

## Under-5 Year Mortality: Result of In-Hospital Study, Tehran, Iran

Marzieh Nojomi\*, Morteza Naserbakhat, Mojdeh Ramezany, and Khatereh Anbary

Department of Community Medicine, School of Medicine, Iran University of Medical Sciences, Tehran, Iran

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**Abstract:** In July 2003, the Bellagio Study Group on Child Survival estimated that the lives of 6 million children could be saved each year if 23 proven interventions were universally available in the 42 countries responsible for 90% of child deaths in 2000. The aim of this study was to determine frequency of important causes of mortality among under-5 year old children in hospitals, Tehran, Iran. Information about Mortality data of under-5 year old children from 16 hospitals in the West of Tehran was collected. The study period was conducted from 1 October 2005 to 30 March 2006. Educated health personnel in each hospital interviewed parents of children who died in hospital and filled out a checklist. 142 under-5 year old children died over the course of study, of whom, 118 (83%) were neonates (under 28 days-old), 53.5% had low birth weights (< 2500 Kg), 62 (43%) were girls and 80 (57%) boys. The most common cause of under-5 year death was due to certain conditions originating in the perinatal period (ICD-10: P00-P96) (68%). Congenital abnormalities (12%) and pneumonia (5%) were the second and third most common causes respectively. Among 28-day to one-year old children, the leading cause of death was pneumonia (27.3%), while for children being 1 to 5 years of age, this included pneumonia and chronic hepatitis (about 30%). Overall, the most common causes of death were disorders related to short gestation and low birth weight. Therefore, achievement of the millennium development goal of reducing child mortality by two-thirds from 1990 rate will depend on renewed efforts to prevent and control low birth weight, preterm delivery, pneumonia, and infectious diseases in our setting.

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### Introduction

Under-5 year mortality rates are highest among the poorest, but they are high even for the relatively wealthy. Infant and under-5 year mortality rates fell by more than half between 1960 and 1990. But progress slowed in the 1990s. Unsafe water, inadequate immunization, war and civil conflict, high levels of poverty and malnutrition, poor access to basic education, specially for girls are the most important causes of under-5 year mortality in the world (1).

Over 10 million children aged under 5 years die every year, almost 90% of them in a few countries in sub-Saharan Africa and South Asia. 60-70% of these deaths could be prevented (2-7).

Several studies were carried out on causes of children mortality rates. In a survey done in Mafikeng, Krug et al (8) found that the main causes of under-5 year mortality were lower respiratory tract infections, AIDS, and

sepsis. The study of leading death cause in China from 1996 to 2000 was done by Wang et al (9). This study, based on data from the national child mortality surveillance network, including 116 cities throughout China, reported a steady decline in the under-5 year mortality due to diarrhea, pneumonia, and neural tube defect.

Several surveys have been done on the effects of single risk factors of under-5 year mortality, such as preceding birth intervals, political and welfare determinants, seasonal patterns, social class, and malnutrition (10-14).

During 2000-03, six causes accounted for 73% of the 10.6 million yearly deaths in children younger than 5 years of age, namely pneumonia (19%), diarrhea (18%), malaria (8%), neonatal pneumonia or sepsis (10%), preterm delivery (10%), and asphyxia at birth (8%) (15).

The east Mediterranean region accounts for almost 15% of the total global burden of newborn and child mortality, most of which is concerned in a few countries.

\*Corresponding Author: Marzieh Nojomi

Department of Community Medicine, School of Medicine, Iran University of Medical Sciences . Crossroads of Hemmat and Chamran Expressways :15875-6171 . Tehran, Iran  
Tel : +98 21 88602225, Fax : +98 21 88602217, E-mail : drnojomi@iums.ac.ir

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The region comprises 22 predominantly Islamic countries, and health indicators vary widely. 91% of under-5 year deaths occur in just seven countries (Pakistan, Afghanistan, Egypt, Sudan, Somalia, Iraq, and Yemen) (16).

Iran ranks sixteenth among the largest countries of the world. It is located in south-west Asia, in the Middle East region. Primary Health Care (PHC) Networks have reached a considerable degree of expansion in our country. Between 1985 and 1991, over 8,800 Health Houses, 600 Rural Health Centers, 430 Urban Health Centers and 147 Behvarz Training Centers have been built and such centers have grown from 4,236 in 1985 to 19,468 in 1991. By 1997, over 94% of the population was covered by PHC services via the network. Today, under 5-year mortality rate and infant mortality rate in our country are 25 and 21 per 1000 live births respectively. In Iran, children are cared for within Primary Health Care system (PHC) up to the age of 6 (17).

However, to our knowledge, there are no studies investigating causes of death in children based on hospital data. So, we do not know anything about the most important causes of death in children by formal data.

The aim of this study was to determine the frequency of causes of deaths in under-5 year old children based on hospital data in Tehran, Iran. About 10% of Iran's population lives in Tehran, and gathering data from such large population would be useful and representative.

## Patients and Methods

The study focuses on all hospitals in the West of province of Tehran. These hospitals were located in the West of city of Tehran, cities of Karaj, Savojbolagh, Robatkarim, and Shahriar. We gathered data on the children mortality between 1 October 2005 and 31 March of 2006 using a cross-sectional design. The study covered all under-5 year deaths of children in 16 hospitals of 5 locations. The data collection method was based on checklists and review of medical records of children.

A trained health staff was assigned to each hospital to fill out checklists. We had some classes for training the observers about filling out the checklists. Every checklist would be assessed by another observer for completeness and reliability of data. If the checklist was not completed, the second observer would correct it by using hospital records and, occasionally, by calling the parents.

We included all deaths of children upon birth to aged 4 years, 11 months and 29 days. All stillbirths were excluded from the study. In a study on incidence of death

in 23 provinces of Iran, the investigators showed that more than 90% of infantile deaths and about 80% of under-5 year deaths were recorded in the hospitals (17). Mortality of all under-fives, both inpatients and outpatients, was included in the present study.

We used ICD-10 for describing the causes of death. The underlying cause of death was used to determine frequency of causes of deaths.

Variables of age, sex, duration of hospitalization for inpatients, literacy and occupation of parents, birth order, and season of death, were measured. We categorized the children to 3 groups based on age: < 28 days (neonate), 28 days to one year-old, and 1 to 5 years old.

All statistical analyses were performed using SPSS (version 14.0; SPSS inc, Chicago, IL). T-test was used for continuous variables.  $P < 0.05$  was considered significant.

## Results

Over the course of study, we found 142 deaths among under-5 year old children. 43% were female and 57% were male. Mean age was 314 ( $\pm 96$ ) days. Mean age of male and female children were  $303 \pm 106$  and  $329 \pm 83$  days respectively. This difference was not statistically significant.

They were hospitalized for averagely 41 hours. (0.5 to 550 hours). Children of 28 days to one year of age were hospitalized longer than two other groups. 81% of children had died within the first 48 hours of birth.

About 48% (68 cases) of children who died had first order of birth. There was a negative correlation between birth order and mortality. 13% (18 cases) of children were of fourth order and more.

25.4% (36 cases) of deaths occurred in February, 2006, and 8.5% (12 cases) had died in March 2006 (the most and least frequency based on month).

83.6% of the under-5 deaths occurred during the first 28 days of life; 7.8% between 28 days to first year; and 8.5% during first to fifth year.

Table 1 illustrates the frequency of children mortality by underlying cause of death. About 68% of under-5 year mortality was due to certain conditions originating in the perinatal period.

These conditions included birth trauma, infections specific to the perinatal period, disorders related to length of gestation and fetal growth, and other disorders originating in the perinatal period. Congenital malformations, deformations and chromosomal abnormalities were the second cause of death among under-5 year children (11.7%).

**Table 1.** Frequency distribution of underlying causes of death of under-5 year children

Cause of death	Frequency	Percent	ICD-10 code
Certain conditions originating in the perinatal period	96	67.9	P00 - P96
Congenital malformations and chromosomal abnormalities	16	11.7	Q00- Q99
Certain infectious and parasitic diseases	4	2.8	A00 – B99
Complications of pregnancy, and delivery	4	2.8	O00 – O99
Non-intentional accidents	2	1.4	V01 – X59
Pneumonia	7	4.9	J12 – J18
Diseases of skin and subcutaneous tissue	1	0.7	L00 – L99
Diseases of nervous system	1	0.7	G00 – G99
Chronic hepatitis	2	1.4	K73
Endocrine, nutritional and metabolic diseases	1	0.7	E00 – E88
Diseases of the circulatory system	4	2.8	I00 – I99
Febrile convulsions	2	1.4	R56.0
Garbage code	2	1.4	R00 – R99
Total	142	100	--

Among neonates, disorders related to short gestation and low birth weight were the most common causes of death (49.2%). Bacterial sepsis of newborn (6.0%) and birth asphyxia (6.0%) were the second common causes among this group (Table 2).

About 16% of neonates had died due to other causes included: hydrops fetalis, cardiovascular anomalies, kernicterus, convulsions, unspecified infections, respiratory

system anomalies, acute myocarditis, poisonings, coetaneous disorders.

The most common cause of death among children aged 28 days to one year was pneumonia (27.3%; Table 3).

There were 12 deaths among one to five-year-old children, of which About 30.8% had died from pneumonia and chronic hepatitis (Table 4).

**Table 2.** Frequency distribution of underlying causes of death of neonates (< 28 days)

Cause of death	Frequency	Percent	ICD-10 code
Disorder related to short gestation and low birth weight	58	49.2	P07
Bacterial sepsis of newborn	7	6.0	P36
Birth asphyxia	7	6.0	P21
Neonatal aspiration syndromes	5	4.3	P24
Intra uterine hypoxia	4	3.4	P20
Newborn affected by noxious transmitted via placenta	3	2.5	P04
Congenital malformations of musculoskeletal system	3	2.5	Q65 – Q79
Congenital malformations of digestive system	2	1.7	Q35-Q45
Down's syndrome	2	1.7	Q90
Slow fetal growth and fetal malnutrition	2	1.7	P05
Congenital Pneumonia	2	1.7	P23
Pneumonia	2	1.7	J12 – J18
Other*	19	16.3	-----
Total	118		

\* Included : hydrops fetalis, cardiovascular abnormalities,, kernicterus, convulsions, unspecified infections, .....

\*\* The causes of 9 cases were not identified

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**Table 3.** Frequency distribution of underlying causes of death of children aged 28 days to one year-old

Cause of death	Frequency	Percent	ICD-10 code
Congenital malformation of cardiac chamber and connections	1	9.1	Q20
Congenital malformations of the digestive system	2	18.2	Q35 – Q45
Pneumonia	3	27.3	J12 – J18
Chronic hepatitis	2	18.2	K73
Acute myocarditis	2	18.2	I40 – I41
Febrile convulsions	1	9.1	R56.0
Total	11	100	-----

Table 5 shows the frequency distribution of causes of death among under-5 year old children by sex. As we can see, the most common causes of death among two groups are certain conditions originating in the perinatal period (about 67 - 68%). The other causes of death were almost the same between male and female children, except for diseases of circulatory system which accounted for about 4% of male versus 2% of female cases of death (I00-I99).

Among neonates, the leading causes of death in male and female were certain conditions originating in the perinatal period (55.3% and 42.3%, respectively). One female child in the group of 28-day to one-year-old children was died due to congenital malformation of cardiac chamber and connections (Q20). Four boys were died from Pneumonia and acute myocarditis (J12-J18 and I40-I41) in infants group (data was not shown).

**Table 4.** Frequency distribution of underlying causes of death of children aged 1 to 5 years-old

Cause of death	Frequency	Percent	ICD-10 code
Microcephaly	1	8.3	Q02
Congenital hydrocephalus	1	8.3	Q03
Chronic viral hepatitis	1	8.3	B18
Airway obstruction with foreign body	1	8.3	W80
Pneumonia	2	16.6	J12 – J18
Chronic hepatitis	2	16.6	K73
Other metabolic and endocrine diseases	1	8.3	E00
Febrile convulsions	1	8.3	R56.0
Diseases of pulmonary circulation	1	8.3	I26 – I28
Toxoplasmosis	1	8.3	B58
Total	12	100	-----

**Table 5.** Frequency distribution of underlying causes of death of under-fives by sex

Cause of death	Male N (%)	Female N (%)	ICD-10 code
Certain conditions originating in the perinatal period	55 (68)	41 (67)	P00 - P96
Congenital malformations and chromosomal abnormalities	8 (10)	8 (13)	Q00- Q99
Certain infectious and parasitic diseases	2 (2.5)	2 (3.2)	A00 – B99
Complications of pregnancy, and delivery	2 (2.5)	2 (3.2)	O00 – O99
Non-intentional accidents	2 (2.5)	0 (0)	V01 – X59
Pneumonia	4 (5)	3 (4.8)	J12 – J18
Diseases of skin and subcutaneous tissue	0 (0)	1 (1.6)	L00 – L98
Diseases of nervous system	0 (0)	1 (1.6)	G00 – G99
Chronic hepatitis	1 (1.2)	1 (1.6)	K73
Endocrine, nutritional and metabolic diseases	1 (1.2)	0 (0)	E00 – E88
Diseases of the circulatory system	3 (3.7)	1 (1.6)	I00 – I99
Febrile convulsions	1 (1.2)	1 (1.6)	R56.0
Garbage code	1 (1.2)	1 (1.6)	R00 – R99
Total	80 (100)	62 (100)	-----

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## Discussion

We found that 68% of under-5 year mortality was due to certain conditions originating in the perinatal period. Among neonates, disorders related to short gestation and low birth weight were the most common causes of death (49.2%).

As part of the Millennium Development Goals (MDGs), nations pledged to ensure a reduction of two-thirds in child mortality by 2015 from the base year 1990 (18).

During 2000-03, six causes accounted for 73% of the 10.6 million yearly deaths in children younger than age 5 years, namely, pneumonia (19%), diarrhea (18%), malaria (8%), neonatal pneumonia or sepsis (10%), preterm delivery (10%), and asphyxia at birth (8%) (15).

In our study, the leading cause of death among 28 day to one year-old children was pneumonia. It consisted of 3 out of 11 deaths among this age group. Although this rate accounts for about 27% of all deaths in this group, but due to few children, perhaps it can not be representative. However, it is in accordance with other studies (1, 8, 15).

More than two-thirds of deaths in under-5 year old children were among neonates (< 28 days). We showed that the majority of causes of death among these children are disorders related to short gestation and low birth weight. Of the 130 million babies born every year, about 4 million die in the first 4 weeks of life- the neonatal period (19). Most neonatal deaths (99%) arise in low-income and middle-income countries (4). Child survival programs in the developing world have tended to focus on pneumonia, diarrhea, malaria, and vaccine-preventable conditions, which are important causes of death after the first month of life. Between 1980 and 2000, the neonatal mortality rate was reduced by only about a quarter. About two-thirds of neonatal deaths arise in the African and Southeast Asia regions of WHO.

The proportion of deaths in children younger than age 5 years that takes place in the neonatal period varies between regions, being much higher in southeast Asia (47%) than in sub-Saharan Africa (26%) (4). In our study, this proportion was so large (about 84%). Although our sample was not large, but it seems that, to meet Millennium development Goals (MDGs), a substantial reduction in NMRs is needed, and reducing deaths in the first week of life will be essential to progress.

Estimates from 2000 of the distribution of direct causes of death indicate that preterm birth (28%), severe infections (36%, including sepsis/pneumonia (26%), tetanus (7%), and diarrhea (3%)), and complications of

asphyxia (23%) account for most neonatal deaths. Of the remaining 14%, 7% of deaths were related to congenital abnormalities (20). About 49% of neonatal deaths in current study was due to preterm birth. It is larger than the expected rate. Preterm birth is the most important cause of low birth weight. Prematurity and in-utero growth restriction are also indirect causes or risk factors for neonatal deaths. A study in Bangladesh reported that the risk of death was several folds higher in preterm infants than in full-term infants whose growth had been restricted in utero (risk ratio 4.78, 95% CI 3.14-7.27) (21).

However, attempts to reduce the proportion of babies born with low birth weight at the population level, in general, have been met with little success. Most deaths in moderately preterm babies can be prevented with extra attention to warmth, feeding, and prevention or early treatment of infections (22-24).

This study can be criticized for a number of limitations. The first potential limitation of this study is its inability to collect under-5 year deaths outside the hospitals, although the majority of such deaths reportedly occur in hospitals. We also collected all data related to children who had died before being taken to hospital. The second limitation of this study is that it did not include some causes of deaths in summer seasons, especially diarrheal conditions. Another limitation is the some errors made in recording causes of death based on ICD-10, although we confirmed cloudy data by second review of records and contact with the parents. In conclusion, we found that 83% of mortality between under-5 year old children occurs during the first 28 days of life. The most common causes of death were disorder related to short gestation and low birth weight. Therefore, achievement of the millennium development goal of reducing child mortality by two-thirds from 1990 rate will depend on renewed efforts to prevent and control low birth weight, preterm delivery, pneumonia, and other infectious diseases in our setting.

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