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Epidemiology of under-five mortality in İstanbul: changes from 1988 to 2011

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Background/aim: Understanding the causes of under-five deaths is key to realizing sustainable developmental goals. The aim of this descriptive study was to investigate the causes of under-five mortality in İstanbul during 2011 and compare the findings to those of 1988 and 2000.

Materials and methods: All burial records of İstanbul were evaluated, and cemetery records of 1494 children, who died at under five years of age and were buried in İstanbul Metropolitan Municipality Cemeteries between 1 January and 31 December 2011, were analyzed. Several sociodemographic characteristics and causes of death were compared with the results of studies carried out in 1988 and 2000 in İstanbul with similar methods.

Results: Under-five mortality rate was lower in 2011 than in 1988 and 2000. Of all deaths, 58.8% had occurred in the neonatal period and most were in the first day of life, similarly to those of 1988 and 2000. The proportion of deaths in the age group of 1–4 years was found to be increasing. Prematurity and perinatal causes remained the main cause of death under five years of age in İstanbul during the 23-year period. Unknown causes, due to misclassification, were still seen in a relatively high proportion.

Conclusion: Under-five mortality rate and death due to infectious diseases decreased in İstanbul from 1988 to 2011. Our findings showed a need for more emphasis on perinatal events and better evaluation of causes of death in clinical practice.

Key words: Under-five mortality, causes of death, infants, children

1. Introduction
One of the most important measures of health is death. Understanding the incidence and causes of under-five deaths is key to realizing sustainable developmental goals.

The annual death statistics published by the Turkish Statistical Institute (TÜRKSTAT), based on the records provided by provincial and district health centers, are the most commonly used source of information about deaths in Turkey. However, there are noteworthy problems with the grouping of data collected by TÜRKSTAT.

In Turkey, the death certificate is prepared in three copies containing the same information. The first copy is given to the local health authority; the second is given to the family of the deceased to be used as a burial permit and to be archived at the Department of Cemeteries; and the third is archived at the institution where the death occurred. The International Classification of Diseases (ICD) for identifying the cause of death and illness, suggested by the World Health Organization (WHO), is used in the 'cause of death' database (1).

There are studies demonstrating the reliability of cemetery records in metropolitan cities (2,3). The examination of cemetery records is quite comprehensive, and the possibility of interment outside cemeteries is not practically possible. İstanbul receives immigration from all provinces of Turkey and hosts the general structure of the country. Although the epidemiological research that was conducted in İstanbul does not represent the exact status of the general population of the country, it gives us an illustration.

The aim of this study was to investigate the causes of under-five mortality in İstanbul based on the cemetery records of İstanbul Metropolitan Municipality (İMM) during 2011, and to compare the findings with the results of studies conducted with similar methods in 1988 and 2000.

2. Materials and methods
Ethical approval was obtained from the Ethics Committee of the Faculty of Medicine, İstanbul University (21.12.2012/21).

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2.1. Data collection

There are 322 cemeteries in İMM. The death certificates from all cemeteries are collected in 8 regions. In this study, all death certificates of 2011 in the 8 regions of the İMM Cemeteries Department were analyzed between January and November 2013.

The cemetery offices archive the burial permits as different files according to province and district. The information in these documents is transferred to a separate record book in every cemetery office and to an electronic system that is available for public use. The research was based on the information of the burial permits by taking into consideration errors or shortcomings that may occur during information transfer. The first name, surname, sex, date of birth, date of death, cause of death, birth weight (if written), and gestational age of all under-five mortalities were recorded.

In the death certificates, it was observed that some neonatal deaths had 'audible' and 'silent' recorded next to their names. It was understood that 'audible' were the infants who cried, and 'silent' were the ones who showed some vital signs, such as respiration and heartbeat, without crying. It was demonstrated that these definitions had been made to separate the stillbirths from the newborns that showed vital signs; therefore, the latter were included in our study.

2.2. Determining cause of death

In the death certificates, cause of death was divided into two main sections. The first section recorded the causes that directly lead to death and their reasons; the second section recorded other important situations that had had an impact on the death, but were not related to the disease or the condition that caused it. In most cases, it was observed that the causes of death were not listed chronologically and the main, middle, and final cause cycles were not formed. In some of the deaths, the information was evaluated according to the child's age and the physiopathology of the problems for redetermination of the main cause of death. For this purpose, we sought the opinion of relevant specialists (pediatric epidemiologists, neonatologists, and pediatric cardiologists).

2.3. Grouping of causes of death

Diseases and situations that cause or contribute to a death were grouped according to the ICD-10 classification with a method that was based on the main cause of death (Table 1). The classification of main causes of death was developed in the study carried out in 1988. The method published by the WHO and specified in the ICD classification was used for the identification of the main causes (2–4). Thus, it was possible to compare the data of 2011 with the results of the research carried out in 1988 and 2000.

2.3.1. Grouping according to the ICD-10 classification

While the causes of death were classified, the deaths were evaluated according to age. In the first 7 days after birth, all causes except 'prematurity' and 'congenital anomalies' were investigated under the title 'perinatal problems'. For example, in the first 7 days of the postnatal period, a newborn who died because of septicemia was classified under 'perinatal problems'. The preterm birth and immaturity cases were grouped under the title of 'prematurity'. Other causes of death besides prematurity were evaluated and classified according to cause, age at death, and gestational age.

Table 1. Classification of the causes of death.

Main causes of death	Causes of death according to ICD-10
1. Prematurity	1. Perinatal problems
2. Perinatal problems	2. Prematurity and related problems
3. Congenital anomalies and chromosomal diseases	3. Congenital anomalies
4. Unknown	4. Respiratory system disease
5. Other infections	5. Infectious diseases
6. Pneumonia	6. Nervous system diseases
7. Accidents	7. Digestive system diseases
8. Other	8. Circulatory system diseases
9. Malignancies	9. Blood, blood-forming organs, and immune system diseases
10. Sudden infant death syndrome	10. Neoplasia
11. Acute gastroenteritis	11. External causes
12. Malnutrition	12. Unclassified
	13. Pregnancy, childbirth, and postpartum pathology
	14. Endocrine, nutritional, and metabolic diseases

In the first two months, intracranial hemorrhages were evaluated under the title 'perinatal problems' by considering the late hemorrhagic disease of the newborn (5). The intracranial hemorrhages that occurred after the second month were examined under the title 'nervous system diseases'.

The deaths that were recorded as investigated or 'sudden infant death syndrome' were evaluated under the title 'unclassified', because the main cause of death was unknown. According to the ICD-10 classification, the infections related to systems were examined in the group of system-related diseases. Heart failure was examined in the group of 'circulatory system diseases'.

2.3.2. Grouping according to the main causes of death
Prematurity and perinatal problems were the same as in the ICD-10 classification. Deaths due to hereditary neurological disease were added to the congenital anomalies group, in addition to those in the ICD-10 classification. The deaths defined as investigation and/or cardiopulmonary arrest were evaluated in the group 'Unknown', if they did not belong to the perinatal period, because the main causes of deaths were unknown. While the respiratory and heart failure cases were examined under the relevant systems title in the ICD-10 classification, they were also examined in the group 'Unknown', according to the classification of the main causes of death. Cardiomyopathy, status/ persistent convulsions, and immunodeficiency were in the group 'Other'.

Infection-related diseases were evaluated, without considering system, under the title of 'Other infections'. Respiratory system diseases were classified under the title of 'Pneumonia'. Blood diseases with a poor prognosis, such as Langerhans cell histiocytosis and hemophagocytic syndrome, were added to the group 'Malignancies', which was similar to the ICD-10 classification.

The definitions in *Robertson's Textbook of Neonatology* were used for the classification of birth weight and gestational week of the infants (6).

2.4. Statistical methods
In the study, Number Cruncher Statistical System (NCSS), Power Analysis and Sample Size (2007 & PASS), and 2008 Statistical Software (NCSS, Kaysville, UT, USA) programs were used for statistical analysis. The descriptive statistical methods (frequency and rate), Fisher's exact test, and Pearson's chi-square test were used for the analysis. Statistical significance was evaluated at $P < 0.05$.

3. Results

3.1. Causes of under-five mortality in 2011 according to the ICD-10 classification
According to the information on the death certificates, 53,109 deaths were identified within the confines of İMM

between January and December 2011, and 3591 (6.7%) of these were identified as under-five mortality cases. During this study, it was discovered that the fetuses that died before 20 weeks of gestation were buried in graveyards.

Of all under-five death records, 2097 deaths were excluded from the study, because 128 of them were registered as 'abortus' and 1969 were registered as 'stillbirth'. As a result, 1494 children that were born alive but died under-five were evaluated. More than half of the deaths occurred in the first month, and approximately half of these had occurred within the first 24 hours (Table 2). The number of deaths between 1 and 11 months was higher than those between 1 and 4 years. The sex distribution of deaths according to age group is presented in Table 3. Male rate was high in all age groups. When all under-five mortality cases were evaluated, the male/female ratio was 1.09.

The distribution of death causes according to the ICD-10 classification is presented in Table 4 (1). In 'perinatal problems', which is in the second row, respiratory distress syndrome (RDS) and conditions related to RDS formed more than half of this group. In 2/3 of the 'congenital anomalies' group, the cause was detected as congenital heart disease. Sixty-five percent of the 'unclassified' group was identified as 'investigation'. 'Sudden infant death syndrome' cases were included in the 'unclassified' group. Half of the 'respiratory system disease' group was diagnosed as pneumonia deaths. The deaths related to septicemia constituted the majority of the 'infectious disease' group. Trauma-induced deaths formed more than half of the 'external causes' group.

3.2. Comparison of findings with those of 1998 and 2000 according to the main causes of death
The results of the classification according to main causes of death were compared to the research findings that were realized with a similar method in the years 1988 and 2000, based on cemetery records of İstanbul Metropolitan Municipality.

In 2011, neonatal deaths constituted 58.8% of the under-five mortality. This value was similar to the results of studies in 1988 and 2000. In all three studies, the deaths on the first day had the highest value in the neonatal period.

Table 2. Distribution of deaths according to age.

Age of death	n	%
0–29 days	879	58.8
1–11 months	400	26.8
1–4 years	215	14.4
Total	1494	100.0

Table 3. Sex distribution of deaths according to age group.

Age at death	Sex				Male/female
	Male n (%)	Female n (%)	AG n (%)	Unspecified n (%)	
0–1 day (n = 411)	189 (46)	172 (41.8)	2 (0.5)	48 (11.7)	1.09
2–6 days (n = 283)	147 (52)	123 (43.5)	3 (1.0)	10 (3.5)	1.19
7–29 days (n = 185)	98 (53)	87 (47.0)	0	0	1.12
1–11 months (n = 400)	200 (50)	198 (49.5)	0	2 (0.5)	1.06
1–4 years (n = 215)	112 (52)	103 (48.0)	0	0	1.09
Total (n = 1494)	746 (50)	683 (45.7)	5 (0.3)	60 (4.0)	1.09

AG: Ambiguous genitalia.

Table 4. Distribution of the causes of under-five mortality based on ICD-10 classification in 2011.

Causes of death	n	%
Prematurity	428	28.7
Perinatal problems	294	19.7
Congenital anomalies	153	10.2
Unclassified	148	10.0
Respiratory system diseases	110	7.4
Infectious diseases	100	6.7
External causes	64	4.3
Endocrine, nutritional, and metabolic diseases	46	3.0
Circulatory system diseases	44	2.9
Nervous system diseases	47	3.1
Neoplasia	25	1.7
Blood and blood-forming organ diseases	15	1.0
Digestive system diseases	10	0.7
Pathologies of pregnancy, childbirth, and puerperal	9	0.6
Genitourinary system diseases	1	0.01
Total	1494	100.0

Over the years, this ratio has decreased, but the proportion of deaths between 2 and 6 days had increased. The increase in death ratio between the ages of 1 and 4 years as well as 2 and 6 days was found to be statistically significant over the years. On the other hand, in 2011, a significant decrease was observed in the first 24 hours and between 1 and 11 months (Table 5).

According to the main causes of death, in 1988, the first three common causes were 'perinatal problems', 'pneumonia', and 'prematurity'; in 2000, it was 'perinatal problems', 'prematurity', and 'congenital anomalies'; and the order changed in 2011 to 'prematurity', 'perinatal problems', and 'congenital anomalies' (Table 6).

Table 5. Comparison of age distribution of under-five mortality in İstanbul in 1988, 2000, and 2011 (3,4).

	2011		2000		1988		P	
	N	%	n	%	n	%		
0–1 month	879	58.8	1712	58.9	4232	57.5	*a*0.344	-
0–1 day	411	27.5	1092	37.6	2540	34.5	a0.001**	2011 < 1988 <2000
2–6 days	283	18.9	394	13.6	728	9.9	a0.001**	1988 < 2000 < 2011
7–29 days	185	12.4	226	7.8	964	13.1	a0.001**	2000 < 1988 = 2011
1–11 month(s)	400	26.8	890	30.6	2407	32.7	a0.001**	2011 < 2000 < 1988
1–4 year(s)	215	14.4	305	10.5	721	9.8	a0.001**	1988 = 2000 < 2011
Total	1494	100.0	2907	100.0	7360	100.0		

*Pearson's chi-square test
**P < 0.01

Table 6. Comparison of the main causes of under-five mortality in 1988, 2000, and 2011 in İstanbul (3,4).

Main cause of death	2011		2000		1988		P	
	n	%	n	%	n	%		
Perinatal problems	303	20.3	957	32.9	1774	24.1	a0.001**	2011 < 1988 < 2000
Prematurity	428	28.6	599	20.6	1207	16.4	a0.001**	1988 < 2000 < 2011
Congenital anomalies and chromosomal diseases	226	15.1	334	11.5	589	8.0	a0.001**	1988 < 2000 < 2011
Unknown	192	12.9	262	9.0	567	7.7	a0.001**	1988 < 2000 < 2011
Other infections	111	7.4	230	7.9	1000	13.6	a0.001**	2011 = 2000 < 1988
Pneumonia	71	4.8	207	7.1	1280	17.4	a0.001**	2011 < 2000 < 1988
Other	47	3.1	154	5.3	273	3.7	a0.001**	2011 = 1988 < 2000
Accidents	66	4.4	87	3.0	258	3.5	a0.049*	2000 < 2011
Sudden infant death syndrome	17	1.1	35	1.2	0	0.0	a0.001**	1988 < 2011 = 2000
Acute gastroenteritis	1	0.1	20	0.7	412	5.6	a0.001**	2011 < 2000 < 1988
Malnutrition	0	0.0	11	0.4	0	0.0	b0.001**	2011 = 1988 < 2000
Malignity	32	2.1	11	0.4	0	0.0	a0.001**	1988 < 2000 < 2011
Total	1494	100.0	2907	100.0	7360	100.0		

a: Pearson's chi-square test
b: Fisher's exact test

In 2011, 'prematurity' appeared in first place as cause of death during the first six days. From 2000 onwards, 'pneumonia' did not appear in the first three causes between 7 and 29 days; instead, 'prematurity' and 'perinatal causes' came to the forefront. In 2011, 'pneumonia' did not appear in the first three causes between 4 weeks and 11 months, but, for this age group, 'other infections' and 'congenital anomalies' appeared as the first three causes (Table 7).

Within the period of 23 years, there have been changes in the first three causes of death occurring between 1 and 4 years of age (Table 7). In 2000 and 2011, 'unknown' causes appeared in first place in this age group. The frequency of 'unknown' causes in 2000 was explained by the density of 'cardiopulmonary arrest' deaths records.

4. Discussion

Knowing the causes of children's deaths and finding solutions to preventable causes especially would save the lives of the infants at a lower cost by using the right resources. This study provided important findings about

Table 7. The five most common causes of under-five mortality in İstanbul according to years and age.

Age	0–6 days			7–29 days			4 weeks–11 months			1–4 years		
Year	1988	2000	2011	1988	2000	2011	1988	2000	2011	1988	2000	2011
1.	Perinatal problems	Perinatal problems	Prematurity	Other infections	Prematurity	Prematurity	Pneumonia	Unknown	Other infections	Accidents	Unknown	Unknown
2.	Prematurity	Prematurity	Perinatal problems	Pneumonia	Other infections	Congenital anomalies	Other infections	Pneumonia	Congenital anomalies	Pneumonia	Pneumonia	Accidents
3.	Unknown	Congenital anomalies	Congenital anomalies	Prematurity	Perinatal problems	Unknown	Congenital anomalies	Other infections	Unknown	Other infections	Other infections	Other
4.	Congenital anomalies		Unknown	Perinatal causes		Perinatal problems	Unknown	Congenital anomalies	Prematurity	Other	Other	Pneumonia
5.	Pneumonia											

the causes of under-five mortality and shed light on the epidemiology of under-five mortality in İstanbul from 1988 to 2011. The fact that the study covered only the city of İstanbul could be seen as a limitation. Nevertheless, it can be considered that the study represents the general structure of the entire country, because İstanbul receives immigration from all provinces of Turkey.

Globally, there has been a significant reduction in under-five mortality (7). A similar reduction has been observed in Turkey (8,9). The reduction in under-five mortality rate was 74% in Turkey, according to a world health statistics survey conducted by the WHO (10). Similar changes were also presented in a report prepared by the Turkish Ministry of Health (11). Our study presents similar findings.

In the results of the Turkey Demographic and Health Survey (TDHS) 2008, there was no sex disaggregation for neonatal deaths; in the postnatal period, it was determined that the proportion of males had increased (male/female: 1.6) and the ratio of male/female was 1.2 among under-five deaths (12). In our research, the ratio of male/female was between 1.09 and 1.12 in the neonatal period, but these values were different for the ratio presented by the TDHS between 1 and 11 months (male/female: 1.06). The results of a study that was carried out throughout Turkey with the infant mortality monitoring system by the Ministry of Health were similar to our results, with a male/female ratio of 1.19 (13). The higher death rate of females under 1 year of age has been reported in developing countries (3,14). Hence, in a recent multicentered study from developing countries, it was reported that males were more likely to die than females (15).

Changes in the causes of under-five mortality were also expected. Mortality rate related to infectious diseases, especially pneumonia, diarrhea, and measles, has decreased globally, including in Turkey (16). Our findings showed these changes. A significant decrease in deaths related to infection was observed in İstanbul from 1988 to 2011. Additionally, there was an increase in the proportion of deaths due to prematurity, congenital anomalies, and accidents. Increases in vaccination and decreased malnutrition might be considered as supporting facts for these changes (Turkey Demographic and Health Survey 1993, 1998, 2003, and 2008: Summary Reports). In this systematic analysis of studies that were conducted regionally throughout the world between 2000 and 2013, more than the half of under-five mortality cases (52%) were caused by preventable causes such as infections. In this analysis, pneumonia was the second most common cause of death after prematurity; a slight increase in congenital anomalies, prematurity, neonatal septicemia, and rate of accidents was also reported (16).

There are few community-based studies on the causes of under-five mortality in Turkey (2–4). Most studies are hospital-based. A study by Hacettepe University Hospital reported prematurity as the most frequent cause of death, similarly to our study (17). The rise of prematurity to the first rank can be explained by the increase in premature births in recent years (18). Higher maternal age and the use of assisted reproductive techniques may be other causes of this increase (19–21). According to our findings, the proportion of death related to congenital anomalies among children under the age of five has increased. Environmental pollution, teratogenic drugs, and chemical agent exposure may lead to an increase in deaths due to congenital anomalies. The development of new diagnostic techniques might enhance this increase (22–25). More detailed research is required on this issue.

In Europe, between 1990 and 2004, the first three most common causes of under-five mortality were listed as 'perinatal problems', 'other', and 'infectious diseases' (23). Prematurity was not in first place, which may be due to different definitions. According to a recent study from the USA, the causes of death for children under 12 months of age were reported to be congenital anomalies, low birth weight, maternal complications, and sudden infant death syndrome (24). Accordingly, the causes of death in the USA were similar to the causes of under-five mortality in İstanbul in 2000 and 2011, except for sudden infant death syndrome. While most under-five mortality deaths consisted of neonates, a new classification system for deaths during the perinatal period (including late neonatal deaths) was developed in 2016 by the WHO through the WHO application ICD-10, called ICD-PM (perinatal mortality) (26). By using ICD-PM classifications it could be standardized, and information on causes of death around the critical time of childbirth may increase. ICD-PM is based on a three-step process: a) classifying the type of death based on timing (antepartum, intrapartum, stillbirth-unknown timing, neonatal death), b) identifying the main disease or condition that caused the stillbirth or neonatal death (congenital, antepartum complications, intrapartum complications, complications of prematurity, infections, other cause of stillbirth or neonatal death, unknown/unspecified), and c) identifying the disease or condition of the mother (26).

In global reports, the causes of death between the ages of 1 and 4 years were listed as accidents, congenital anomalies, and malignant diseases (25). This sorting was different to the one in our findings, except for accidents. According to our research, in İstanbul, malignant diseases were not among the most common causes, but were on the rise within the years (2,3) This may suggest an increase in cancer cases in İstanbul. Besides that, easy accessibility to new, comprehensive diagnostic methods may lead to this increase.

In our study, it was found that several death certificates were not filled as needed. 'Unknown' causes were in the fourth rank among the causes of under-five mortality in 2000 and 2011; however, they were reported in sixth place in 1988. This situation, besides the increase in diagnosed cases, can be explained by the increase in death causes such as heart failure and cardiopulmonary arrest, which were examined under the 'unknown' group. It may be the result of intense circulation of patients in some facilities, lack of knowledge and/or lack of interest among healthcare workers, or lack of awareness of the importance of death certificates. The most important reason for incomplete and inaccurate information on death certificates may be the inadequate audit systems in health institutions. To prevent misidentifications and misclassifications, the WHO published a guideline to audit and review stillbirths and neonatal deaths (27). Awareness of this issue will increase by establishing this program and carrying out new studies.

In conclusion, the causes of under-five mortality in İstanbul have changed from 1988 to 2011; deaths due to infectious diseases have decreased, and deaths due to prematurity complications and congenital anomalies have increased. The rate of unknown causes was higher in 2000 and 2011 than in 1988. There should be qualified and generalized audit and review systems to explain the right situation about under-five mortality. Precautions should be taken for child mortality with target-specific, efficient, and cost-effective solutions tailored to Turkey's conditions. The determination of the causes of death is indispensable for finding solutions, and our research presents important findings in this respect. Our results also indicate a need for greater emphasis on causes of death and their relevance to community health in medical education. Further studies are required on the cause of unknown deaths.

References

1. World Health Organization. International Statistical Classification of Diseases and Related Health Problems. 10th ed. Geneva, Switzerland: WHO; 2011.

2. Dolar O, Gökçay G, Bulut A, Neyzi O. İstanbul'da beş yaş altı çocuk ölümlerinin epidemiyolojisi: 12 yılda neler değişti? Nüfusbilim Dergisi 2005; 27: 35-48 (in Turkish).

3. Gökçay G, Bulut A, Neyzi O, Shorter F, Kayatürk F. İstanbul'da 5 yaş altı çocuk ölümlerinin epidemiyolojisi. Doğa Dergisi 1992; 16: 331-338 (in Turkish).

4. Bulut A, Gökçay G, Neyzi O, Shorter F. İstanbul'da bebek ve çocuk ölümleri. Nüfusbilim Dergisi 1990; 12: 5-18 (in Turkish).

5. Zipursky A. Prevention of vitamin K deficiency bleeding in newborns. Br J Haematol 1999; 104: 430-437.

6. Macfarlane A, Mugford M. Epidemiology. In: Rennie JM, editor. Rennie & Roberton's Textbook of Neonatology. 5th ed. London, UK: Elsevier; 2012. pp. 3-53.

7. United Nations Children's Fund. The State of the World's Children Reports 2012. New York, NY, USA: UNICEF; 2012.

8. United Nations Children's Fund. Levels and Trends in Child Mortality: Report 2014. New York, NY, USA: UNICEF; 2014.

9. Koç I, Eryurt A. Trends in timing and extent of under-five mortality in Turkey: 1978–2008. Çocuk Sağlığı ve Hastalıkları Dergisi 2011; 54: 39-44 (article in Turkish with an abstract in English).

10. World Health Organization. World Health Statistics 2015. Geneva, Switzerland: WHO; 2015.

11. Republic of Turkey, Ministry of Health. Mortality: Health Statistical Yearbook 2014. Ankara, Turkey: Sentez; 2014. pp. 15-25.

12. Türkiye Nüfus ve Sağlık Araştırmaları 2008. Ankara, Türkiye: Hacettepe Üniversitesi Nüfus Etütleri Enstitüsü; 2009 (in Turkish).

13. Korkmaz A, Aydın Ş, Çamurdan AD, Okumuş N, Onat FN, Özbaş S, Polat E, Şenel S, Tezel B, Tezer B et al. Analysis of infant mortality causes and a new national mortality registration system in Turkey. Çocuk Sağlığı ve Hastalıkları Dergisi 2013; 56: 105-121 (article in Turkish with an abstract in English).

14. Birleşmiş Milletler Çocuklara Yardım Fonu. Türkiye'de 5 yaş altı ölüm hızında azalma, bir durum çalışması. Ankara, Turkey: UNICEF; 2009.

15. Fottrell E, Osrin D, Alcock G, Azad K, Bapat U, Beard J, Bondo A, Colbourn T, Das S, King C et al. Cause-specific neonatal mortality: analysis of 3772 neonatal deaths in Nepal, Bangladesh, Malawi and India. Arch Dis Child Fetal Neonatal Ed 2015; 100: F439-447.

16. Liu L, Oza S, Hogan D, Perin J, Rudan I, Lawn JE, Cousens S, Mathers C, Black RE. Global, regional, and national causes of child mortality in 2000–13, with projections to inform post-2015 priorities: an updated systematic analysis. Lancet 2015; 385: 430-440.

17. Korkmaz A, Akçören Z, Alanay Y, Özyüncü Ö, Yiğit Ş, Deren Ö, Talim B, Orhan D, Güçer Ş, Yurdakök M et al. Perinatal mortality analysis from 2001–2006 at Hacettepe University Hospital. Çocuk Sağlığı ve Hastalıkları Dergisi 2010; 53: 175-188 (article in Turkish with an abstract in English).

18. Önderoğlu LS, Başaran A. Preterm Birth. Türkiye Klinikleri J Surg Med Sci 2006; 2: 29-41.

19. Eras Z, Pekcici Bingöler BE, Atay G. Mortality and morbidity of premature infants. Bakırköy Tıp Dergisi 2011; 7: 85-88 (article in Turkish with an abstract in English).

20. Turkish Neonatal Society Study Group on Assisted Reproductive Techniques and Multiple Pregnancies. Neonatal outcome of assisted reproduction and multiple pregnancies. Çocuk Sağlığı ve Hastalıkları Dergisi 2010; 53: 258-266 (article in Turkish with an abstract in English).

21. Ege E, Akın B, Altuntuğ K. Prevalence of spontaneous preterm birth and related factors. Turk J Obstet Gynecol 2009; 6: 197-205.

22. Dolk H. EUROCAT: 25 years of European surveillance of congenital anomalies. Arch Dis Child-Fetal 2005; 90: 355-358.

23. World Health Organization. Causes of death. In: The Global Burden of Disease: 2004 Update. Geneva, Switzerland: WHO; 2008. pp. 14-17.

24. Kochanek KD, Murphy SL, Xu J, Arias E. Mortality in the United States, 2013. Hyattsville, MD, USA: National Center for Health Statistics; 2014.

25. Stanton BF, Behrman RE. The field of pediatrics. In: Kliegman RM, Stanton BF, Schor NF, St. Geme III JW, Behrman RE, editors. Nelson Textbook of Pediatrics. 19th ed. Philadelphia, PA, USA: Saunders; 2011. pp. 1-25.

26. World Health Organization. The WHO Application of ICD-10 to Deaths during the Perinatal Period: ICD-PM. Geneva, Switzerland: WHO; 2016.

27. World Health Organization. Making Every Baby Count: Audit and Review of Stillbirths and Neonatal Deaths. Geneva, Switzerland: WHO; 2016.