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Original Article

Trends of Under-Five Mortality in Nineveh (2004–2013): A Time Series Analysis

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Abstract

Context: Under-five mortality rate (U5MR) is the number of deaths since birth up to 5 years of age in a specific year divided by the number of live birth (LB) of the same year × 1000. It is a key indicator of child well-being including health and nutrition status, coverage of child survival interventions, and more broadly of social and economic development. **Aim:** The aim is to study U5MR and their cause trends in Nineveh Governorate for 10 years (2004–2013). **Methodology: Design of the Study:** This was a biometric (descriptive) study design. **Sample of the Study:** Under-five deaths plus LBs for the years 2004–2013 were taken. **Research Settings:** This study was carried out in Nineveh Governorate/Northwest of Iraq. **Data Sources:** The data were taken from vital registration system and death certificates. **Outcome Measures:** Various rates and proportions in addition to Chi-squared test for trend. **Results:** <5 MR varied from 17.83 in 2004 to 20.28/1000 LB in 2013 being worst in 2007 (26.28/1000LB) most of these deaths were among males. The main causes were respiratory distress syndrome, sepsis, congenital anomalies, infections, pneumonia, and accidents. **Conclusions:** About 20 children died every year for each of 1000 LBs before reaching their 5th birthday.

Keywords: Nineveh, trend, under-five mortality

Introduction

Under-five mortality rate (U5MR) is the number of deaths since birth up to 5 years of age in a specific year divided by the number of live births (LBs) of the same year ×1000 as defined by the WHO.[1]

Since 1990s, U5MR almost halved from 12.6 million to 6.6 million. This remarkable achievement makes us visualize a world where no child is born to die from easily preventable causes.[2]

In Iraq, two decades ago, the U5MR was 121/1000 LBs; this means that 1 in every 8 LBs died before the age of 5 years.[3] However, this rate exhibited a great fall toward the current century to reach 48/1000 LBs in 2000 and 45/1000 LBs in 2007 although still higher than its Millennium Development Goal-4 (MDG4) according to the WHO reports. The last rate was almost the double of the average global U5MR (25/1000 LBs).[4]

More recently, 38.4/1000 ever live born died before their 5th birthday as estimated by Abid Al-Ahad[5] in 2012.

One of the MDGs was to reduce U5MR by two-thirds between 1990 and 2015.[6] It was declined considerably in most developing countries. However, this decline did not show a homogeneous dispersion geographically due to the differences in environmental, socioeconomic factors and the quality of health-care services and their access.[7] In 2013, the U5MR in developing countries was 12 times higher than developed nations.[8] Four out of five under-five deaths occur in Sub-Saharan Africa and South Asia.[9]

New estimates in levels and trends in child mortality report released by the UNICEF, the WHO, and the World Bank Group indicate that 16000 children under the age of 5 years still die every day[10] mostly from preventable causes and treatable diseases, even though, in some occasions, the

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knowledge and technologies for lifesaving interventions are available.[11]

Despite the fact that U5M has been fallen, the proportion of neonatal deaths has increased. Globally, the WHO database analysis on the burden of disease showed that more than one-third (37%) of the U5M causes from 2000 to 2003 had been attributed to neonatal causes, 19% to pneumonia, 17% to diarrhea, 28% to injuries, measles, HIV/AIDS, and malaria.[12] Then, the neonatal portion had increased in 2008 to 41%. Among neonatal causes, preterm labor (29%), birth asphyxia (23%), and infections including sepsis and pneumonia (25%) were the main causes of death.[13] Thus, reducing neonatal mortality will greatly impact the under-five survival.

Aim of the study

The aim is to study U5MR and their cause trends in Nineveh Governorate for the years 2004–2013.

Methodology

Ethical consideration

Ethical consideration and official agreements were acquired from the Ethical and Research Committee in the College of Medicine at Mosul University and then followed by formal agreement from Nineveh Health Directorate.

Design of the study

Biometric study design was implemented in this research analyzing the data obtained from vital registration system followed by time series analysis.

Research setting

This study was carried out in Nineveh which ranks the second among Iraqi Governorates regarding its population following Baghdad with a total population reaching three and half million. Its crude birth rate was 43.4/1000; crude death rate was 3.6/1000 midyear population and a growth rate approximating 4%.[14] The required data were taken from vital registration system of Statistical Department in Nineveh Health Directorate.

Sample of the study

All deaths under-five years of age and all live births were taken for 10 years (2004-2013).

Duration of the study

This study was conducted from January 1 to June 1, 2018.

Data sources

Vital registration system data were used depending on the death certificates.

Statistical analysis and outcome measures

The following measures are used in this research:

1. $$\text{U5MR} = \frac{\text{No. of deaths (0–1824 days of age) in a specific year}}{\text{Total number of LB in the same year}} \times 1000$$

2. $$\text{Prop. of U5M by sex} = \frac{\text{No. of U5M with certain sex in a specific year}}{\text{Total no. of U5M in the same year}} \times 100$$

3. $$\text{Prop. of U5M by sex and cause} = \frac{\text{Number of U5M with certain sex and cause in a specific year}}{\text{Total number of U5M in the same sex and year}} \times 100$$

The trends of U5MR and their causes were analyzed using Chi-squared test for trend by StatsDirect program version 3. Cambridge, UK. Company no.: 04399867. The significance of this test was considered by adopting a $P < 0.05$.

Results

Just about 20 children under the age of 5 years died every year/1000 LBs [Table 1]. Mortality among under-five children fluctuated from 17.83/1000 LBs in 2004 to 20.28/1000 LBs in 2013 with worst rate recorded in 2007 (26.28/1000 LBs). A highly significant change in U5MR trend was documented in general and for both sexes ($P < 0.0001$) each.

Males reported higher rates of mortality compared with females except the years 2011 and 2012 where the reverse picture was reported.

Regarding the causes of U5M, respiratory distress syndrome (RDS), sepsis, and congenital anomalies were dominated and responsible for about two-thirds of U5M or even more each year [Table 2]. In contrast, infections, pneumonia, and accidents were recorded lower figures and constituted roughly about 20% of U5M causes.

Most causes showed highly significant changes ($P < 0.0001$) with raise in RDS, congenital anomalies, and infections and drop in sepsis as revealed in Table 2 and Figure 1.

Males and females demonstrated a consistent ranking for the causes of U5M with highly significant changes in their trends ($P < 0.0001$) each, except pneumonia and accidents among males, and infections and pneumonia among females that were not changed significantly during the study period.

Discussion

Approximately, more than 6 million children die each year before their 5th birthday mostly in developing countries and generally from treatable or preventable diseases. In 2000, the United Nations fixed a target of reducing under-five mortality to one-third of its 1990 level by the year 2015 as MDG4. This goal, together with other seven, was considered to improve the economic, social, and health environments in the world's poorest countries.[13]

In the present study, U5MRs were fluctuating significantly between 2004 and 2013 from 17.83 to 20.28/1000 LBs, i.e., 1 for each of 50 LBs died before reaching their 5th birthday. Males

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had a greater share in mortality compared to females except the years 2011 and 2012. These rates were lower than the national levels reported by the WHO for U5M between 1990 and 2010 where it was 59.5/1000 LBs in 1990 and then almost halved to 31.9/1000 LBs during 2010. This inconsistency is due to the differences in data sources between the present study which depends on death certificate and that of the WHO which depends on censuses and active surveys. However, the U5MR in Iraq was also higher than most of the Middle East countries with few exceptions as Egypt, Morocco, Iran, and Turkey where these countries exhibited higher U5MR in 1990 but lower levels in 2010 compared with Iraq. The later ranked the third in the highest levels of U5M in the Middle East after Yemen and Morocco in contrast to the United Arab Emirates which registered the lowest level of U5MR (3/1000 LBs) during 2010.[15]

Some Arab countries had since 2013 achieved their MDG and even lower than their expected levels for 2015 such as Egypt, Bahrain, Oman, and Qatar; however, Iraq still lagging behind its expected U5MR for the year 2015 when its observed value during 2013 (34/1000 LB) was about the double of the MDG4 target (18/1000 LBs). Higher mortality was shown among males by most of these countries.[16]

Table 1: Trends of under-five mortality rates and by sex in Nineveh (2004-2013)

Year	Number of live births	Children death <5 years of life			
		Total deaths		Male, *n* (%)	Female, *n* (%)
		n	<5 MR/1000		
2004	83,717	1493	17.83	879 (58.87)	614 (41.13)
2005	88,916	1951	21.94	1134 (58.12)	817 (41.88)
2006	99,137	2361	23.82	1353 (57.31)	1008 (42.69)
2007	95,526	2510	26.28	1440 (57.37)	1070 (42.63)
2008	117,067	2651	22.65	1541 (58.13)	1110 (41.87)
2009	130,244	2761	21.20	1540 (55.78)	1221 (44.22)
2010	137,775	2594	18.83	1466 (56.52)	1128 (43.48)
2011	146,040	3011	20.62	1239 (41.15)	1772 (58.85)
2012	146,864	3106	21.15	1272 (40.95)	1834 (59.05)
2013	149,297	3028	20.28	1686 (55.68)	1342 (44.32)
P	-	-	<0.0001	<0.0001	<0.0001

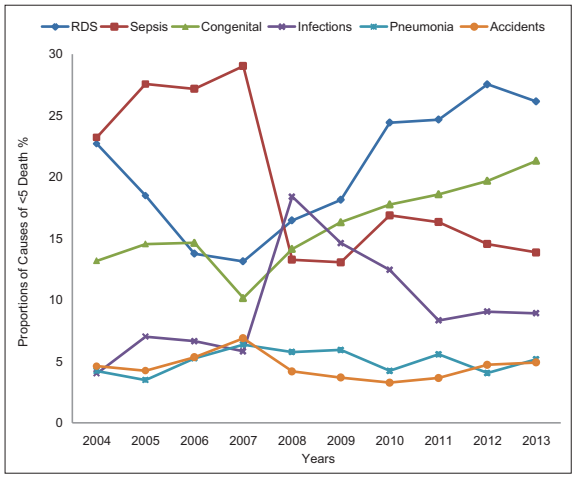

Figure 1: Trends of causes of under-five mortality in Nineveh (2004–2013)

Table 2: Trends of causes of under-five mortality and by sex in Nineveh (2004-2013)

Causes of death (%)	Year										*P*
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
Total											
RDS	22.71	18.50	13.77	13.15	16.48	18.15	24.44	24.68	27.56	26.16	<0.0001
Sepsis	23.24	27.58	27.19	29.04	13.28	13.07	16.89	16.34	14.55	13.87	<0.0001
Congenital anomalies	13.19	14.56	14.65	10.16	14.15	16.33	17.77	18.60	19.70	21.33	<0.0001
Infections	4.02	7.02	6.65	5.82	18.41	14.63	12.45	8.34	9.05	8.92	<0.0001
Pneumonia	4.22	3.49	5.25	6.37	5.77	5.94	4.24	5.58	4.06	5.18	0.845
Accidents	4.62	4.25	5.34	6.89	4.19	3.69	3.28	3.65	4.73	4.92	0.06
Male											
RDS	24.23	19.31	15.30	14.44	18.30	18.12	25.38	16.22	19.34	28.77	<0.0001
Sepsis	23.09	27.07	27.05	28.82	13.11	12.79	16.51	11.95	9.36	14.06	<0.0001
Congenital anomalies	12.74	14.29	13.38	9.65	14.28	16.62	17.53	24.78	25.63	20.28	<0.0001
Infections	3.19	6.08	6.36	6.53	17.13	13.70	12.48	10.82	11.71	8.48	<0.0001
Pneumonia	3.53	3.44	5.40	5.76	5.39	5.65	4.02	7.18	4.64	4.74	0.149
Accidents	5.01	5.03	5.91	7.01	3.70	4.35	3.89	4.92	7.31	5.40	0.707
Female											
RDS	20.52	17.38	11.71	11.40	13.96	18.18	23.23	30.59	33.26	22.88	<0.0001
Sepsis	23.45	28.27	27.38	29.35	13.51	13.43	17.38	19.41	18.16	13.64	<0.0001
Congenital anomalies	13.84	14.93	16.37	10.84	13.96	15.97	18.09	14.28	15.59	22.65	<0.0001
Infections	5.21	8.32	7.04	4.86	20.18	15.81	12.41	6.60	7.20	9.46	0.813
Pneumonia	5.21	3.55	5.06	7.20	6.31	6.31	4.52	4.46	3.65	5.74	0.194
Accidents	4.07	3.18	4.56	6.73	4.86	2.87	2.48	2.77	2.94	4.32	0.006

RDS: Respiratory distress syndrome

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A great reduction in U5M was demonstrated globally in the past two decades. It was roughly halved since 1990 from 90 to 46 in 2013/1000 LBs. However, the progress was slowest in developing countries, especially in Southern Asia and Sub-Saharan Africa where the problem of death remains highest.[16] In Sub-Saharan Africa, about 1 out of every 10 children dies annually before reaching their 5th birthday (92/1000 LBs) compared to 1 out of 100 children in the European region (12/1000 LBs).[17]

These higher rates of U5M in developing countries including Iraq are expected in the light of the high fertility levels in these countries beyond the governmental capacity to provide their people with the essential health-care services.

In the present work, between half and two-thirds of U5M were the results of just three causes, namely RDS, sepsis, and congenital anomalies. Other causes such as infections, pneumonia, and accidents were followed. These causes had the same ranking among both sexes and most of their trends were changed significantly throughout the study period. Approximately, the same causes were reported for Iraq by the WHO but with different ranking and proportions. Between 2000 and 2010, the national causes of U5M and their ranges were prematurity (20%–20%), pneumonia (17%–18%), birth asphyxia (15%–15%), congenital anomalies (11%–14%), neonatal sepsis (6%–5%), and injuries (6%–6%).[18]

Different sets of U5M causes were demonstrated worldwide. In Istanbul between 2005 and 2009, cardiovascular diseases were dominating (31.2%) followed by perinatal (22.7%) and respiratory problems (12.1%),[19] while in Zimbabwe, neonatal causes comprised only 29% of U5M in 2010, but the single most important cause of death was HIV/AIDS which contributed to 22% of U5M.[20] Furthermore, infectious problems alone account for nearly 70% of child deaths in Sub-Saharan Africa.[21] Worldwide, more than half (51.8%) of under-five deaths during 2013 were due to infectious diseases such as pneumonia, diarrhea, and malaria. On the other hand, 44% of U5M died in the neonatal period mainly due to prematurity, congenital anomalies, sepsis, birth asphyxia, and accidents.[22]

The results of the present work were almost consistent with that of the global pattern, especially regarding neonatal causes, but may differ from the results of developing countries in which infectious diseases were dominating; this is expected as infections such as HIV and malaria are uncommon and thus had a null contribution to childhood mortality in the present study locality. Preventing avoidable mortality is urgently needed worldwide. One of the WHO and UNICEF strategies is the integrated management of childhood illnesses that has been applied recently to reduce U5MR, especially in developing countries.[23]

Conclusions and Recommendations

About 20 out of each of 1000 LBs died before reaching their 5th birthday. Most of them did so as a result of RDS, sepsis, congenital anomalies, infections, pneumonia, and accidents. Further reduction in U5MR through the provision of lifesaving interventions such as mass immunization and antibiotics are recommended.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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