Trends in Neonatal Mortality Rates in Iraq During the Period of 2008-2017

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ABSTRACT:

BACKGROUND:

Neonatal mortality is mainly caused by infections, birth asphyxia and pneumonia (developing nations). Determinants included socioeconomic-demographic factors, healthcare system and culture. Risk factors: low birth weight, prematurity, insufficient antenatal care, repeated caesarian deliveries. Limited neonatal deaths research in Iraq justified this study.

AIM OF THE STUDY:

Describe and plot the neonatal mortality trend during the period of 2008-2017, and finding relation with key determinants and risk factors.

METHODS:

Retrospective software and hardcopy neonatal medical records review & analysis (February-June 2019) in MOH, Central Statistical Organization, Baghdad's Health directorates, International Health Organizations, & 2-3 conveniently selected hospitals in health directorate. Records studied: Annual Statistical Reports, "Neonatal deaths Statistics Form", "Born", admission files, intensive care units' logbooks, death certificates, international organizations' estimates & Multiple Indicator Cluster Surveys.

RESULTS:

Highest mortality rate was in West region 2015 (18.38/1000), lowest in east 2014 (3.78/1000) excluding Kurdistan; the decline during 2014-2015. Highest admission deaths: males (57.8%), cesarean deliveries (52%), extreme low birth weight (8.5%), preterm (71.2%), >31 years (20.2%). Top death cause: Respiratory distress syndrome (51.9%), & late death: sepsis (33.36%).

CONCLUSION:

Mortality rate declined to lowest in 2014, followed by a rise attributed to increased registration; highest in west 2015, lowest in east 2014. Respiratory distress & sepsis were the most common causes. Most deaths in: preterm neonates, males, extremely low birth weight, operative deliveries & >31 years maternal age.

KEYWORDS: Neonatal, Mortality, Determinant, Preterm.

INTRODUCTION:

Neonatal death (N.D) is an estimator of socioeconomic status and efficiency of the country's health services [1]. Achieving the 2015 "Millennium Development Goal (MDG) for child survival" wasn't met due to higher contribution of N.D with disproportional decline [2]. The largest share of global neonatal mortality occurred within low and middle income countries (99%). Maternal mortality, socioeconomic and demographic factors, the health care system, cultural practices and technologies are some determinants of N.D [3]. In developed countries, the main cause is congenital anomalies (CA), while in developing nations commonly due to infections, birth asphyxia and pneumonia [4] A Baghdad study found that the lower is birth weight, the higher is the mortality rate [5]. Studies in Al-Diwaniya (2016) and Basra (2016) found that the highest mortality was due to immaturity and low birth weight (LBW) [6,7]. A Baghdad study revealed higher percentage of male neonates dying, with male to female ratio = 2:1 [8]. An Erbil study (2017) showed elective caesarian section (CS) deliveries to be accompanied with a significant neonatal morbidity and mortality [9]. A study in Namibia described older mothers to have higher neonatal mortality risk [10], while another

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study in Sub Saharan Africa suggested that N.D was associated with young mother's age [11].

Neonatal Infections as neonatal sepsis were commonly associated with neonatal mortality [12]. Iraq was found to be unable to reach Sustainable Developmental Goal (SDG)-target 3 of reducing the neonatal mortality rate (NMR) to 12 / 1000 live births (L.B) in 2030, with about twice excess [13]. Evidence suggested that community-driven packages could decrease neonatal morbidity & mortality especially in less economically advantageous nations [14]. Limited research in the trend of NMR in Iraq was conducted. This justifies the importance of the subject. The study aimed to describe and plot the trend of NMRs from years 2008 to 2017 in Iraq, and finding out the relation with key determinants and risk factors.

MATERIALS AND METHODS:

This is a retrospective study review of medical records (electronic & paper), with an analytic component, done during mid-February to end of June 2019, Conducted in Iraqi Ministry of Health (MOH), Ministry of planning/Central Statistical Organization (MOP/COSIT), Al-Karkh, Al-Rusafa, & Medical city Health directorates, WHO & UNICEF offices in Green Zone, & seven pediatric and maternity hospitals selected within Karkh, Rusafa, & Medical City via convenient sampling. Secondary Data Collection was done (collection and analysis of the data previously collected by other party) from MOH annual statistical reports of country's NMR, governmental NMR. When not available mortality rates and deaths were extracted from the annual number of N.D and L.B by the formula NMR = (No. of N.D / LB) x1000] & [No. of N.D = (LB*NMR) / 1000] respectively. Data collected from Health directorates include monthly N.D statistics form, unified N.D statistics (Born). Variables collected include gender, birth procedure, birth weight, and gestational age, maternal age, & neonatal outcome. Data collected from Hospitals include electronic health records & statistical forms, logbooks within the neonatal intensive care units (NICU), admission files & death certificates. Data collected from international organizations include multiple indicator cluster surveys, regional deaths, and rates estimates. Data collected from the Ministry of Planning were multiple indicator cluster surveys.

RESULTS:

The initial decline was accompanied by a slight increase in registered deaths for two years followed by a steady pattern [Fig 1]. During 2014 and 2015, a steep decrease in registered death numbers as well as NMR, followed by a slow increment. From 2012, the NMR started to decline at higher rate. The widest variation was in 2014 where the MOH' NMR was lower by 33.7%, while in 2017 it lower by 12.9% [Fig 2]. The highest registered value was 18.38 N.D / 1000 live among western governorates in 2015 -though the highest governorate was Basra (southern)- and the lowest value was 3.78 N.D / 1000 L.B in eastern region in 2014 corresponding to Maysan [Fig 3]. Respiratory distress syndrome (ARDS) was the most common cause of early N.D, and with CA, became less prominent as age advances, similar to birth asphyxia, and neonatal jaundice; neonatal sepsis was the most common cause of late deaths; congenital pneumonia and renal failure showed similar figures. The 10th rank was for the diaphragmatic hernia in early deaths while for the late deaths, it was the hydrocephalus [table 1]. First table was made by the new Neonatal death statistics form while subsequent tables were constructed by data derived from the "Born". A Higher proportion of N.D was within the preterm stratum (12.96%), doubling that of the term newborns (6.60%). Male newborns manifested a slightly lower percentage of deaths within gender-specific admissions than females, while representing a higher percentage of the total number of deaths in both genders [table 3]. The highest rate for N.D was within the extremely LBW group, while the lowest rate was within the normal birth weight stratum [table 4]. A higher mortality seen within vaginal delivery (VD) group vs. the cesarean delivery group. However, out of 3034 total deaths, CS contribution was higher than VD [Table 5]. Lowest and highest proportion of N.D were within "21-30 years" and ">31 years" maternal age groups, respectively.

TABLES & FIGURES

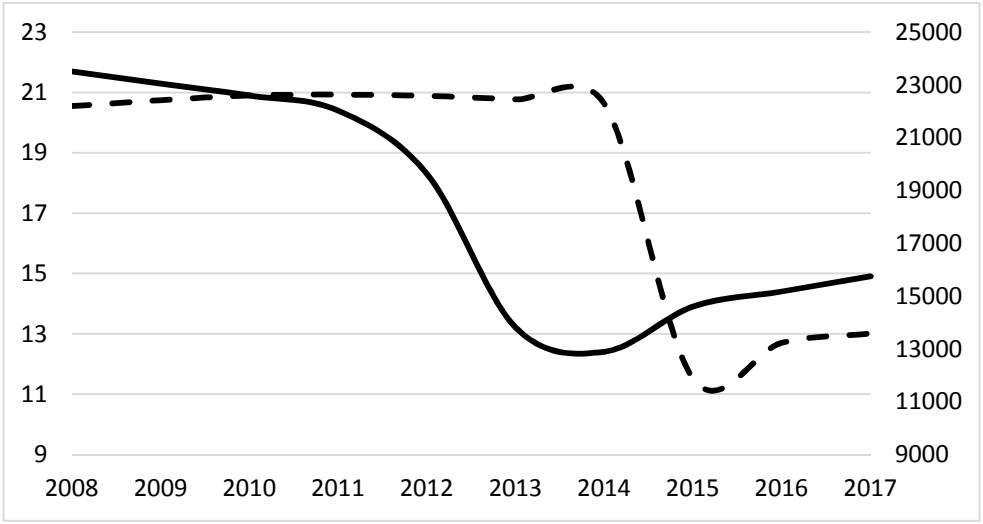

Fig 1: Comparison of the neonatal mortality rate trend (N.D/1000 live births) vs. N.D trend in Iraq (MOH data). Source: 2009-2011 INO, 2012-2017 MOH.

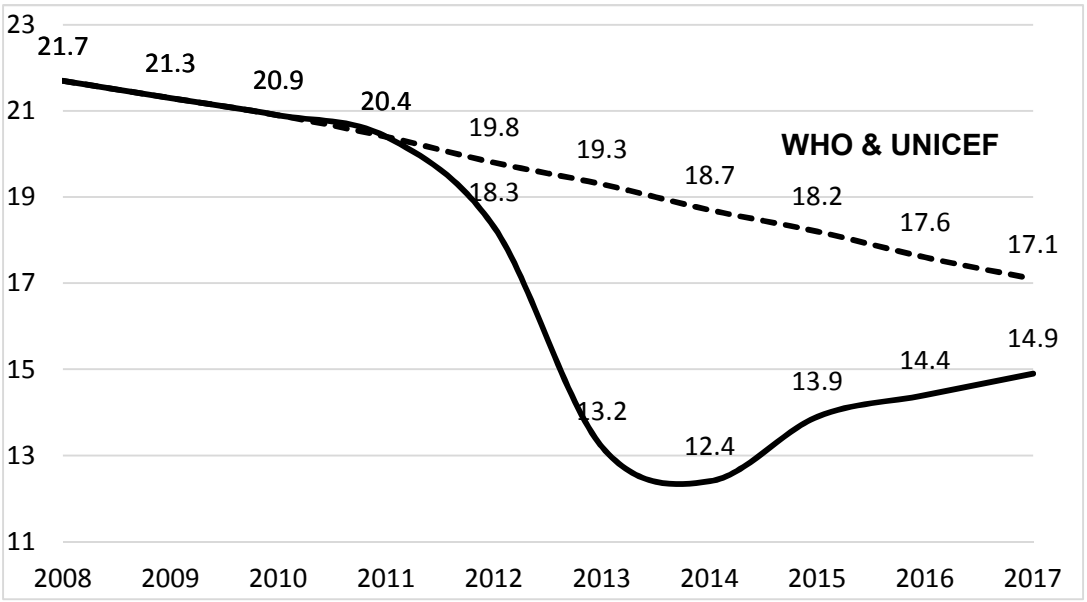

Fig 2: Comparison of neonatal mortality rate in Iraq from different sources (MOH, UNICEF, WHO). Source: 2009-2011 INO, 2012-2017 MOH.

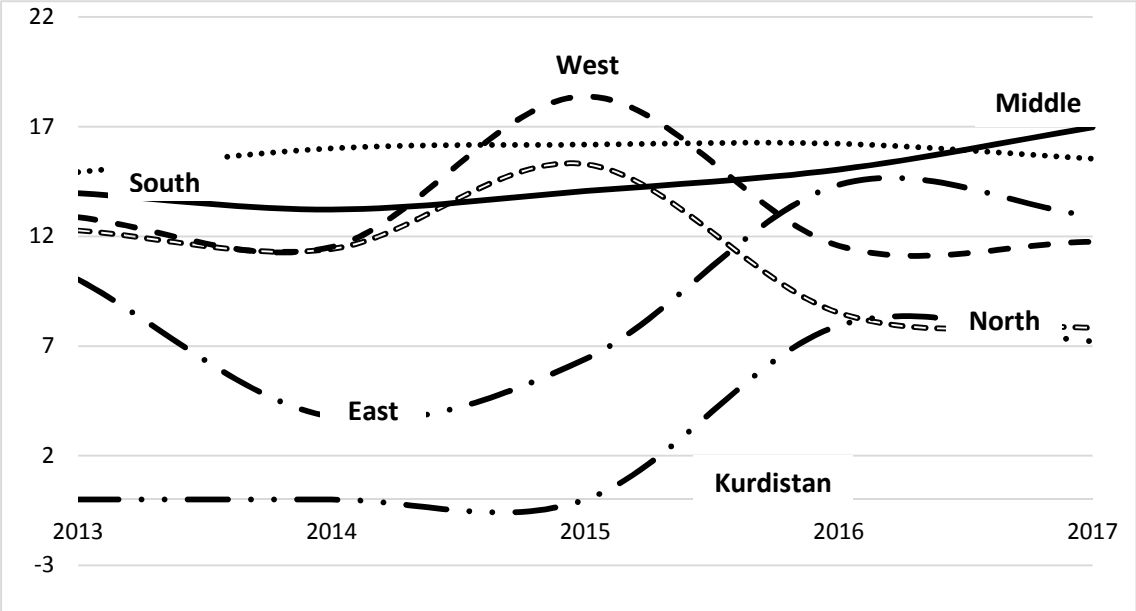

Fig 3: N.D/1000 live births in Iraq's sub-regions during 2013-2017, using formula: NMR = (No. of ND / LB) x1000, from the MOH's governmental NMR values (No Data available before 2013).

Table 1: Comparison of the top ten causes of neonatal mortality, according to the neonatal age period, in Baghdad during 2016 & 2017. Data source: New Neonatal death statistics form.

		Early			Late	
Death cause	Count	(%)	Rank	Count	(%)	Rank
ARDS	2874	51.9	1	370	18.58	2
CA	775	13.99	2	206	16.77	3
Sepsis	498	8.99	3	186	33.36	1
Birth asphyxia	434	7.84	4	82	1.71	8
Short gestation	380	6.86	5	67	6.04	5
LBW	287	5.18	6	37	3.34	6
Neonatal jaundice	73	1.32	7	21	1.62	9
Cong. Pneumonia	51	0.92	8	19	7.39	4
Renal failure	15	0.27	9	18	1.89	7
Diaphragmatic hernia Hydrocephephalus	14	0.25	10	11	0.99	10
Others	137	2.47	11	92	8.3	11
Total	5538	100		1109	100	

Table 2: Distribution of the neonatal outcome according the gestational age, among the NICU admissions only, in Baghdad during 2016 & 2017. Data source: Consolidated register of N.D "Born".

Gest. Age	Alive (%)	Dead (%)	Total (%)	ND/1000	
Preterm (<37) wks.	14496 (87.04)	2159 (12.96)	16655 (100)	129.63	X2=328.1813 P-value<0.00001 DF= 1
Term (37-41 wks.)	12386 (93.40)	875 (6.60)	13261 (100)	65.98	
Post-term (>41)wks.	3 (100)	0 (0)	3 (100)	0	
Total	26885	3034	29919	101.41	

Table 3: Distribution of the neonatal outcome according the gender among the NICU admissions only, in Baghdad during 2016 & 2017. Data source: Consolidated register of N.D "Born".

Sex	Alive (%)	Dead (%)	Total (%)	ND/ 1000	
Male	16278 (90.27)	1754 (9.73)	18032 (100)	97.27	X^2 = 7.643 P-value = 0.006 DF =1
Female	10602 (89.29)	1272 (10.71)	11874 (100)	107.12	
Unclassified	5 (38.46)	8 (61.54)	13 (100)	615.38	
Total	26885 (89.86)	3034 (10.14)	29919 (100)	101.41	

Table 4: Distribution of the neonatal outcome according the birth weight, among the NICU admissions only, in Baghdad during 2016 & 2017. Data source: Consolidated register of N.D "Born".

Birth weight	Alive (%)	Dead (%)	Total (%)	ND/1000	
Extremely LBW (<1000g)	79 (23.44)	258 (76.56)	337 (100)	765.58	X^2 = 3444.1571 P-value < 0.00001 DF= 4
Very LBW (1000-1499g)	692 (58.89)	483 (41.11)	1175 (100)	411.06	
LBW (1500-2499g)	6075 (85.41)	1038 (14.59)	7113 (100)	145.93	
Normal BW (2500-4000g)	19457 (94.12)	1216 (5.88)	20673 (100)	58.82	
Macrosomia (>4000g)	582 (93.72)	39 (6.28)	621 (100)	62.8	
Total	26885 (89.86)	3034 (10.14)	29919 (100)	101.41	

Table 5: Distribution of the neonatal outcome according the mode of delivery among the NICU admissions only, in Baghdad during 2016 & 2017. Data source: Consolidated register of N.D "Born".

Mode	Alive (%0	Dead (%)	Total (%)	ND /1000 LB.	
CS	16079 (91.07)	1577 (8.93)	17656 (59%)	89.32 (1000)	X^2 = 69.0869 P-value<0.00001 DF = 1
VD	10806 (88.12)	1457 (11.88)	12263 (40.98)	118.81 (1000)	
Total	26885 (89.86)	3034 (10.14)	29919 (100)	101.41 (1000)	

Table 6: Distribution of the neonatal outcome according to the maternal age, among the NICU admissions only, in Baghdad during 2016 & 2017. Data source: Consolidated N.D register "Born".

Maternal age	Alive (%)	Dead (%)	Total (%)	ND/ 1000	
11-20 years	5296 (89.82)	600 (10.18)	5896 (100)	101.76	$X^2 = 39.6788$ P-value<0.00001 DF = 2
21-30 years	17322 (90.49)	1821 (9.51)	19143 (100)	95.13	
31> years	4267 (87.44)	613 (12.56)	4880 (100)	125.61	
Total	26885 (89.86)	3034 (10.14)	29919 (100)	101.41	

DISCUSSION:

In 2014, death rates decline accompanied by gradual increment, expressed by the eastern region's lowest mortality figure due to lowest registration within Maysan governorate during 2014 and 2015 caused by non-issuing of death certificates for in many instances. Subsequent years' higher rate could be explained by adopting new registration forms, which included those without death certificates. The increase after 2014 could be explained by weakening of the health services with excess admissions, as mentioned by Bash SS in a Baghdad study in 2018, which found a 4 folds increase in admissions' deaths in 2016 compared to 2012 [15], and was attributed to large internal people migration(s) after 2014. The resultant poor/absent ANC, poor nutrition and highly stressful situations culminated into considerable increase of prematurity and LBW, as Darweesh A explained [16]. Lafta R et al. Demonstrated that health systems were severely debilitated as a result of combats and battles [15-17]. Northern region's low mortality rate might be due to local conflicts and wars, with breakdown of health services infrastructure causing less-than-optimal vital statistical registration. A gradual increase in the mortality rate within middle region during 2013-2017 could be explained by partial population displacements posterior to terrorists' invasion, with higher neonatal births within their parents' new residence resulting in registered N.D inflation, plus the lessened N.D registrations secondary to military activities with health infrastructure breakdown. ARDS was the single most common cause of N.D deaths. This disagreed with a study performed by Debelew GT et al. who described birth asphyxia, prematurity or infections as most common causes [18], but agreed with another study performed by Azize PM et al. in Kurdistan [19]. A proposed explanation was incorrect documenting, coding and/or under-reporting. Neonatal infections/sepsis encompassed most of late deaths with variable relative contributions, such phenomenon was explained by Oza S et al. in relation to death age, the country-specific death rate and variation throughout time [20]. Chemicals, depleted Uranium exposure during wars was suggested by Al-Azzawi SN as the culprit of increased CA [21]; also, it could be due to mislabeling birth asphyxia as ARDS, misclassification of preterm neonates as being term for medico-legal motives. Death rate for the preterm neonates was double that for term, and it's expected as neonates born prior to reaching the term pregnancy suffer from worse prognosis, as depicted by Haroon A. et al. [22]. Gender-related N.D showed mixed figures: a higher proportion of the males contributing to the total N.D, which agreed with Weng YH et al., who showed males to be more susceptible to unfavorable outcome including death [23], while showing a slightly lower category-specific deaths proportions; possible explanation includes: dilution effect caused by the higher number of male L.B, gender discrimination favoring motivation for the parents to treat their newborns, preterm males who were mistaken as abortions, as males have more death liability than females when born prematurely, which was described by O'Driscoll DN et al. [24]. The highest rate was noticed within the extremely LBW neonates, and agreed with existing literature by Tsai LY et al. [25]. Similarly, higher death proportions seen in Macrosomia category in comparison to the normal birth weight: it appeared that increasing the birth weight above the upper normal limit was associated with increased risk of poor maternal and neonatal outcome, which is agreed on by Said AS et al. [26]. While vaginal delivery showed slightly more category-specific

deaths, CS showed a higher total deaths proportion, a finding agreed with the assumption that operative delivery is more favorable for the fetus, while a recent study by Prado DS et al. disagreed [27], and others like Blue NR et al. found the vaginal delivery to decrease ARDS while CS delivery was associated with elevated risk of ARDS [28]. It appeared that birth mode per se can't be empirically used for predicting N.D, as many potential confounding factors must be controlled, and clinical decision of birth mode should be taken as per individual bases weighing the benefits and risks for both the mother and her newborn. The death proportions elevated with increasing maternal age; it was expected as pregnant older women represent a risk group for consequent possible adverse events / outcome, and the same applies for pregnancy within the adolescent age group, depicted by Donoso E. et al. [29]. However, though study did found higher adverse maternal and neonatal outcomes among the pregnant older (especially nulliparous) than younger women, the mortality figure wasn't higher; which could be explained by Schimmel MS et al. to be a result of sufficient antenatal care [30].

CONCLUSION:

NMR declined in 2014, followed by a gradual incline due to increased registration. Military operations increased CA, and terrorists' invasion caused health infrastructure breakdown, adversely affecting registration data and deaths inflation. The most common cause of early deaths was ARDs, CA and sepsis, and for late deaths: sepsis, ARDS and CA. The preterm deaths were twice that of the term. Male neonates showed more NICU admissions and lower survival. Most deaths were among those with extremely low birth weight. Category-specific deaths of those vaginally born were higher, while operative deliveries made up a higher contribution to the total deaths. Deaths were lowest within the third decade of maternal age, increasing or decreasing maternal age increased death rate. It is recommended to Improve the registration system, with additional variables inclusion, & strengthening care during birth and postpartum.

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