Trends of Infant Mortality in Nineveh (2004-2013), A Time Series Analysis

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Abstract:

Context: Infant mortality rate is the number of deaths under one year of age in a year divided by total number of live birth in the same year × 1000. It is a standard measure that is not affected by population age structure and therefore suitable to use for comparisons over time and across regions, in addition, it reflects the underlying well-being of communities and the social environment that cultivate health and access to health-promoting resources.

Aim: Determine the trend of infant mortality in Nineveh for 10 year period (2004-2013).

Subjects and Methods:

Study Design: Descriptive biometric study design.

Study Settings: Nineveh Governorate/ North of Iraq.

Study Sample: Infant deaths and live births from 2004 to 2013.

Data Collection Tool: Death certificates, vital registration system.

Outcome Measures: Infant mortality rate in general in addition to the proportions of their mortality by sex and causes with their trends by using various rates, proportions, and Chi-squared test for trend.

Results: The trend of infant mortality rate fluctuated significantly from 15.36 to 16.93/1000 live births between 2004 and 2013. Most of these deaths were due to respiratory distress syndrome, sepsis, congenital anomalies, infections, birth asphyxia, and pneumonia.

Conclusions and Recommendations: Infant mortality was relatively low and most of its causes were preventable, thus; more efforts are still needed to control such causes and improve infants' survival.

Keywords: Infant, Trend, Mortality, Nineveh.

Introduction:

According to WHO infant mortality rate (IMR) is defined as the number of deaths under one year of age in a year × 1000 divided by total number of live births (LB) in the same year [1, 2]. It is an important indicator reveals the overall health status of a population, considered a major determinant of life expectancy at birth as it is the largest single age-category of mortality, reflects the influence of socio-economic, lifestyles, and health systems conditions on maternal and newborns health, and deaths at this age are due to specific set of diseases and conditions to which adult population is less exposed or less vulnerable [3, 4].

During the economic sanction imposed on Iraq in the 1990s of the past century, Awqati et al. [5] conducted a national household survey to study the causes of childhood mortality during the period 1994-1999. They found that 1 in every 10 LB died before reaching their 1st birthday (IMR =91/1000 LB) reflected the adverse effects of socioeconomic factors prevailed in that time on infants mortality.

During the current century, WHO [6] reported in 2007 a wide disparity in IMR between developed and developing countries ranging, on average, from 13 in Europe to 88/1000 LB in Africa. In Iraq, 36 infants died for every 1000 LB in the same year that was higher than all the neighboring countries like Kuwait 9, Jordan 18, Iran 29, Saudi Arabia 20, Syria 15, and Turkey 21 infant deaths for each 1000 LB.

The international variation in IMR may be related to variations in registration practices for the very premature infants, for example, several countries in Europe apply a minimum threshold of a gestational period of 22 weeks (or a birth weight threshold of 500 grams) for babies to be registered as LB [4] which affects the comparability of IMR across countries.

Despite the improvements in availability and accessibility to health care facilities, infant mortality remains a critical health issue in many developing countries. Lawn et al. [7] proved that the prevalent causes of infant deaths globally are congenital anomalies, infections, complication of preterm birth and birth asphyxia. Most of infant deaths happened in the neonatal period, thus; cost-effective and inexpensive interventions can reduce neonatal deaths by (41-72%) and improve infant's survival [8].

Aim of the study:

Determine the trend of infant mortality in Nineveh for 10 year period (2004-2013).

Subject and Methods:

Ethical Consideration and Study Setting:

Administrative agreements and ethical consideration were obtained from the Ethical and Research Committee in Mosul College of Medicine, followed by formal agreement from Nineveh Health Directorate that in turn provided official permissions directed to all study settings involved in this work.

Study Setting:

This research was done in Nineveh, the 2nd most populated governorate in Iraq after Baghdad with a total population approximating three and half million. The registered crude birth rate equal to 43.4/1000 midyear population and crude death rate approaching 3.6/1000 midyear population with (4%) growth rate [9]. Mortality data were obtained from vital registration system/ Statistical Department/ Nineveh Health Directorate.

Study Design:

Descriptive biometric study design which involves the analysis of routinely available data such as vital registration system to provide valuable information at local or national level [10], then followed by time series analysis.

Study Sample:

Calculation of IMR and their trends require total infant deaths and their subdivision by sex in addition to the live births for 10 year period.

Data Collection Tool and Duration of the Study:

In the absence of relevant census information, vital registration data were used which depend on death certificate. The duration of performing this research last from 1st January 2018 to 1st May 2018.

Outcome Measures and Statistical Analysis:

To achieve the aim of the study, the following measures are used:

$$1.\ \text{IMR} = \frac{\text{No. of infant death (0-364 days of age) in a specific year}}{\text{Total no. of LB in the same year}} \times 1000$$

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

$$3.\ \text{Prop. of IM by sex and cause} = \frac{\text{No. of IM with certain sex and cause in a specific year}}{\text{Total no. of IM in the same sex and year}} \times 100$$

The significant changes in the trends of mortality and their causes were examined by Chi-squared test for Trend using Statdirect software program version 3. The Chi-squared test for Trend can be calculated manually using sophisticated mathematical equations [11]. P-value < 0.05 was considered statistically significant throughout data analysis.

Results:

Table (1) shows that IMR trend was significantly fluctuated during the 10 year study period (p=0.007) from 15.36 to 16.93/1000 LB between 2004 and 2013 being worst during 2007 (20.83/1000 LB) followed by gradual relief toward 2013.

A clear predominance of males among decedents was noticed in almost all years except 2011 and 2012. Highly significant changes were shown by both males and females in their mortality trends during infancy with p<0.0001 each.

Table (2) demonstrates the causes of infant mortality in which there was a predominance of respiratory distress syndrome (RDS) which was responsible for about one quarter of infant deaths (ranged between 16.43% in 2007 and 32.4% in 2012). Sepsis, on the other hand, was responsible for about one fifth of infant deaths with highest level reached in 2007(35.13%) followed by a rapid fall to reach a proportion of (16.58%) at the end of the study period. Congenital anomalies, infections, birth asphyxia, and pneumonia came thereafter. Most of these causes revealed highly significant changes in their trends in general and for both sexes throughout the study period (p<0.0001).

Meanwhile RDS and congenital anomalies were significantly increased, sepsis portrayed a significant decrease in its trend during the study period as demonstrated in table (2) and figure (1).

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

Year	Live births	Infant deaths (0-364) days of life					
		Total		Male		Female	
		No.	IMR/ 1000	No.	%	No.	%
2004	83717	1286	15.36	768	59.72	518	40.28
2005	88916	1622	18.24	947	58.38	675	41.62
2006	99137	1915	19.32	1110	57.96	805	42.04
2007	95526	1990	20.83	1169	58.74	821	41.26
2008	117067	2235	19.09	1320	59.06	915	40.94
2009	130244	2304	17.69	1288	55.90	1016	44.10
2010	137775	2229	16.18	1271	57.02	958	42.98
2011	146040	2552	17.47	992	38.87	1560	61.13
2012	146864	2642	17.99	1030	38.99	1612	61.01
2013	149297	2527	16.93	1418	56.11	1109	43.89
P-value	------	------	0.007	------	<0.0001	-------	<0.0001

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

Causes of death in %	Year										P-value
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
Total											
RDS*	26.36	20.65	16.97	16.43	19.28	21.70	28.40	29.11	32.40	31.30	<0.0001
Sepsis	26.05	32.12	32.48	35.13	15.53	15.63	19.69	19.28	17.03	16.58	<0.0001
Congenital anomalies	13.69	15.41	15.14	10.60	14.50	16.28	16.91	17.44	20.36	21.92	<0.0001
Infections	3.19	6.04	5.54	5.08	18.79	14.11	11.80	8.23	9.08	8.47	<0.0001
Birth asphyxia	5.83	6.29	4.70	4.47	5.32	6.03	5.74	6.47	5.56	6.33	0.08
Pneumonia	3.73	3.14	5.07	5.98	5.46	5.08	3.63	4.66	3.44	4.19	0.225
Male											
RDS*	27.73	22.81	18.65	17.54	21.06	21.58	29.27	20.26	23.88	34.13	<0.0001
Sepsis	25.91	31.57	32.25	33.96	15.08	15.22	19.12	14.82	11.46	16.64	<0.0001
Congenital anomalies	12.89	14.99	13.87	9.92	14.09	16.54	16.99	25.30	27.77	20.80	<0.0001
Infections	2.47	4.96	4.86	5.99	17.58	13.74	11.72	11.39	12.62	7.76	<0.0001
Birth asphyxia	6.64	6.86	5.68	4.45	6.44	6.21	6.69	5.54	4.47	6.91	0.86
Pneumonia	2.86	3.17	5.32	5.05	5.08	5.05	3.30	6.15	4.27	4.09	0.38
Female											
RDS*	24.32	17.63	14.66	14.86	16.72	21.85	27.24	34.74	37.84	27.68	<0.0001
Sepsis	26.25	32.89	32.80	36.78	16.17	16.14	20.46	22.12	20.60	16.50	<0.0001
Congenital anomalies	14.86	16.00	16.89	11.57	15.08	15.94	16.81	12.44	15.63	23.35	0.002
Infections	4.25	7.56	6.46	3.78	20.55	14.57	11.90	6.22	6.82	9.38	0.519
Birth asphyxia	4.63	5.48	3.35	4.51	3.72	5.81	4.49	7.05	6.27	5.59	0.001
Pneumonia	5.02	3.11	4.72	7.31	6.01	5.12	4.07	3.72	2.92	4.33	0.006

*RDS= Respiratory distress syndrome

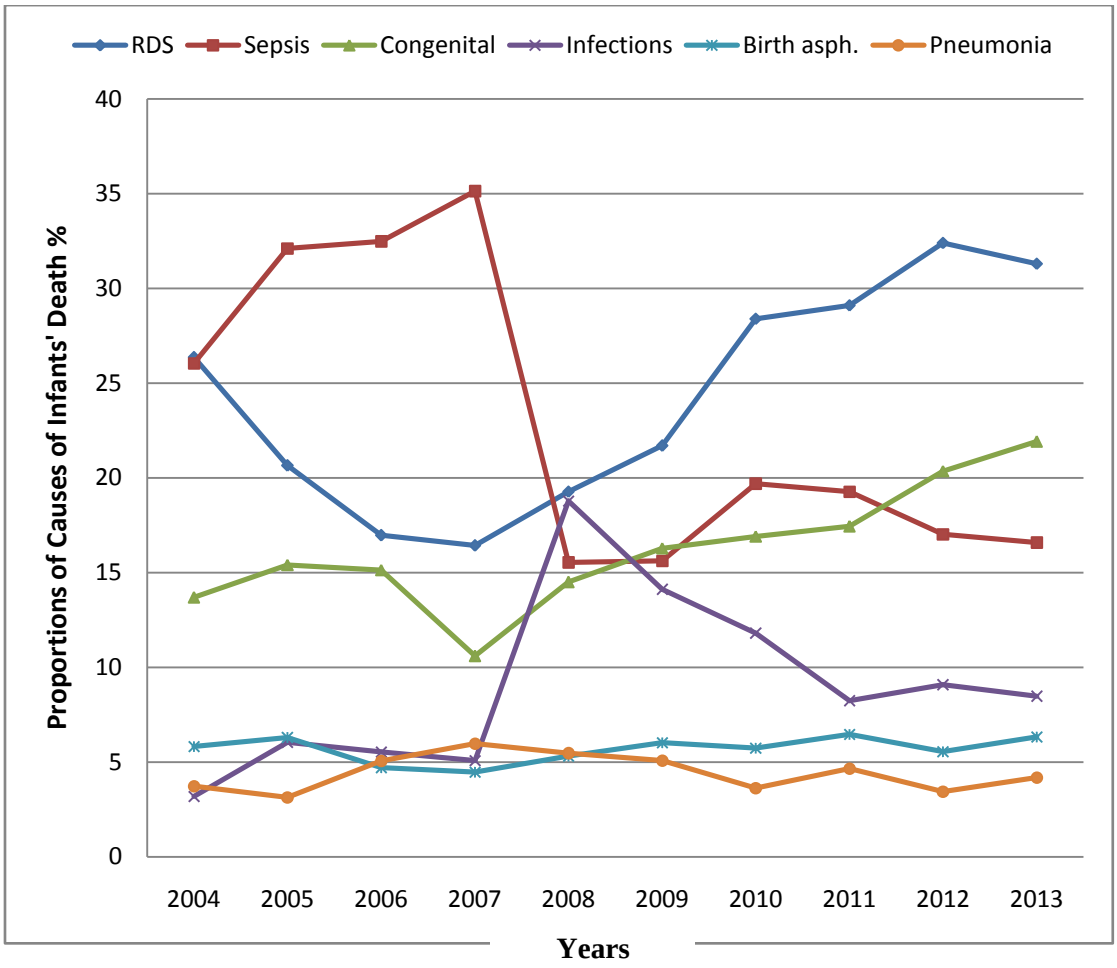

Figure (1): Trends of causes of infant mortality in Nineveh (2004-2013).

Discussion:

Infant mortality reflects the effect of economic and social conditions on the health of newborns, the social environment, individual lifestyles as well as the characteristics and effectiveness of health systems. In some large countries as India, South Africa, and Indonesia IMR remains above 20/1000 LB. In India, although IMR had declined over the past few decades, however; there is still one in every twenty five live births die before their 1st year of age [12].

In the present study, 8 out of each 10 U5M died before their 1st birthday. Their trend was fluctuating significantly from 15.36 in 2004 to 16.93 in 2013 per 1000 LB being worst (20.83/1000 LB) during 2007. Higher proportion of mortality was seen among males, but the contrary was true among females during 2011 and 2012. A higher level of IMR (32.5/1000 ever born LB, three quarters of them living in rural areas) was estimated by Abid Al- Ahad [13] during 2012 due to the use of estimated birth technique rather than the registered mortality reflecting the problem of under registration practices especially in rural areas.

In an earlier study, Indrayan [14] demonstrated the two global extremes of IMR during 2004 which were Singapore (2/1000 LB) and Sierra Leone (165/1000 LB). Four years later, among the 1st 35 countries that registered the lowest rates of infant mortality, Luxembourg occupied the 1st place with

IMR of 1.8/1000 LB and Turkey ranked last with a rate of 17/1000 LB [15].

More recently, in 2013, IMR was ranging between 1.3 in Iceland to 41.4/1000 LB in India. The trends of IMR between 2000 and 2013 were variable in most countries, while Chili and United States showed a flattened pattern of IMR trends, Turkey, on the other hand, exhibited a great reduction from above 40/1000 LB to <10/1000 LB during the same time period [12].

Most of developing countries experienced some sort of decline in infant and childhood mortality since the past century. According to WHO [16] almost all Middle East countries experienced various levels of reduction in IMR between 1990 and 2010 such as Iraq from 48 to 27.4, Jordan 29 to 13, Kuwait 11.8 to 7.3, Lebanon 27.3 to 9.5, Libya 32.2 to 12, and Iran 50.3 to 27.1 for each 1000 LB. Thus, a great disparity in the levels and trends of IMR were examined between developed and developing countries including the present study locality due to the socioeconomic and health inequalities as stated by Graham [17].

In the present work, on average, one quarter of infant death was resulting from RDS, one fifth attributed to sepsis, and another one fifth to congenital anomalies, then infections, birth asphyxia, and pneumonia were followed with lower shares in infant mortality. Meanwhile RDS, congenital anomalies, and infections raised significantly, sepsis exhibited a dramatic reduction in its trend throughout the study period. The same ranking of these causes with significant changes in most of their trends were portrayed among both males and females.

These results were parallel to Abid Al-Ahad [13] study during 2012 who documented prematurity (26.9%), congenital anomalies (16.7%), sepsis (11.5%), pneumonia (10.3%), and diarrhea (8.9%) as the main causes of infant death.

In contrast, congenital anomalies were the 1st leading cause of infant death in USA between 1980 and 2010 followed during 1980 by SIDS, RDS, prematurity and LBW, and during 2010 by prematurity and LBW and SIDS [18]. However, in 2011, prematurity became the 1st leading cause of infant death accounted for more than one third (35.4%) followed by congenital anomalies (20.9%), other perinatal conditions not directly related to prematurity (14.5%), SIDS (14.2%), and accidents (4.8%) [19].

Conversely, South Africa's infant death in 2014 were caused by RDS (14.5%), intestinal infections (12.9%), influenza and pneumonia (9%), sepsis and prematurity (4.7%) each [20] just corresponding to that seen in Ethiopia where three infectious diseases namely pneumonia, malaria, and diarrhea blamed to be responsible for the majority of infant death [21].

Meanwhile congenital anomalies were the leading cause of infant death in many developed countries, surprisingly, they ranked 3rd in the present study despite the deleterious effects of wars on Iraqi population. This could be explained as that, developed countries exert meticulous efforts to control preventable causes of death such as sepsis and RDS leading the uncontrollable diseases to emerge and be the principal cause of their infant death such as congenital anomalies. On the other hand, the sharp fall in sepsis mortality during 2008 in the present work may be artificial due to the change in coding diseases from ICD9 to ICD10

and not attributed to improved medical care.

Despite the advances in medical sciences, survival of infants continues to be a challenge worldwide. Everybody worth to live in a world in which there are no preventable deaths, where every pregnancy is wanted, every birth is celebrated, and women, babies and children survive and thrive to reach their full potentials [(22)].

Conclusions and Recommendations:

Although low levels of IMR were experienced, provision of essential health care services and make them accessible to those who need them are recommended for further reduction in infant mortality and controlling preventable causes of their deaths.

References:

[1]. Lwanga SK, Cho-YT, Ayeni O. Teaching health statistics: lessons and seminars outlines. WHO, Geneva, 1999.

[2]. World Health Organization. Catalogue of health indicators: A selection of important health indicators recommended by WHO programs. Unit of strengthening country health information, division of health situation and trend assessment. Geneva, 1996.

[3]. Park K. Park text book of preventive and social medicine. 22nd Ed. Banarsidas Bhanot publishers. India, 2013.

[4]. Mathews TJ, Marian F., Mac Dorman MF, Thoma ME. Infant mortality statistics from the 2013 period: Linked birth/infant death data set. National Vital Statistics Reports 2015; 64 (9).

[5]. Awqati NA, Ali MM, Al-Ward NJ, Majeed FA, Salman K, Al-Allak M, Al-Gasseer N. Causes and differentials of childhood mortality in Iraq. BMC Pediatrics 2009; 9(40): 1431-71.

[6]. World Health Organization. World health statistics. WHO Department of Health Statistics and Information Systems of the Health Systems and Innovation Cluster, Geneva, Switzerland, 2009.

[7]. Lawn JE, Cousens S, Zupan J. Four million neonatal deaths: When? Where? Why? Lancet 2005; 365 (9462): 891-900.

[8]. Darmstadt GL, Bhutta ZA, Cousens S, and Lancet Neonatal Survival Steering Team. Evidence-based, cost-effective interventions: How many newborn babies can we save? Lancet 2005; 365(9463):977-988. Available from: http://dx.doi.org/10.1016/S0140-6736(05)71088-6

[9]. Population of Nineveh. Nineveh Health Directorate, Statistical Department, 2013.

[10]. Al-Khafajei AMB. Problem- based learning in epidemiology: Simulated exercise from the practice of public health medicine, 1998.

[11]. Kirkwood BR and Sterne JA. Essential medical statistics, 2nd Ed. Blackwell Science Ltd, 2003.

[12]. Organization for Economic Cooperation and Development (OECD). Infant mortality. In: Health at a Glance 2015. OECD Indicators, OECD Publishing, Paris, 2015. Available at: http://dx.doi.org/10.1787/health_glance-2015-12-en.

[13]. Abid Al-Ahad AK. Assessment of nutritional indicators among under 5 children at Al-Hamdaniya district North of Iraq. Thesis in Community Medicine/ College of Medicine/ University of Mosul, 2012.

[14]. Indrayan A. Measures of mortality: Indicators of child mortality, Medical Biostatistics, 3rd Ed. Chapman and Hall, CRC Press; 2012.

[15]. Epidemiology, Assessment and Program Development Branch, Maternal, Child and Adolescent Program, Center for Family Health. Infant mortality. California Birth and Death Statistical Master Files 2000-2010. California department of public health, 2012.

[16]. Rajaratnam JK, Marcus JR, Flaxman AD, Wang H, Levin-Rector A, Dwyer L, Costa M, Lopez AD, Murray CJ. Neonatal, post-neonatal, childhood, and under-5

mortality for 187 countries, 1970–2010: a systematic analysis of progress towards MDG 4. WHO, Lancet 2010; DOI:10.1016/S0140-6736(10)60703-9.
[17]. Graham H. Unequal lives: health and socioeconomic inequalities. Maidenhead: Open University Press; 2007.
[18]. Center for Disease Control and Prevention. The leading causes of death in USA 1908-2010. CDC, National Vital Statistics System/ Vital statistics of the USA, Washington DC: Public Health Service, 2012. Available at: http://www.cdc.gov/nchs/data/nvsr/nvsr61/nvsr61_04.pdf.
[19]. United States Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau. Child Health USA 2014. Rockville, Maryland: US Department of Health and Human Services, 2015. Available from: http://mchb.hrsa.gov/chusa14/
[20]. Lehohla PJ. Mortality and causes of death in South Africa2014: Findings from death notification. Statistics of South Africa, 2015.
[21]. Deribew A, Tessema F, Grima B. Determinants of under-five mortality in Gilgel Gibe Field Research Center, Southwest Ethiopia. Ethiop J Health Dev 2007; 21(2):117-124.
[22]. Lawn JE. Newborn survival: A multi-country analysis of a decade of change. Health Policy and Planning 2012; 27(3): 6-28. Data sources: UNICEF 2012 and WHO MMR estimates 2014.