Mortality Associated Factors in VLBW Preterm Newborns between 2002-2011 in a Peruvian Hospital

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Abstract: *Objective*: Describe the trend in mortality and identify risk factors for diminished survival in preterm very low birth infants (VLBW) born at the Hospital Nacional Cayetano Heredia (HNCH) between 2002 and 2011.

Methods: Retrospective cohort that includes 549 VLBW babies born at the HNCH registered on a database created for a multicentric network between 2002 and 2011. The chi-square test was used to determine associated factors with mortality ($p<0.05$). Survival analysis was performed using the Kaplan-Meier curves with primary outcome being death during hospital stay. Log rank test and Wilcoxon test were then applied to these curves. A multivariate analysis using the Cox Model was performed.

Results: Overall mortality rate was 40.80%, 60.71% of which was attributed to early mortality and 39.29% to late mortality. Associated factors were gestational age (HR: 0.85; IC 95%: 0.18-0.90; $p<0.0001$), prenatal steroids (HR: 1.46; IC 95% 1.09-1.95; $p< 0.011$), neonatal resuscitation (HR: 1.50; IC 95% 1.06-2.13; $p<0.021$), early sepsis (HR: 1.52; IC 95%: 1.01-2.28; $p<0.043$), respiratory distress syndrome (RDS) (HR: 8.47; IC 95%: 3.50-20.46; $p<0.0001$) and CPAP (continuous positive airway pressure) (HR: 0.25; IC 95%: 0.18-0.34; $p<0.0001$). Factors associated with neonatal survival were gestational age, neonatal resuscitation, early sepsis, RDS and CPAP.

Conclusion: Mortality in VLBW infants has declined considerably in this Peruvian hospital in the 2002-2011 period. The risk factor with the highest association to mortality in this population was RDS.

Keywords: Mortality, neonate, newborn, premature, survival, very low birth weight.

1. INTRODUCTION

Neonatal mortality represents approximately 35-40% of mortality in infants and children under 5 years of age. The greatest risk for these newborns occurs during the first weeks of life, and even more so for babies born with low weight. This makes neonatal mortality and the associated factors important indicators of health care [1]. When comparing various countries with different development indexes there are great variations in mortality rates [2]. Japan has a rate of one newborn death per one-thousand live births, while Somalia presents a rate of 51 deaths per one-thousand live births [3]. In South America, Chile and Brazil have rates of 5 and 6 deaths per one-thousand live births, respectively. Different from that, the Ministry of Health in Peru states a rate of 9 deaths per one-thousand live births [3].

While it is common knowledge that neonatal mortality is multifactorial, it is also known that there is a greater risk in very-low-birth-weight (VLBW) preterm newborns [4]. Some series consider VLBW infants to comprise only 1.5% of all live births, but more importantly, their mortality represents around 50% of infant deaths and one third of newborn mortality. A study conducted in Peru by Un Jan, collected data from the years 2000 to 2002 in a tertiary hospital and reported a mortality of 36.5% for VLBW newborns [4]. In this population, mortality can also be described as early or late. This differentiation partially helps underscore the significance of different factors affecting mortality at different times (early Vs late). Risk factors associated with early mortality are most often related to prenatal conditions, while late mortality is more often affected by postnatal conditions and NICU management [5-9].

There are multiple studies that identify various factors associated with neonatal mortality in the preterm VLBW group, such as gestational age (GA) under 28weeks, absence of prenatal care, use of antenatal corticosteroids, sepsis, respiratory distress syndrome (RDS), use of CPAP, necrotizing enterocolitis (NEC), intraventricular hemorrhage (IVH), asphyxia and the need for cardiopulmonary resuscitation (CPR) [10-13]. In different scenarios, the factors with the strongest association vary, although

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birth weight remains the most important determining factor for survival [14-17]. In the NICU of the Hospital Nacional Cayetano Heredia (HNCH) in Lima, there is a perception of a decrease in mortality for this preterm newborn VLBW population, mimicking what has been observed in most of the world. The goal in this study is to describe the trends of mortality rates and survival curves in this group between the years 2002 and 2011 in this NICU. This study also looks for the associated risk factors for mortality in this population.

2. MATERIALS AND METHODS

This study is a retrospective cohort conducted in a tertiary hospital in Lima. The neonatal unit of this hospital is part of NEOCOSUR, a group of Latin American neonatal units that share information for research purposes. Since 2002, selected neonatologists from the neonatal unit at HNCH have been filling out a sheet created by NEOCOSUR for every live preterm baby born at this hospital weighing 1500gr or less. In these sheets, information on every event of the newborn's life is recorded until discharge or demise. This is the data used for this study.

The inclusion criteria were live newborns with VLBW born in the HNCH between the years 2002 and 2011. Newborns with ambiguous sex and congenital defects incompatible with life were excluded. This resulted in a total of 549 patients.

A review of the literature was used to initially identify candidate variables for mortality prediction. The ensuing 23 selected variables were codified and the data set interrogated. There were small deficiencies in information of some patients, resulting in no record of the following data: use or not of invasive mechanical ventilation in 18 patients, presence or not of late sepsis in 17 patients, presence or not of early sepsis in 4 patients, use or not of positive pressure ventilation in one patient and presence or not of respiratory distress syndrome in one patient.

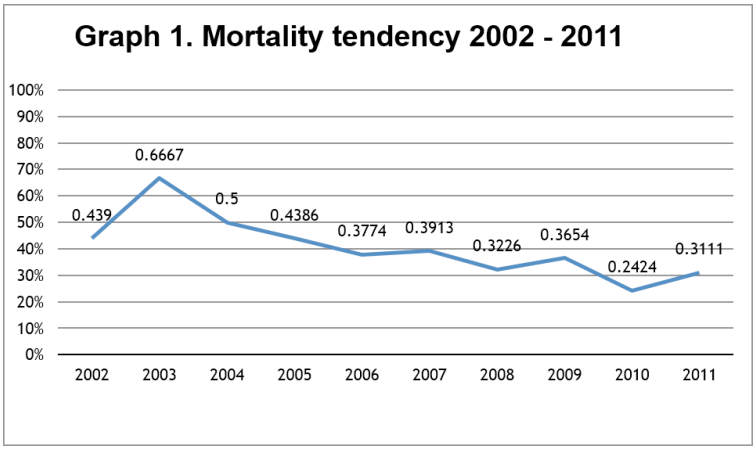
Survival was defined as discharging a live infant from the hospital. Early mortality, as defined by the WHO, is death during the first seven days of life, while late mortality occurs after the seventh day. Gestational age was determined by last menstrual period (LMP). When LMP was not available the Ballard method was used to define age. The 2013 Fenton curves for preterm newborns were applied to assess weight appropriate for gestational age for each patient. Use of antenatal corticosteroids was considered complete if the mother received either betamethasone 12mg IM q24h for 2 doses or dexamethasone 6mg IM q12h for 4 doses. If she received at least one dose, but not the complete treatment, it was considered incomplete use. Prenatal care was considered positive if the mother attended at least one appointment before presenting for birth. CPR was defined as receiving positive pressure ventilation, cardiac massage or epinephrine immediately after birth. Early onset sepsis was defined as clinical and/or culture-confirmed sepsis before 72hs of life. Late onset sepsis was defined as this occurring after 72hs of life. Severe NEC was determined by Bell stages II and III. Severe intraventricular hemorrhage was defined as stages III and IV by cranial ultrasound.

Table 1: Population Characteristics 2002-2011 n=549

Variable		n(%) or Mean ± SD or Median (IQR)	
Male		287	(52.3%)
Birth weight		1093.73gr ± 276.81	
	< 1000gr	210	(38.3%)
	≥ 1000	339	(61.8%)
Gestational age		30.05 ± 3.35	
	≤ 28weeks	126	(23.0%)
	28 a 32weeks	208	(37.9%)
	≥ 32weeks	215	(39.2%)
Intrauterine growth	Small	231	(42.1%)
	Appropriate	318	(57.9%)
Live		325	(59.2%)
Deceased		224	(40.8%)
	Early death	136	(24.8%)
	Late death	88	(16.0%)
Days of survival		28(5.48)	
Use of prenatal corticosteroids		285	(51.9%)
	Incomplete	128	(23.3%)
	Complete	157	(28.6%)
Prenatal care		342	(62.3%)
CPR		238	(43.4%)
RDS		429	(78.3%)
Early sepsis		47	(8.6%)
Late sepsis		255	(47.9%)
Severe NEC		49	(9.0%)
Severe IVH		70	(12.8%)
Days on mechanical ventilation		1(0.6)	
	< 3 days	346	(65.2%)
	3 a 7 days	65	(12.2%)
	> 7 days	120	(22.6%)
CPAP		315	(57.5%)

*SD: Standard Deviation.

IQR: Interquartile Range.



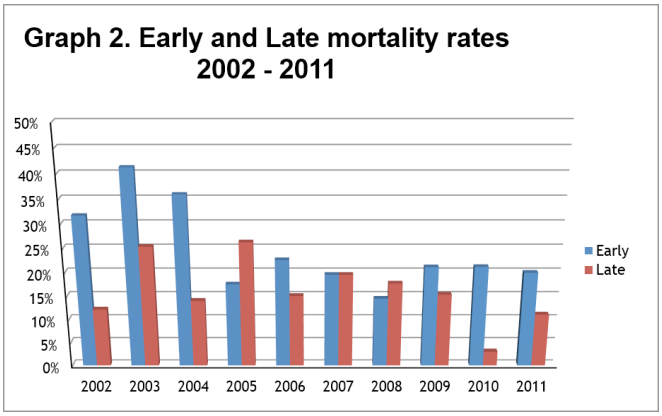
Graph 1: Trend of mortality rates of LBW newborns through the years studied.

The information was processed with STATA/SE 11 software. Univariate analysis was done using the chi-square test to determine associated factors with mortality (p<00.5). Kaplan-Meier curves were constructed with primary outcome being death during hospital stay to determine survival. Log rank test and Wilcoxon test were then applied to these curves confirming statistical relevance. Associations between each variable and mortality were assessed using the bivariate Cox model, after which the variables which showed significant association were analyzed with the multivariate model. This study was approved by the Ethics Committee of the Universidad Peruana Cayetano Heredia with inscription code 62538.

3. RESULTS

The population was comprised by 262 females and 287 males [see Table **1**]. Overall mortality resulted in 40.8%. Of these babies 60.71% died before the 7th day of life. The average survival time was of 35.27 ± 39.66 days, with a median of 28 (IQR: 5-48). The median gestational age was of 30.05 ± 3.35 weeks, and the median weight at birth was of 1092.73 ± 276.81gr.

Graph **1** demonstrates the fall in mortality during the period studied with a high value of 66.67% in 2003 and a great decline to 24.24% in 2010. In a similar way, Graph **2** describes the evolution of early and late mortality with their different frequencies, showing an overall decrease in time.



Graph 2: Differentiation of annual mortality between early and late.

Table **2** shows the significant results of the bivariate COX model applied to quantitative variables associated with survival. In the same way, Table **3** demonstrates the same process applied to categorical variables. Of these results, it is important to point out the lower survival of newborns appropriate for gestational age, compared to the small for gestational age.

Table 2: Variables Associated with Survival in Preterm VLBW Newborns from 2002-2011*

Quantitative Variables	Deceased	Survivors	HR	CI 95%	*p*
Gestational age	27.82 ± 2.88	31.58 ± 2.74	0.75	0.72 – 0.79	<0.000
Weight	934.93 ± 258.81	1201.49 ± 233.27	0.99	0.99 – 0.99	<0.001
Mechanical ventilation	7.87 ± 14.23	5.32 ± 13.62	0.99	0.99 – 1.00	0.77

* According to Cox bivariate model.

HR: Hazard Ratio.

CI: Confidence Interval.

Table 3: Variables Associated with Survival in Preterm VLBW Newborns from 2002-2011*

Categorical Variables		Deceased		Live		HR	CI 95%	*p*
		n	%	n	%			
Sex	Female	89	34.0	173	66.0	1.47	1.10–1.97	0.008
	Male	135	47.0	152	53.0			
Growth	AGA	178	56	140	44.0	0.32	0.23–0.45	<0.001
	SGA	46	20.0	185	80.1			
Use of Prenatal Corticosteroids	Yes	94	33.	191	67.0	1.75	1.31–2.32	<0.001
	No	130	49.2	134	50.8			
Complete Prenatal Corticosteroids	Yes	50	31.9	107	68.2	1.51	1.08–2.10	0.015
	No	174	44.4	218	55.6			
Prenatal Care	Yes	122	35.7	220	64.3	1.42	1.06–1.88	0.016
	No	102	49.3	105	50.7			
CPR	Yes	159	66.8	79	33.2	3.83	2.82–5.19	<0.001
	No	65	20.9	246	79.1			
Early Onset Sepsis	Yes	32	68.1	15	31.9	2.39	1.60–3.55	<0.001
	No	189	38.0	309	62.1			
RDS	Yes	209	48.7	220	51.3	10.31	4.57–23.27	<0.001
	No	14	11.8	105	88.2			
Severe IVH	Yes	50	71.4	20	28.6	2.12	1.53–2.93	<0.001
	No	174	36.3	305	63.7			
CPAP	Yes	93	29.5	222	70.5	0.38	0.28 – 0.50	<0.001
	No	130	55.8	103	44.2			

*According to Cox bivariate model.

HR: Hazard Ratio.

CI: Confidence interval.

Table 4: Variables Associated with Survival in Preterm VLBW Newborns from 2002-2011**

Variables	HR	CI 95%	*p*
Gestational Age	0.85	0.18–0.90	< 0.001
No Prenatal Corticosteroid Use	1.46	1.09–1.95	0.011
CPR	1.50	1.06–2.13	0.021
Early Sepsis	1.52	1.01–2.28	0.043
RDS	8.47	3.50–20.46	< 0.001
CPAP	0.25	0.18–0.34	< 0.001

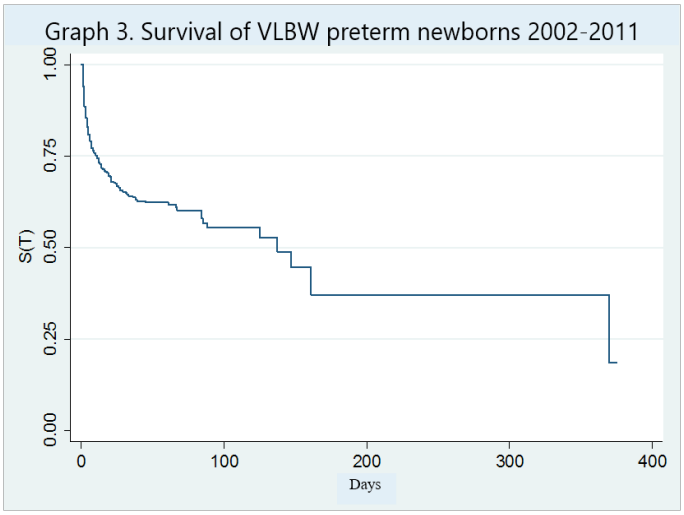
**According to Cox multivariate model.

HR: Hazard Ratio.

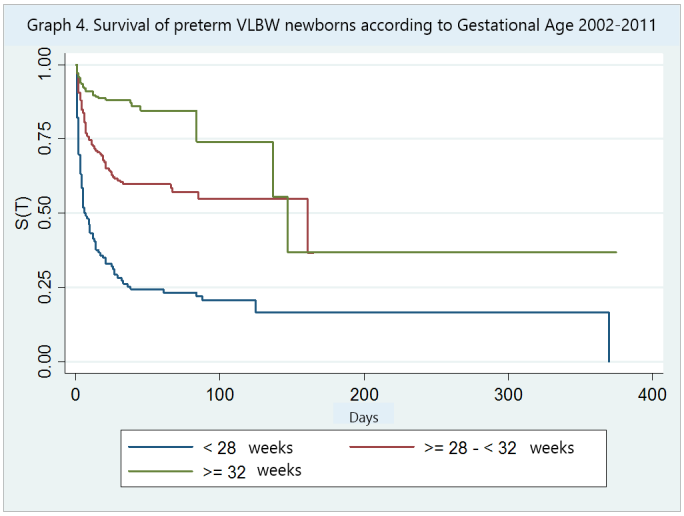
CI: Confidence interval.

The last analysis was done using a multivariate COX model, applied to those variables that resulted significant ($p<0.05$) during the bivariate analysis. These results are shown in Table **4**.

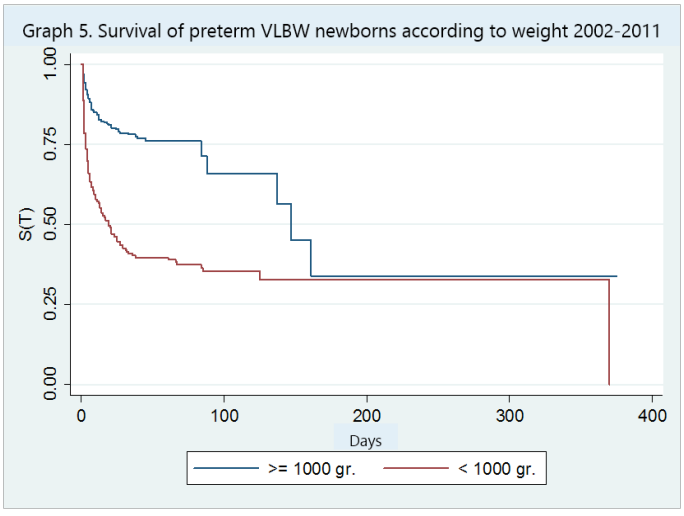
After all the analysis, Kaplan-Meier graphs were constructed to show the associations of survival with the different variables such as GA, weight and growth assessment. These are shown in graphs **3** to **6**.



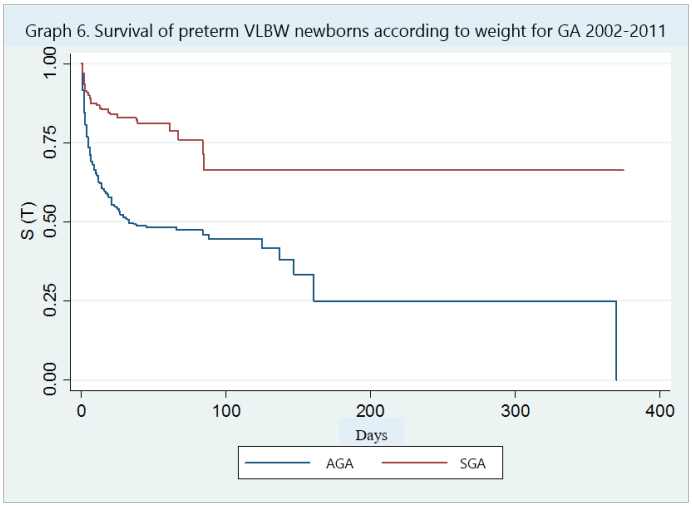
Graph 3: Survival curve determined by days lived.



Graph 4: Survival curves distinguishing by gestational age at birth.



Graph 5: Survival curves determined by birth weight.



Graph 6: Survival curves differentiation AGA from SGA.

4. DISCUSSION

According to the literature, mortality in the VLBW newborns is very variable [18, 19]. This variation goes along with the multifactorial etiology of mortality, in which the socioeconomic and technologic development of the country and hospital plays an important part [2, 18]. Keeping in mind that the study is set in a developing country, our mortality rate is comparable to others in this setting, like Nepal and India with a 39.5% and 36.9% mortality of VLBW newborns, respectively [16, 21]. In a similar way, our early mortality rate of 60.7% is close to those reported in Ethiopia around 70% [22], and as expected, far away from that reported in developed countries like Sweden with a 9.4% rate [9].

When observing the trend in mortality rate between 2002 and 2011, a general decrease is evident. A similar change has been reported all over the world in different settings, and it is usually attributed to the implementation of better technology and improvement in protocols, adhering to newer practices presented in the literature, such as the use of CPAP and antenatal corticosteroid use. Another important change in the HNCH rate has been an increase in medical and nursing staff in the unit, which may also account for a better care of these babies. Although the changes in staff and technology were out of the scope of this study, it would be interesting to see if this is truly significant for the decline in rates. Finally, there has been an increase in awareness of the importance of prenatal care, both by the population and the Peruvian government, which has resulted in better care of the prenatal period.

An interesting result obtained in this study is that in the univariate analysis, survival is better in SGA compared with the AGA infants, which is not commonly reported [24]. This can be explained by the fact that while at a given gestational age, SGA infants may do far worse than their AGA counterparts, at similar weights an older and more mature SGA baby may have a survival advantage. Indeed, in the multivariate analysis gestational age but not growth status is a significant predictor of survival.

The survival analysis shows that it decreases drastically in the first days of life, with 39% of all deaths occurring the first 3 days. It also shows that these newborns have a 71.6% chance of surviving the tenth day of life. Something similar is reported in the United States, where day by day survival curves show that the biggest drop is during the first 3 days of life [26]. This goes in accordance with the high early mortality rate in this population of babies, who typically present with RDS and early sepsis [25]. In a study done with a smaller population in a different tertiary hospital of Peru survival rates are nearly 50% by the third day of life, compared with an 80.8% shown in this study [4]. This may be explained by the higher need of CPR and the rate of neonatal asphyxia presented in the previous study, both of which are risk factors for early mortality.

The survival curves in relation to different variables show that there is a strong decrease in survival for babies born with less than 1000gr. This is similar to what is described in the literature, and can be attributed to the higher rate of pathologies present in this group that influence early mortality. This group is also very fragile, requiring very experienced hands in airway,

access and nutrition management. Some of these patients were previously thought not to have a good enough chance at surviving and were not resuscitated, for which our experience with them is less than with bigger babies. After 100 days, the survival chance is almost birth weight independent [26]. In the same way, when gestational age is grouped in older than 32, 32-28 and under 28 weeks, there is a drastic fall of survival close to 50% in the first days of the youngest group, most likely for similar reasons than the lower weight group.

When the multivariate analysis was done, there were five variables found to be significantly associated with newborn survival. As expected, a higher gestational age was a protective factor. Tagare *et al*. found that newborns of under 28 weeks GA presented a shorter survival, coinciding with this study and many others [9, 33-36].

The second apparent protective factor identified was the use of CPAP. Most of our population presented respiratory distress of variable intensity, requiring some kind of ventilatory support. Taking this into account, if the newborn received CPAP instead of mechanical ventilation understood as intubation, we could assume that they were identified sooner or had mild to moderate grade of distress. Early use of CPAP has been recognized as a potentially beneficial treatment in RDS. Recently there have been studies that compared CPAP to prophylactic surfactant use in newborns to avoid RDS. Some of these studies concluded that CPAP presented better outcomes, avoiding unnecessary intubations to apply surfactant [33-35].

The three remaining variables were associated with a lower survival rate. The strongest morbidity was RDS. Other studies present the same conclusion and some authors even find it to be the number one cause for mortality in newborns [25, 31, 32]. This means that RDS is the number one somewhat preventable cause of low survival in our population, demanding our immediate attention to improve outcomes in our NICU.

The next associated variable was requiring CPR after birth. We can understand from this that those newborns who required CPR most probably were born with a disadvantage that predisposed them to a low chance of survival [25, 28, 30].

Finally, the diagnosis of early sepsis was negatively associated with survival. The same result was described in many studies, associating both probable and confirmed sepsis as a mortality risk factor [21, 27].

This study was conducted as a retrospective view of predefined data, and hence the authors were unable to modify the definitions for each variable. This data was standardized and constantly recollected throughout the years, providing trustworthy information of easy access. This allowed for analysis of a large sized population and obtaining relevant results for the practice of neonatology in our country, where we often rely on international information from locations with different resources and populations, given that we rarely have accurate, large volume studies based here.

CONCLUSION

In conclusion, most countries, including ours, report a decline in newborn mortality in the last decades. This decline coincides with changes in management and availability of resources, the increase in prenatal care and use of prenatal corticosteroids, the frequent use of CPAP, and the improvements in management of sepsis and RDS (9). These improvements in neonatal care have most probably contributed greatly to our decline in mortality of this group of very low birth weight newborns. With this in mind, we suggest a new study that provides data on the changes in number and quality of staff and technology in the neonatal unit of the HNCH and compare them with these results, to define which adjustments have helped the most to decrease mortality and where there is still room for improvement.

ABBREVIATIONS

VLBW (Very low birth weight), HNCH (Hospital Nacional Cayetano Heredia), NICU (Neonatal Intensive Care Unit), GA (Gestational Age), RDS (Respiratory Distress Syndrome), CPAP (Continued Positive Airway Pressure), NEC (Necrotizing Enterocolitis), IVH (Intraventricular Hemorrhage), CPR (Cardiopulmonary Resuscitation), LMP (Last Menstrual Period), SD (Standard Deviation), HR (Hazard Ratio), CI (Confidence Interval).

FINANCIAL DISCLOSURE

The authors have indicated they have no financial relationships relevant to this article to disclose.

DECLARATION OF INTEREST

The authors have indicated they have no potential conflict or declaration of interest to disclose.

REFERENCES

[1] WHO. Cuenta Regresiva 2015: Supervivencia materna, neonatal e infantil. WHO webpage. Available at: http://www.who.int/topics/millennium_development_goals/child_mortality/Countdown_2010_es.pdf (Cited: 11-11-11)

[2] Tetsuya I, Shoo KL, Rintaro M, Satoshi K, Masanori F, Xiang YY, et al. Canadian Neonatal Network, Neonatal Reasearch Network of Japan. Comparison of mortality and morbidity of very low birth weight infants between Canada and Japan. Pediatrics 2012; 130(4): e957-65. https://doi.org/10.1542/peds.2012-0336

[3] WHO. Estadísticas Sanitarias Mundiales 2011. WHO webpage 2011. Available at: http://www.who.int/whosis/whostat/ES_WHS2011_FullPDF (Cited: 11-11-11)

[4] Un-Jan R. Sobrevivencia del recién nacido menor de 1500g y factores que lo afectan en el Servicio de Neonatología - Hospital Nacional Guillermo Almenara Irigoyen - A-os 2000 a 2002. Revista Peruana de Pediatría. 2005.

[5] Lawoyin TO, Onadeko MO and Asekun-Olarimoye EO. Neonatal mortality and perinatal risk factors in rural southwestern Nigeria: a community-based prospective study. West African Journal of Medicine 2010; 29(1): 19-23 https://doi.org/10.4314/wajm.v29i1.56183

[6] Bezzaoucha A, El Kebboub A and Aliche A. Evolution of neonatal mortality at the Blida university Teaching Hospital (Algeria) between 1999 and 2006. Bulletin de la Societe de Pathologie Exotique 2010; 103(1): 29-3. https://doi.org/10.1007/s13149-009-0001-z

[7] Salameh K, Rahman S, Al-Rifai H, Masoud A, Lutfi S, Abdouh G, et al. An analytic study of the trends in perinatal and neonatal mortality rates in the State of Watar over a 30-year period (1977 to 2007): a comparative study with regional and developed countries. Journal of Perinatology 2009; 29(11): 765-70. https://doi.org/10.1038/jp.2009.89

[8] Ronsmans C, Chowdhury ME, Alam N, Koblinsky M and El Arifeen S. Trends in stillbirths, early and late neonatal mortality in rural Bangladesh: the role of public health interventions. Paediatric Perinatal Epidemiology 2008; 22(3): 269-79. https://doi.org/10.1111/j.1365-3016.2008.00939.x

[9] Rüegger C, Hegglin M, Adams M and Bucher HU. Swiss Neonatal Network. Population based trends in mortality, morbidity and treatment for very preterm- and very low birth weight infants over 12 years. BMC Pediatr 2012; 12: 17. https://doi.org/10.1186/1471-2431-12-17

[10] Garcia CR and Mullany LC. Breast-feeding initiation time and neonatal mortality risk among newborns in South India. Journal of Perinatology 2011; 31(6): 397-403. https://doi.org/10.1038/jp.2010.138

[11] Vahabi S, Haidari M, Akbari Torkamani S and Gorbani Vaghei A. New assessment of relationship between Apgar score and early neonatal mortality. Minerva Pediatrics 2010; 62(3): 249-52.

[12] Ben Hamida Nouaili E, Chaouachi S, Ben Said A and Marrakchi Z. Determinants of neonatal mortality in Tunisian population. Tunis Med 2010; 88(1): 42-5.

[13] Gray RH, Ferraz EM, Amorim MS and de Melo LF. Levels and determinants of early neonatal mortality in Natal, northeastern Brazil: results of a surveillance and case-control study. International Journal of Epidemiol 1991; 20(2): 467-73. https://doi.org/10.1093/ije/20.2.467

[14] Ballot DE, Chirwa TF and Cooper PA. Determinants of survival in very low birth weight neonates in a public sector hospital in Johannesburg. BMC Pediatr 2010; 10: 30. https://doi.org/10.1186/1471-2431-10-30

[15] Tomé T, Guimarães H, Bettencourt A and Peixoto JC. Neonatal morbi-mortality in very low birth weight in Europe: The Portuguese experience. J Matern Fetal Neonatal Med 2009; 22(3): 85-7. https://doi.org/10.1080/14767050903199288

[16] Basu S, Rathore P and Bhatia BD. Predictors of mortality in very low birth weight neonates in India. Singapore Med J 2008; 49(7): 556-60.

[17] Gooden M, Younger N and Trotman H. What is the best predictor of mortality in a very low birth weiht infant population with a high mortality rate in a medical setting with limited resources?. Am J Perinatol 2014; 31(6): 441-6. https://doi.org/10.1055/s-0033-1351658

[18] Kasirye-Bainda E and Musoke FN. Neonatal morbidity and mortality at Kenyatta National Hospital newborn unit. East Afr Med J 1992; 69(7): 360-5.

[19] Rocha G and Guimaraes H. On The Limit Of Viability Extremely Low Gestational Age at Birth. Acta Med Port 2011; 24(S2): 181-188.

[20] Omoigberale A, Sadoh W and Nwaneri D. A 4 year review of neonatal outcome at the University of Benin Teaching Hospital, Benin City. Niger J Clin Pract 2010; 13(3): 321.

[21] Shrestha S, Dangol S, Shrestha M and Shrestha R. Outcome of preterm babies and associated risk factors in a hospital. JNMA J Nepal Med Assoc 2010; 50(180): 286-90.

[22] Gizaw et al. Trends and risk factors for neonatal mortality in Butajira District, South Central Ethiopia, (1987-2008): a prospective cohort study. BMC Pregnancy and Childbirth 2014; 14: 64. https://doi.org/10.1186/1471-2393-14-64

[23] Eichenwald E and Stark A. Management and Outcomes of Very Low Birth Weight. N Engl J Med 2008; 358: 1700-11. https://doi.org/10.1056/NEJMra0707601

[24] Giapros V, Drougia A, Krallis N, Theocaris P and Andronikou S. Morbidity and mortality patterns in small-for-gestational age infants born preterm. J Matern Fetal Neonatal Med 2012; 25(2): 153-7. Epub 2011 Apr 4. https://doi.org/10.3109/14767058.2011.565837

[25] Sritipsukho S, Suarod T and Sritipsukho P. Survival and outcome of very low birth infants born in a university hospital with level II NICU. J Med Assoc Thai 2007; 90(7): 1323-9.

[26] Mohamed MA, Nada A and Aly H. Day-by-day postnatal survival in very low birth weight infants. Pediatrics 2010; 126(2): e360-6. https://doi.org/10.1542/peds.2009-2810

[27] Tagare A, Chaudhari S, Kadam S, Vaidya U, Pandit A and Sayyad MG. Mortality and morbidity in extremely low birth weight (EBLW) infants in a neonatal intensive care unit. Indian J Pediatrics 2013; 80(1): 16-20. https://doi.org/10.1007/s12098-012-0818-5

[28] Nayeri F, Dalili H, Nili F, Amini E, Ardehali A, Khoshokrood Mansoori B, et al. Risk factors for neonatal mortality among very low birth weight neonates. Acta Med Iran 2013: 51(5): 297-302.

[29] De Almeida MF, Alencar GP, Schoeps D, Novaes HM, Campbell O and Rodrigues LC. Survival and risk factors for neonatal mortality in a cohort of very low birth weight infants in the southern region of Sao Paulo city, Brazil. Cad Saude Publica. 2011; 27(6): 1088-98. Portuguese.

[30] Terzic S and Heljic S. Assessing mortality risk in very low birth weight infants. Med Arh 2012; 66(2): 76-9. https://doi.org/10.5455/medarh.2012.66.76-79

[31] Navaei F, Aliabady B, Moghtaderi J, Moghtaderi M and Kelishadi R. Early outcome of preterm infant with birth weight of 1500g or less and gestational age of 30 weeks or less in Isfahan city, Iran. World J Pediatr 2010; 6(3): 228-32. https://doi.org/10.1007/s12519-010-0204-1

[32] Almeida MF, Guinsburg R, Martinez FE, Procianoy RS, Leone CR, Marba ST, et al. Perinatal factors associated with early deaths of preterm infants born in Brazilian Network on

Neonatal Research centers. J Pediatr (Rio J) 2008; 84(4): 300-7.

[33] López Maestro M, Pallás Alonso CR, Mu-oz Labián MC, Barrio Andrés MC, Medina López C and de la Cruz Bértolo J. The use of the continuous positive airway pressure for early stabilization in very low birth weight infants. An Pediatr (Barc) Spanish 2006; 64(5): 422-7. https://doi.org/10.1157/13087868

[34] Rojas-Reyes MX, Morley CJ and Soll R. Prophylactic versus selective use of surfactant in preventing morbidity and mortality in preterm infants. Cochrane Database Sys Rev 2012; 3: CD000510. https://doi.org/10.1002/14651858.cd000510.pub2

[35] Vidyasagar D, Velaphi S and Bhat VB. Surfactant replacement therapy in devolping countries. Neonatology 2011; 99(4): 355-66. https://doi.org/10.1159/000326628

[36] Manktelow BN, Lal MK, Field DJ and Sinha SK. Antenatal corticosteroids and neonatal outcomes according to gestational age: a cohort study. Arch Dis Child Fetal Neonatal Ed 2010; 95(2): F95-8. https://doi.org/10.1136/adc.2009.170340

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