Factors associated with neonatal deaths at Arthur Davidson Children's Hospital Ndola Zambia

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ABSTRACT

Background: Neonatal mortality has been a public health concern for a long time and remains relatively unchanged especially in developing countries. In Zambia, 34% of all under-five deaths occur in the neonatal period. **Methods**: The study was designed as a comparison of cases and controls – new-born children who died before the age of 28 days and those who survived (treated) beyond 28 days respectively. Data was extracted from the 2014 and 2015 summary reports from the HMIS at Arthur Davison's Children Hospital in Ndola Zambia. A multivariate logistic regression model was built through a back-wards step process to determine the factors associated with neonatal deaths.**Results**: A total of 1,534 records were extracted from the 2015 HMIS and 924 from the 2014 HMIS. Out of the total, 1,272 were treated whilst 262 died in 2015 and 726 were treated and 198 died in 2014. In 2015, infections caused less neonatal deaths than prematurity (AOR=0.29, CI 95% (0.21, 0.38)). In 2014, the sex of a child was significantly associated with surviving the first week of life; females were less likely to die than males (AOR= 0.62, CI 95 %(0.44, 0.89)). Also in 2014, infections caused less neonatal deaths than prematurity (AOR=0.25, CI 95% (0.18, 0.36)).**Conclusion and recommendations**: This study revealed that factors associated with neonatal mortality include cause of death and sex. The sex of a neonate was significantly associated with surviving the first week of life. Further classification of cause of death would be beneficial in policy formulation.

Key words: Cause of death, Factors, Neonatal mortality, Prevalence, Zambia.

Introduction

The neonatal period which is the first 28 days of life is the most vulnerable time for a child's survival. According to UNICEF, the worldwide neonatal mortality is decreasing and the rate fell by 47% between 1990 and 2015 from 36 to 19 deaths per 1000 live births. Over the same period, the number of newborn babies who died within the first 28 days of life declined from 5.1 million to 2.7 million[1]. Neonatal mortality is an ongoing worldwide public health concern hence the number of interventions worldwide to bring it down. According to Lawn J.E, neonatal mortality rate is defined as the number of neonatal deaths (deaths in the first 28 days of life) per 1,000 live births. Early neonatal deaths are those that occur within the first week of life (day 0 to 6.9). Late neonatal deaths are deaths occurring between the second and fourth week, i.e. from 7 to 28 days [2]. The American Heritage Medical Dictionary defines neonatal mortality as the ratio of the number of deaths in the first 28 days of life to the number of live births occurring in the same population during the same period of time [3]. Neonatal mortality has been a public health concern for a long time. It remains relatively unchanged especially in developing countries. According to a study by Ayaz A et al. almost all neonatal deaths (99%) occur in developing countries, where the majority of babies are delivered at homes. In the same study, it is stated that evidence suggests that these deaths could be prevented by simple, inexpensive practices and interventions during pregnancy, delivery and postnatal period [4].Neonatal mortality rate is an ongoing problem in the Republic of Zambia as is the case in the rest of the world. Zambia as of 2015 had

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achieved Millennium Development Goals (MDGs) 2 and 6 but unfortunately not MDG 4 [5]. Neonatal mortality rate has declined over the years from about 34 per 1000 in 2007 to 27.40 per 1000 in 2011 [6]. Despite this decline the number is still high and unacceptable therefore this study will look at the prevalence rate of neonatal deaths and the factors associated with neonatal deaths at Arthur Davidson Children's Hospital in Ndola.Three-quarters of neonatal deaths occur in the first week and more than one-quarter occur in the first 24 hours [7]. Lloyd L. G. et al, further states that the highest rates are in sub-Sahara Africa, where little progress has been made in the last 15 years towards reducing the number of deaths [8].In a study carried out by Imitaz J. et al, to evaluate the prevalence, sex distribution and causes of neonatal mortality, as well as its risk factors, in an urban Pakistani population with access to obstetric and neonatal care, the following results were obtained; Birth outcomes were ascertained for 1,280 (94%) of the 1,369 women enrolled. The 28-day neonatal mortality rate was 47.3 per 1,000 live births. Preterm birth, Caesarean section and intra-partum complications were associated with neonatal death. Final causes were classified as immaturity-related (26%), birth asphyxia or hypoxia (26%) and infection (23%) [9].According to Macwan'gi M. et al 2008, under 5 mortality rate in Zambia has had periods of improvement and regression and is currently estimated at 119 deaths per 1,000 live births. Thirty four percent (34%) of all deaths among under five children occur in the neonatal period (0-28days); while 48% occur in the post neonatal period and more than half of neonates (53%) die within the first week of their life [10].The aim of this research was to determine the prevalence and factors associated with neonatal deaths at Arthur Davidson's Children's Hospital in Ndola.

Materials and methods

Study population, setting and design

The targeted population was all children aged from 0 to 28 days at Arthur Davidson's Children's Hospital in Ndola. The setting involved a secondary analysis of the data records from the Health Management Information System (HMIS) at the children's hospital. The study was designed as a comparison of cases and controls – new-born children who died before the age of 28 days and those who survived (treated) beyond 28 days respectively.

Sample size

The sample size included allrecords for the children aged 0 to 28 days recorded in the HMIS at the children's hospital in the period 1st January 2014 to 31st December for the years 2014 and 2015.

Data material, collection tool and management

Data materials were the HMIS summary reports for the years 2014 and 2015. The data collection tool was a data extraction code written in SAS ® 9.2 (SAS Institute Inc., Cary, NC 27513-2414, USA). The code was designed to extract the data for new-children aged up to 28 days on their age, sex, infections and maturity as recorded in the HMIS.

Statistical analysis

Frequency and percentage distributions were produced to describe the factors assessed for the infants. A multivariate logistic regression model was built through a back-wards step process to determine the factors associated with neonatal deaths. Building of the model was done by first bivariate contingency tables, on which significance of associations were assessed using Pearson's chi square tests for independence. All the factors extracted from the HMIS were included in the bivariate analysis and those found significant at 10% level of significance were then included in the multivariate logistic regression model. Factors that yielded a p value less than or equal to 0.05 in the model were considered significant.

Ethical considerations

Permission to conduct the study at Arthur Davidson's Children's Hospital was obtained from management of the health facility, and ethical clearance of the study was obtained from the Ethical Review Committee (ERC) at Tropical Diseases Research Centre (TDRC).

Results

Factors associated with neonatal deaths at Arthur Davidson's Children's Hospital in the years 2014 and 2015 are shown in tables 1 and 2 respectively. A total of 1,534 records were extracted from the 2015 HMIS and 924 from the 2014 HMIS. Of these in 2015, 1,272 were treated whilst 262 died. In 2014, 726 were treated and 198 died.For the year 2015, most (76%) of the neonates were aged 0-7 days at either treatment or death. Likewise in 2014, the majority (76%) of neonates were aged 0-7 at either treatment or death. In 2015, the preponderance (52%) of neonates were males at either treatment or death. Similarly in 2014, most (73%) neonates were males at either treatment or death.The majority (56%) of neonates had infections at either death or treatment in 2015. In 2014, the greater number of neonates (70%) had infections at treatment or death.In 2015, most (56%) neonates were not premature at either death or treatment. Similarly in

2014, the majority (70%) of neonates were not premature at either death or treatment.

Table 1: Factors associated with neonatal deaths at Arthur Davidson's Children's Hospital in the years 2015 – Bivariate analysis

Factor	Total	Treated	Deaths	P-value
	N (%)	N (%)	N (%)	
Sex; male	796 (51.9)	668 (83.9)	128 (16.1)	
Female	738 (4.1)	604 (81.8)	134 (18.1)	0.2802
Total	1534 (100.0)	1272 (82.9)	262 (17.1)	
Age ; 0-7	1165 (75.9)	949 (81.5)	216 (18.5)	
8-28	369 (24.1)	323 (21.1)	46 (12.5)	0.0069
Total	1534 (100.0)	1272 (83.0)	262 (17.21)	
Infections; no	682 (44.5)	500 (73.3)	182 (26.7)	
yes	852 (55.5)	772 (90.6)	80 (9.4)	<.0001
Total	1534 (100.0)	1272 (83.0)	262 (17.1)	
Prematurity; no	852 (55.5)	772 (90.6)	80 (9.4)	
Yes	682 (44.5)	500 (73.3)	182 (26.7)	< .0001
Total	1534 (100.0)	1272 (83.0)	262 (17.1)	

Table 2: Factors associated with neonatal deaths at Arthur Davidson's Children's Hospital in the years 2014 – Bivariate analysis

Factor	Total	Treated	Deaths	P-value
	N (%)	N (%)	N (%)	
Sex; female	252	168 (66.7)	84 (33.3)	
male	672	558 (83.0)	114 (17.0)	< .0001
Total	924	726	198	
Age ; 0-7	706	552 (78.2)	154 (21.8)	
8-28	218	174 (79.8)	44 (20.2)	0.6083
Total	924	726	198	
Infections; no	281	167 (59.4)	114 (40.6)	
yes	643	559 (86.9)	84 (13.1)	< .0001
Total	924	726	198	
Prematurity; no	643	559 (86.9)	84 (13.1)	
yes	281	167 (59.4)	114 (40.6)	< .0001
Total	924	726	198	

Significant factors associated with neonatal deaths at Arthur Davidson's Children's Hospital in the years 2015 and 2014 are shown in tables 3 and 4. In 2015, infections caused less neonatal deaths than prematurity (AOR=0.29, CI 95% (0.21, 0.38)).In 2014, the sex of a child was significantly associated with surviving the first week of life; females were less likely to die than males (AOR= 0.62, CI 95 %(0.44, 0.89)). Also in 2014, infections caused less neonatal deaths than prematurity (AOR=0.25, CI95% (0.18, 0.36)).

Table 3: Factors associated with neonatal deaths at Arthur Davidson's Children's Hospital in the years 2015 – Multivariate logistic model

FACTOR	Adjusted Odds Ratio (95% Confidence limit)
CAUSE; Infections	0.29 (0.21, 0.38)
Prematurity	1

Table 4: Factors associated with neonatal deaths at Arthur Davidson's Children's Hospital in the years 2014 – Multivariate logistic model

FACTOR	Adjusted Odds Ratio (95% Confidence limit)
SEX; Female	0.62 (0.44, 0.89)
Male	1
CAUSE; Infections	0.25 (0.18, 0.36)
Prematurity	1

Discussion

This study offers important and useful information on the prevalence of neonatal deaths and factors associated with neonatal deaths at Arthur Davidson's Children's Hospital, a third level hospital catering to a wide population in the country of Zambia comprising North-Western, Luapula, Muchinga, Central and Copperbelt provinces. The information obtained from this study may be of use in policy setting to reduce neonatal mortality at ADCH. The prevalence of neonatal deaths in Zambia is estimated as 34 per 1,000 live births as of 2007 from the Zambia Demographic Health Survey [11]. The neonatal mortality rate estimated for Arthur Davidson's Children's Hospital in this research is 170.7 per 1,000 for the year 2014 and 113.7 per 1,000 for the year 2015.According to a study by Pongou R, infant mortality is higher in boys than in girls in most parts of the world [12]. This is in line with the results (AOR= 0.62, CI 95% (0.44, 0.89) of this research. This has been explained by sex differences in genetic and biological makeup, with boys being biologically weaker and more susceptible to disease and premature death. [13]. In a study by Titaley C.R et al carried out in Indonesia there was a significant 49% increased odds of neonatal death for males compared with females.[14]. In a study by Mekonnen Y et al, male children had a 38% higher risk than females of dying during the neonatal period. Contributing factors included immunodeficiency, higher prevalence of respiratory and other infectious diseases, and congenital malformations of the urogenital system. [15]. In the study carried out by Imitaz et al, early neonatal deaths were slightly higher in males than in females although the difference was not statistically significant [9]. This aligns with the results of this study (AOR= 0.62, CI 95 % (0.44, 0.89) which showed that the sex of a neonate was associated with survival of the first week of life although age was not a significant factor associated with neonatal death. The significant factors associated with neonatal deaths in the year 2015 were sex and cause of death. Cause of death was the only significant factor associated with neonatal deaths in 2014. In both years infections were less likely to cause death than prematurity. This is in line with the results obtained in a study by Yego et al in Kenya [16]. The sample size for the year 2015 was increased due to the adoption of the Ndola Central Hospital Neonatal unit by Arthur Davidson's Children's Hospital thereby increasing the population which in turn resulted in the unmasking of sex as an associated factor. According to a study by Imitaz J et al, causes of death in neonates were classified as immaturity related (26%), birth asphyxia or hypoxia (26%) and infection (23%). This information further augments findings that infections were less likely to cause neonatal death than prematurity which is in line with what was established in this study (AOR=0.29, CI 95% (0.21, 0.38) in 2015 and (AOR= 0.25, CI 95% (0.18, 0.36) in 2014 [9]. However, further classification of grouping of cause of death would be of considerable benefit in determining

causes of death. As shown in the study by Imitaz et al the classification of cause of death was as immaturity related, birth asphyxia and infection [9]. This classification would be useful in the Zambia Health Management System. This would make isolation of the cause of death easier. A recommendable classification would be classifying causes of death as infections, prematurity, congenital anomalies and asphyxia. To holistically tackle the problem of neonatal deaths in Zambia, a further study on the risk factors associated with neonatal deaths can be carried out and the results of such a study including the results of this study can be of immense benefit in future policies made to reduce neonatal death. This is in line with the MDG 4 that Zambia failed to attain by 2015.

Conclusion and recommendations

The prevalence of neonatal mortality was calculated as 170.7 per 1000 for 2014 and 113.7 per 1000 for 2015. The factors associated with neonatal mortality were sex and cause of death (that is prematurity and infections). Cause of death was a constant in both years. Therefore, a further classification of cause of death would be of benefit in pin pointing the most prevalent cause of death and assist in policy formulation to further curb neonatal mortality. A further study that can be carried out is on the risk factors associated with different causes of death. This would help make better policies than at present that would further reduce neonatal mortality at the institution. New studies that can determine the prevalence and causes of neonatal mortality, risk factors associated with neonatal mortality and effectiveness of current policies aimed at reducing neonatal mortality can further reduce the neonatal mortality rate. These studies however, would require excellent record keeping and date entry which we recommend the hospital to improve. These research studies can be repeated to monitor the effectiveness of measures put in place and can also be done at different health institutions country wide in an effort to reduce the country neonatal mortality rate. This study can be repeated next year and a comparison made between 2015 data and 2016 data to determine if sex will still be an associated factor then appropriate measures can be put into place to curb this trend.

Limitations

The study was a secondary analysis of data from the HMIS system which was not necessarily designed to determine factors associated with neonatal deaths. As such certain important factors may have been omitted. Even factors such as infections may have been more insightful if broken down to specific infections. However, the study is a first step in the elucidation of the factors associated with neonatal mortality at the hospital and although based on secondary data which prevented consideration of all possible factors, and essentially demonstrates use of routinely collected data; the HMIS is considered robust enough to inform policy formulation

Declarations

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Authors' contributions

MMC conceptualized the study, participated in the protocol preparation, data collection, analysis and interpretation of data, drafting and revision of manuscript. DM participated in the conceptualization of the study and in the protocol preparation. DKM wrote the data extraction code and participated in data management and analysis, interpretation of findings, and revision of the manuscript. SS supervised data analysis and preparation of the manuscript.

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