Original Article

IDENTIFICATION OF VARIABLES AFFECTING INFANT MORTALITY RATE IN ESKISEHIR (TURKEY)

Selma Metintas[1], Inci Arikan[2], Huseyin Fidan[3], Cemalettin Kalyoncu[4], Mesut Goktepe[5]

ABSTRACT

Objective: An understanding of the factors related to infant mortality is important. This study aimed to identify the determinants of infant mortality rate in Eskisehir (central part of Anatolia) in Turkey.

Methodology: This was a cross-sectional ecologic study. The data source for the analysis was Eskisehir Provincial Directorate of Health from which survival information of 15,600 infants born and 227 infant deaths between 2006-2007 was examined. Multiple linear regression was performed to analyze the factors associated with infant deaths, using demographic, maternal and infant indicators and health service determinants. Neperian log transformation was applied in the dependent variable to normalize residue distribution.

Results: Infant mortality rate was found as 14.55 per 1000 live births and Neonatal mortality rate as 10.96 per 1000 live births in Eskisehir. The variables that predicted infant mortality rate were the rate of non-schooled women. The possible determinants identified for still birth rate included infants with low birth weight and the percentage of deliveries outside the hospital. The variable that predicted neonatal death rate was found as the percentage of deliveries outside the hospital.

Conclusions: Women enrollment rate in school as well as deliveries outside the hospital and low birth weight determinants should be taken into account when planning the interventions to reduce infant mortality in Eskisehir, Turkey.

KEY WORDS: Infant mortality rate, Stillbirth rate, Ecological study, Risk factors.

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1. Selma Metintas, MD, PhD, Professor
2. Inci Arikan, MD, Assistant doctor
3. Huseyin Fidan,MD
4. Cemalettin Kalyoncu, MD, Professor
5. Mesut Goktepe, MD

1-4: Eskisehir Osmangazi University Medical Faculty, Public Health Department 26480 Meselik-Eskisehir/Turkey.

5. Eskisehir Provincial Directorate of Health, Eskisehir/Turkey.

Correspondence:

Inci Arikan
E-mail: iciarikan@hotmail.com
selmamet@ogu.edu.tr

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INTRODUCTION

Infant Mortality Rate (IMR) is a significant criterion closely related to the health level of a society.[1-2] It is known that IMR is directly related to a variety of factors. These factors include infant-related features such as premature and low birth weight, maternal features such as age younger than 20 or older than 40, low education level, and socio-economic situations.[1,3] Various factors such as access to health services, disease rates and quality of the environment are also closely related to infant mortality.[3,4] Socio-economic situations in a geographical location and the quality of health services are also important factors.[4]

Considerable achievements have been made in an attempt to decrease IMR in Turkey and around the world. Various programs have been implemented recently. In Turkey, IMR was 29 per thousand in 2003. It has now decreased to 21.7 per thousand in 2007, and it is estimated to be 20.0 per thousand in 2010.[5,6] However, it has not yet achieved the level of developed countries. Infant mortality rate is 9 per thousand in Europe and 6.8 per thousand in the USA.[7]

Eskisehir (Central Anatolian Region) is the first crowded city which has pioneered a new health system under the Turkey-Health Transformation Project since 2006. Therefore, it is important to determine the IMR because it is a significant indicator of availability and use of the health service. Eskisehir is a province in Turkey with a relatively low level of IMR. Reduction in infant mortality is still a great challenge to Eskisehir. Despite the important decrease recorded in the last decade, especially due to post-neonatal mortality, rates are still high.[8] There is a relative increase in neonatal mortality, because of the reduction in post-neonatal mortality. This situation is worsened when we see that more than 90% of these deaths of younger than one year old could have been avoided with prevention actions, diagnoses and early treatment, or with partnerships with other sectors.

An understanding of the factors related to infant mortality is important to guide the development of focused and evidence-based health interventions to prevent infant deaths. This study aimed to identify the determinants of IMR in Eskisehir between 2006-2007 years.

METHODOLOGY

This study is a cross-sectional ecological study and carried out by the Eskisehir Provincial Directorate of Health and the Eskisehir Osmangazi University Department of Public Health. Approval of the local Ethical Committee (Certification Number: 2009/279) were obtained for this study.

Eskisehir, where the study was carried out, is a province in the Central Anatolian Region. It is located to the west of the capital city Ankara and has a population of 706,250 (urban: 574,121, rural: 132,029). Eighty percent of the population lives in the city center, and 20% lives in rural areas. The rate of illiteracy is 20% among women and 6% among men. The considerable majority of the population is engaged in industry and farming. Eskisehir is a province under the Health Transformation Project. The units responsible for the Maternal and Infant Health Services are the Public Health Centers. There are four centers in the city center and eleven in the periphery.[9]

Public Health Center data were taken as the basis for this study. When a birth registration form is filled at a maternity ward and/or postnatal ward and/or home visit by midwifes, every newborn is also given a unique personal identification number. The infant death registration form is filled by a responsible doctor. All live births and infant mortality reported to the Public Health Center Database in 2006-2007 were linked to the Eskisehir Provincial Directorate of Health-Birth and Infant Mortality Database, using the unique personal identification number. The linkage was successful for 99% of births and infant deaths.[9]

The WHO definition of live birth has been used in Eskisehir. Infant mortality is defined as the number of infant deaths (one year of age or younger) per 1000 live births. Neonatal (<28 days) and post-neonatal (28 days to 364 days) mortality rates per 1000 live births were calculated. The still birth rate was calculated by dividing the number of fetuses who died after the 22nd week of pregnancy by the total of still and alive deliveries in the particular year. Infants with a birth weight under 2500g were considered to be low birth weight.[10]

Infant mortality causes were studied using the Expanded Wigglesworth Classification. This system was based on clinical-pathological evaluation of the fatal mortalities under seven headings: congenital defect/malformations, prematurity, perinatal asphyxia, infections, other specific reasons and sudden infant death/unknown causes. [11]

To obtain the remaining indicators, different sources have been used from the Health Infor-

mation System of the Eskisehir Provincial Directorate of Health, State Statistics Institution and the 2003 Turkey demographic and Health Survey.[8,9]

The following indicators were used in this study:

1. *Epidemiological indicators (dependent variable):* Infant mortality rate, still birth rate, neonatal mortality rate
2. *Demographical indicators:* Percentage of rural population, percentage of non-schooled women
3. *Maternal and infant percentages:* Percentage of women delivering at an age younger than 18, percentage of infants with low birth weight
4. *Indicators of health service:* Rate of deliveries outside the hospital, patients per practitioners and nurses, number of midwives per woman between the ages of 15 and 49, average number of annual pregnancy follow-ups, average number of annual puerperant follow-ups, average number of annual infant follow-ups, average of annual follow-ups for women between 15 and 49 years of age.

Statistical Analysis: According to Szwarcwald, a regression coefficient is the best indicator of inequality in health when health and social levels are to be analyzed quantitatively.[12] Infant mortality rates in Public Health Centers were calculated considering particular regions. A simple and multiple linear regression analysis was used in the IMR-related model. This allowed for the calculation of regression coefficients concerning each variable.

The models to identify variables affecting IMR and still birth rate were built using single variable and linear correlations between the results and the independent variables. Variables that had values $p<0.10$ in simple regressions were taken into the model to create a linear multiple model. Logarithms of dependent variables were calculated according to Neperian bases of multiple linear models (IMR, still birth rate and neonatal mortality rate). These values were then transformed into a normal distribution. Coefficients of variables (R^2) and the normality of the residues were taken into consideration in the selection of the final model.

RESULTS

A total of 15,600 live deliveries, 227 infant mortalities (171 neonatal deaths), 175 still births were seen in a period of two years (2006-2007) in Eskisehir. Of the infant mortalities, 56.4% were male, and 43.6% were female. The causes of infant mortality were prematurity (34.8%), congenital defect/malformations (19.4%), infections (13.7%), perinatal asphyxia (11.4%), other specific reasons (12.8%), and sudden infant death/unknown reasons (7.9%).

There was no difference in IMR, neonatal mortality rate and still birth rate among the Public Health Centers. The overall IMR was 14.55/1000 for live births, neonatal mortality rate was 10.96/ 1000 for live births, post-neonatal mortality rate was 3.59/1000 for live births and still birth rate was 11.09/1000 total births a period of two years (2006-2007) in Eskisehir.

A simple and multiple linear regression model was used to map the socio-demographic variables in the city and compare them to the infant mortality rates. The parameters that were used as indicators of demographic, maternal and infant indicators and health service determinants in the province are given in Table-II.

Table-I: Distribution of infant mortality causes in neonatal and post-neonatal deaths

Infant mortality causes	*Neonatal deathsn (%)**	*Post-neonatal deathsn (%)**	*All infantsdeathsn (%)**
Congenital defect/malformations	30 (17.5)	14 (25.0)	44 (19.4)
Perinatal asphyxia	23 (13.5)	3 (5.4)	26 (11.4)
Prematurity	79 (46.2)	-	79 (34.8)
Infections	16 (9.4)	15 (26.8)	31 (13.7)
Other specific reasons	18 (10.5)	11 (19.6)	29 (12.8)
Sudden infant death/unknown causes	5 (2.9)	13 (23.2)	18 (7.9)
Total**	171 (75.3)	56 (24.7)	227 (100.0)

*: The percentage of column **: The percentage of row

Table-II: Descriptive analysis of infant mortality rate and demographic, maternal and infant indicators and health service determinants

Variables	*Mean±SD**	*95% CI**
Percentage of non-schooled women (%)	22.90±1.61	19.74-26.06
Percentage of rural population (%)	52.26± 5.68	41.13-63.39
Percentage of women delivering at an age younger than 18 (%)	2.94± 1.20	0.59-5.29
Percentage of infants with low birth weight (%)	6.03± 3.26	0.36-12.42
Rate of deliveries outside the hospital (%)	3.00± 1.80	0.53-6.53
Average number of annual pregnancy follow-ups	5.76± 0.35	5.07-6.45
Average number of annual puerperant follow-ups	1.69± 0.12	1.45-1.93
Average number of annual infant follow-ups	9.92± 0.58	8.78-11.06
Average of annual follow-ups for women between 15 and 49 years of age	2.53± 0.51	1.53-3.53
Patients per practitioners	966.44± 63.04	842.88-1090.00
Patients per nurses	1073.68± 125.98	826.76-1320.60
Number of midwives per woman between the ages of 15 and 49	435.03± 79.88	278.47-591.59

*:SD: Standart Deviation, CI: Confidence Intervals

In the simple regression, the infant mortality rate was found to increase with a variety of factors, including low birth weight (ß=0.527; p=0.015), the rate of deliveries outside the hospital (ß=0.948; p=0.016) and the rate of non-schooled women (â=1.066; p=0.016). Variables affecting the still birth rate included the rate of infants with low birth weight (ß=1.442; p=0.023) and the percentage of deliveries outside the hospital (â=1.980; p=0.091). Neonatal mortality rate was found to increase with the percentage of deliveries outside the hospital (ß=0.669; p=0.040).

The Neperian logarithm of the mortality rates better identified the independent variables. Independent variables with a significance level of 0.010 and lower were included in the multivariable model. The variables that predicted IMR were the rate of non-schooled women. The following possible determinants were identified for still birth rate, infants with low birth weight and the percentage of deliveries outside the hospital. The variable that predicted neonatal death rate was found as the percentage of deliveries outside the hospital.

DISCUSSION

There are many factors affecting IMR. In a report by the specialists' committee of WHO, the factors affecting IMR in a community are classified as maternal and infant-based factors. These variables are tied to demographic and socio-economic situations.[13]

The control programs applied in a particular region to decrease infant mortality rates at a particular level are largely similar.[14] The decrease in high IMRs is abrupt in the beginning, but it gradually slows down.[15] This study investigated the causes and reasons for infant mortality in regions with IMRs lower than 20 per thousand.

The Confidential Enquiry into Stillbirths and Deaths in Infancy (CESDI) was published in the UK in 2003. According to the Wigglesworth classification, the infant mortality causes in the neonatal period included prematurity (49.7%), congenital anomalies (22.9%) and intrapartum reasons (9.1%). In the post-neonatal period, causes included congenital anomalies (29.7%), sudden infant death (22.9%), and infections (16.0%).[16] Similar mortality causes in the neonatal period were found in this study. For the post-neonatal period, the causes with higher rates included infections (26.8%), congenital anomalies (25.0%) and sudden infant death (23.2%).

This study is an ecological analysis. The main limitation of ecologic analysis is to expect that causal assumptions of the ecological effect reflect on the biological effect at the individual level. Another problem is the presence of close interactions between the social, demographic

Table-III: The multiple linear regression results show the variables related to the infant mortality rate, still births rate and neonatal mortality rate

Variables	*Regression coefficient ß*	*Standard Regression coefficient ß*	*ß significance*	*Confidenceinterval of ß (95% CI)*
Neperian logaritm of infant mortality rate				
Constant	1.993		0.001	0.972; 3.013
Percentage of non-schooled women	0.048	0.589	0.001	0.009; 0.094
Neperian logaritm of stillbirths rate				
Constant	2.995		0.000	2.618; 3.372
Percentage of infants with low birth weight	-0.114	-0.580	0.014	-0.199; -0.030
Rate of deliveries outside the hospital	-0.184	-0.536	0.020	-0.330; -0.037
Neperian logaritm of Neonatal mortality rate				
Constant	2,335		0.000	1.966; 2.704
Rate of deliveries outside the hospital	0.055	0.603	0.038	0.004; 0.107

The model of Infant Mortality Rate: R^2= 0.566; F=5.744; p=0.022, The model of Still Birth Rate: R^2= 0.732; F=10.945; p=0.005, The model of Neonatal Mortality Rate: R^2= 0.364; F=5.719; p=0.038

and environmental variables that we used. Data aggregation leads to statistical problems due to reduction of variability, with reflecting on the interences.[12]

Independent variables used in studies that affect IMR were isolated from the data set. The results can only be called "possible determinants" due to the model of the study. The independent variables that we identified are responsible for 56.6% of the Neperian logarithm of the IMR (R^2) and for 73.2% of the stillbirth rate. The rest of the variation stems from the other variables in this model.

Our study showed that the rate of non-schooled women was the most significant determinant of IMR. The regression models developed in a similar study in the Ceará region in Brazil included the low education levels of the women. Education level is one of the most significant determinants of maternal and family-related socio-economic level .[12] World Bank studies report that education policies will ensure significant improvement in health. [17] The effect of maternal education level on infant and child health has been shown in various national and international studies, especially in TDHS.[8,18,19] Maternal risk factors can vary. A high frequency of risk factors can be a significant cause of infant mortalities. Various factors may affect these results, including education, culture, social support, nutrition, receiving/not receiving prenatal care, lifestyle, family structure and social support.[20]

The most significant variable affecting stillbirth rate is the percentage of infants with low birth weight. In many studies, it is reported that the mortality rate of infants with low birth weight is high. In a study carried out in the UK, it is reported that interregional IMR differences are related to the percentage of infants with low birth weights.[21] Birth weight is the strongest and most significant risk factor related to neonatal infant mortality and is responsible for 67% of the neonatal infant mortality rate. [21] In a study carried out in Bangladesh, it is reported that low birth weight and prematurity are responsible for 75% of neonatal mortalities.[22]

The percentage of infants with low birth weight in our study region was 6.8%. In some regions of the world, one in every five infants is under normal weight. It is reported that low birth weight is the most frequent reason for neonatal mortality in India. In a study in rural areas, it was reported that the mortality in infants with low birth weight is five times the rate of infants with normal weight.[23] In a study carried out in a village in Guatemala, it was concluded that infant mortality can be decreased by 30% if low birth weight can be prevented.[24]

The place of delivery is another factor affecting infant mortality rate. There are various

reasons for the selection of the place of delivery.[25-27] In Turkey, 78.2% of deliveries take place in a health institution, and 21.2% take place at home. Also, 36.3% of births take place with the help of health staff. [5] In a study carried out in Istanbul, 19.7% of deliveries that took place at home were lost.[28] The only variable related to neonatal mortality was deliveries outside the hospital at home. This variable had an effect of 36%. This is very important because home deliveries comprise 3% of all deliveries in Turkey.

Risk factors at individual levels affect IMR and associated social risk factors are important. There is a need for further studies to clarify social risk factors affecting individuals. Further studies are required to identify the relationship between factors at a macro level and the risk factors at an individual level.[29]

CONCLUSIONS

We investigated to identify the determinants of IMR in Eskisehir between 2006-2007 years. The IMR in Eskisehir is lower than 20 per thousand live deliveries. Women enrollment school rate as well as deliveries outside the hospital and low birth weight determinants should be taken into account when planning the interventions to reduce infant mortality in Eskisehir.

The next step is to decrease the IMR in Eskisehir to the level of developed countries. We must identify the variables at macro and micro levels that affect low birth weight and deliveries outside the hospital. Our study emphasizes the need for continued analysis of perinatal health data to target health education efforts and intervention strategies to the groups at highest risk for suboptimal pregnancy outcomes and to those with the highest need for services.

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