estimates of Table 13. Robust and clustered at household level standard errors are in brackets beneath regression coefficient and odds ratio. The level of statistical significance of each estimate is indicated by ***, ** and * for the one, five and ten percent levels, respectively.

5.3. Place of Delivery

Children are categorized into six groups according to the place of delivery. The base category in this regression is delivery at a state hospital. The estimation results indicate that infants who are born in a private hospital, clinic or a private doctor's office are found to have the highest chance of survival among all the infants in this sample. The odds of an infant surviving are 4 times larger if the infant is born at a private hospital, clinic or a private doctor's office rather than he/she is born at a state hospital, holding other variables constant. (The coefficient is statistically significant at 10 percent level.)

5.4. Maternal Age at Birth

The estimated coefficients of all of the dummy variables for mothers' age groups are positive when the maternal age at birth between 25 and 29 is taken as the base category. This means that compared to the infants of women who gave birth between the ages of 25 and 29, the infants of women who gave birth at all other ages face a higher infant mortality risk. According to the results, the children of mothers who give birth before age 20 bear the highest risk of dying before reaching the age of 1. As can be seen in Table 13, if a mother gives birth before she is 20, the odds of her infant dying are 4.3 times higher than the odds if she were to give birth between the ages 25 and 29, holding other variables constant. (The coefficients are statistically significant at the 1 percent level.) Moreover, the evidence of commonly argued curvilinear relationship between the maternal age and infant mortality risk is also found in this study [7, 11, 12]. The curvilinear relationship suggests higher infant mortality risk for the infants of mothers who gave birth at very young and very old ages.

5.5. Previous Birth Interval

Previous birth interval is defined as short if the birth interval between the index child and his/her older sibling is shorter than 14 months and the infant is not the first child. First children are taken as if they are in the favorable group with preceding birth interval longer than 13 months. A dummy variable indicating a short preceding birth interval and its interaction with the wealth index are included in the model. The results imply that among the poorest families in the data – families with wealth index 0 – the difference between the infant mortality risk of children with short preceding birth interval and the infant mortality risk of the children with preceding birth interval longer than 13 months is not statistically significant.

One way through which preceding birth interval affects infant health is competition between the siblings. Restricted resources of the family have to be shared among the children. Fewer resources may be correlated with infant mortality therefore a short preceding birth interval may increase the risk of infant mortality. If this proposition held we would expect decline in the positive correlation between short preceding birth interval and infant mortality with the increasing wealth indices of the families. Table 15 presents the impact of the length of the preceding birth interval at selected values of the wealth index. The sign of the estimated impact for the poorest families is positive and the magnitude of the impact decreases as the wealth index rises, as expected. However, none of the estimated coefficients for any wealth index level is statistically significant. Therefore, we do not observe any association between the preceding birth interval and infant mortality in this sample.

Table 15 Impact of preceding birth interval at selected levels of wealth index

Wealth Index	**Short preceding birth interval (Preceding Birth Interval <14)**	
	Coefficient	**Odds Ratio**
0	1.162	3.198
	[0.970]	[3.101]
0.1	0.864	2.373
	[0.654]	[1.552]
0.2	0.566	1.761
	[0.445]	[0.784]
0.3	0.268	1.307
	[0.501]	[0.656]
0.4	-0.030	0.970
	[0.767]	[0.744]
0.5	-0.328	0.720
	[1.099]	[0.791]
0.6	-0.627	0.534
	[1.453]	[0.776]
0.7	-0.925	0.397
	[1.816]	[0.720]
0.8	-1.223	0.294
	[2.183]	[0.643]
0.9	-1.521	0.218
	[2.553]	[0.558]
1	-1.819	0.162
	[2.925]	[0.474]

Notes: These estimates are based on the estimates of Table 13. Robust and clustered at household level standard errors are in brackets beneath regression coefficient and odds ratio. The level of statistical significance of each estimate is indicated by ***, ** and * for the one, five and ten percent levels, respectively.

5.6. Succeeding Pregnancy

The impact a succeeding birth is measured by using a dummy variable that is equal to 1 if the mother becomes pregnant before the index child enters a certain age interval, and 0 otherwise. The interaction of this pregnancy dummy with the wealth index is also included in the model.

Table 16 presents the estimated coefficients of the succeeding pregnancy at selected levels of wealth indices. Except for the poorest families, we find that succeeding pregnancy in fact increases the infant mortality risk. However, we do not find any evidence that this effect is stronger for poorer families. In fact, maybe surprisingly, the estimated positive coefficient of succeeding pregnancy is higher for wealthier families. However, the interaction term of wealth with succeeding pregnancy is not statistically significant.

Table 16 Impact of succeeding pregnancy for selected levels of wealth index

Wealth Index	Occurrence of conception	
	Coefficient	**Odds Ratio**
0	0.135	1.144
	[0.586]	[0.670]
0.1	0.334	1.397
	[0.483]	[0.675]
0.2	0.534	1.705
	[0.412]	[0.702]
0.3	0.733*	2.081*
	[0.388]	[0.808]
0.4	0.932**	2.540**
	[0.422]	[1.072]
0.5	1.132**	3.101**
	[0.501]	[1.553]
0.6	1.331**	3.785**
	[0.608]	[2.300]
0.7	1.530**	4.620**
	[0.730]	[3.374]
0.8	1.730**	5.640**
	[0.862]	[4.862]
0.9	1.929*	6.884*
	[0.999]	[6.879]
1	2.129*	8.403*
	[1.140]	[9.579]

Notes: These estimates are based on the estimates of Table 13. Robust and clustered at household level standard errors are in brackets beneath regression coefficient and odds ratio. The level of statistical significance of each estimate is indicated by ***, ** and * for the one, five and ten percent levels, respectively.

6. CONCLUSION

The aim of this study is to shed light on the regional, household and individual level factors that are associated with the mortality among the children under the age one in Turkey. For this purpose, the 2003 wave of the Turkey Demographic and Health Survey is used. The method employed to model the determinants of infant mortality risk is survival analysis.

The results of the study show that breastfeeding, maternal age at birth, place of delivery, and prenatal care are correlated with infant mortality risk. At the same time, the association of these variables with infant mortality exhibit important differences according to family wealth and the child’s age in months.

Breastfeeding is found to be negatively correlated with infant mortality risk at all stages of infancy regardless of family wealth. This implies that children who are not breastfed have to be given good substitutes of breastfeeding as nutriment. Moreover, these substitutes should be made available to lower income households in order to improve infant health in Turkey.

We find a curvilinear association between infant mortality risk and maternal age-at-birth in Turkey is consistent with the findings in literature for several other countries. (see, e.g., [7, 11, 12]). Infant mortality risk is highly correlated with giving birth before the age of 20.

The place of delivery also emerges as an important covariate of infant mortality. After controlling the other variables infants born in a private hospital, in a private clinic or in a private doctor's office are found to experience a lower infant mortality risk than the infants born in a government hospital.

A longer duration of prenatal care received by the mother is associated with a higher chance of infant survival for children between the ages 0-11 months, however is not associated with the risk of dying at birth. Therefore, making prenatal care more accessible for pregnant women through public policies might be another way to improve infant survival chance in Turkey.

With regard to water source, we find that families using water from a public well are observed to have the highest infant mortality risk. Gender gap and the education of mother are found to be statistically insignificant in this analysis after controlling for the other variables. Finally, the negative correlation between birth-order and infant's survival change becomes insignificant after the inclusion of prenatal health inputs, place of delivery and inter-birth intervals in the model.

REFERENCES

[1] "Millennium Development Goals Indicators," United Nations, 2009.

[2] K. I. Wolpin, "Determinants and Consequences of the mortality and health of infants and children," in *Handbook of Population and Family Economics*. vol. 1A, M. R. Rosenzweig and O. Stark, Eds. Amsterdam: Elsevier, 1997.

[3] J. Davanzo and J. P. Habicht, "Infant-Mortality Decline in Malaysia, 1946-1975 - the Roles of Changes in Variables and Changes in the Structure of Relationships," *Demography,* vol. 23, pp. 143-160, May 1986.

[4] A. Palloni and M. Tienda, "The effects of breastfeeding and pace of childbearing on mortality at early ages," *Demography,* vol. 23, pp. 31-52, Feb 1986.

[5] A. R. Pebley and P. W. Stupp, "Reproductive patterns and child mortality in Guatemala," *Demography,* vol. 24, pp. 43-60, Feb 1987.

[6] M. R. Rosenzweig and T. P. Schultz, "Consumer Demand and Household Production - the Relationship between Fertility and Child-Mortality," *American Economic Review,* vol. 73, pp. 38-42, 1983a.

[7] S. Bhalotra and A. van Soest, "Birth-spacing, fertility and neonatal mortality in India: Dynamics, frailty, and fecundity," *Journal of Econometrics,* vol. 143, pp. 274-290, Apr 2008.

[8] A. K. Majumder, M. May, and P. D. Pant, "Infant and child mortality determinants in Bangladesh: Are they changing?," *Journal of Biosocial Science,* vol. 29, pp. 385-399, Oct 1997.

[9] M. A. Koenig, J. F. Phillips, O. M. Campbell, and S. Dsouza, "Birth Intervals and Childhood Mortality in Rural Bangladesh," *Demography,* vol. 27, pp. 251-265, May 1990.

[10] M. Murphy and D. Wang, "Do previous birth interval and mother's education influence infant survival? A Bayesian model averaging analysis of Chinese data.," *Population Studies-a Journal of Demography,* vol. 55, pp. 37-47, Mar 2001.

[11] P. Maitra, "Parental bargaining, health inputs and child mortality in India," *Journal of Health Economics,* vol. 23, pp. 259-291, Mar 2004.

[12] A. T. Geronimus, "The effects of race, residence, and prenatal care on the relationship of maternal age to neonatal mortality," *American Journal of Public Health,* vol. 76, pp. 1416-21, Dec 1986.

[13] R. J. Olsen and K. I. Wolpin, "The Impact of Exogenous Child Mortality on Fertility: A Waiting Time Regression with Dynamic Regressors," *Econometrica,* vol. 51, pp. 731-749, 1983.