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MORBIDITY AND FACTORS ASSOCIATED WITH EARLY IN- HOSPITAL MORTALITY AMONG NEONATES AT RURAL UNIVERSITY TEACHING HOSPITAL.

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ABSTRACT

Introduction:

Neonatal period is the most vulnerable life period because of the physiological and immunological immaturity. As a result, neonates frequently affected by various disease, which in most cases are preventable. Globally, neonatal deaths contribute to more than one-third of infant mortality most of which occur in low and middle – income countries (LMICs). Despite significant progress in reducing infant mortality in the past 25 years, neonatal mortality rate remains high especially in sub Saharan Africa. This study aimed at determining risks and factors associated with early in – hospital mortality among neonates admitted in the Neonatal Care Unit (NCU) at prototypical rural hospital in south western Uganda.

Methods: *This was prospective cohort study among 276 neonates admitted at the Neonatal Care unit of Kampala International University. Prospective neonates were enrolled over a 10- months period and followed for 14 days following admission. Data was collected by administering standardized questionnaires to mothers. Comprehensive clinical assessment done, and treatment data obtained prospectively. Risk ratio (RR) was used to determine mortality and factors associated with neonatal mortality determined using Generalized Linear Model.*

Results: *Among 276 enrolled neonates, the common morbidities were presumed neonatal sepsis (38.8%), prematurity and related complications (31.5%). Incidence of neonatal mortality was 68.8 per 1000live births (95%, CI =44.2- 105.7). The factors associated with in – hospital neonatal mortality were gestational age of 24-28 (adj RR= 1.48, 95% CI = 1.24 -1.76, P=< 0.001) and 29-32 weeks of amenorrhea (adj RR = 1.13, 95% CI = 1.04 – 1.23, P= 0.004); separated mother (adj RR= 1.33, 95% CI = 1.10 – 1.61, P=0.004) and single mother (adj RR= 1.33, 95% CI = 1.56 – 3.97, P = 0.001).*

Conclusion and Recommendation: *The leading causes of neonatal ICU admissions are presumed neonatal sepsis and prematurity and related complications. The incidence of in – hospital neonatal mortality is high. Prematurity and mothers without support systems are associated with neonatal mortality.*

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Key words: neonatal mortality, neonatal morbidity.

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Introduction

Neonatal period is the most vulnerable to diseases which, in most cases, are preventable (13),(24). The principal direct causes of neonatal morbidity are infectious diseases, birth asphyxia, complications of prematurity, birth injuries and birth defects. Infection and birth asphyxia account for almost 90% of neonatal deaths worldwide (2), (4). According to the UNICEFs "The state of the world`s children 2010" report, admission due to prematurity to be as high as 60.7%. According to WHO report, the major morbidities are preterm births complications, pneumonia and intrapartum – related complications(4). The major cause of neonatal morbidity in Uganda, like other Sub-Saharan African countries, include Sepsis, Pneumonia, Tetanus, Diarrhea, Prematurity and birth Asphyxia (5). Globally 8.2 million children under five die each year of whom 3.3 million are neonates, 90% occur in low and middle-income countries (3), (16), (21), (25). Sub-Saharan Africa (SSA) lags behind other regions with a neonatal mortality rate of 31deaths per 1000live births in 2013 contributing 39% of neonatal deaths worldwide. In Uganda 45,000 neonates die each year with about 27 out of 1000 live births (5). The underlying causes of neonatal deaths in Uganda like other developing countries relate to poor access and underutilization of health services during pregnancy and child birth. Different scholars have identified several obstetric factors (antenatal visits, place and who conducts delivery, premature rupture of membranes, prolonged labor, maternal fever) implicated in neonatal morbidity and mortality (5), (11), (15) (17) as well as demographic characteristics of neonates that play an important role in survival (4), (8), (11), (17). Therefore the study aimed at describing the common morbidities, determine early in - hospital mortality as well as factors associated with early in- hospital mortality among neonates admitted in a rural based teaching hospital in South Western Uganda from the month of January to November 2017.

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Methods

Study Design, Site and Population

This was a prospective cohort study among neonates admitted at Kampala International University Teaching Hospital neonatal care unit. The study was conducted at neonatal care unit of Kampala International University Teaching Hospital. The hospital is a rural university teaching hospital for Kampala International University medical school. It's located in Ishaka-Municipality Bushenyi district 319Km South –west of Kampala, the capital of Uganda. It a referral hospital for five districts (Bushenyi, Sheema, Buhweju, Mitooma and Rubirizi) with a total catchment population of 205,671 people. The hospital offers tertiary and primary care services to adults, children and neonates. In 2015, 22975 patients were admitted in 2015, of whom 4210, were children and 417 neonates, paediatrics and neonatal services are headed by paediatricians. The neonatal care unit was established in 2016 and provides special care to neonates. It has two sections newborn care unit and Kangaroo mother care unit. The Neonatal care unit has 5 incubators, 3 oxygen concentrators, one oxygen cylinder, and one phototherapy machine. The unit however lacks ventilator machine, CPAP, Apnea monitors, facilities for exchange transfusion, surfactant and parenteral nutrition, infusion pumps. The Kangaroo mother care unit has 18 beds. All neonates term and preterm delivered at Kampala International University Teaching Hospital and those delivered from other health centers and at home were included for longitudinal follow-up and prospectively enrolled by followed -up for fourteen days for final outcomes. The study took ten months in total. All eligible neonates were consecutively enrolled for ten months till the desired sample size was reached. Neonates who were brought in dead before admission were not included in the study. All neonates whose mothers died during delivery were excluded.

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Sample size

The Sample size estimation was based on the Fleiss formula (1981) for cohort studies as described in Kelsey et al., 2007. We assumed a statistical power of 80% at 95% significant level and maximum accepted error of 5%. Using a neonatal mortality of 16.2% as previously shown in two prospective cohort study in two referral Hospitals in Uganda on neonatal deaths, of 235 neonates admitted to NICU, overall mortality was 38(16.2 %) (12), our sample size was estimated to be 276 neonates.

Sampling procedure

At admission, patients were first given emergency treatment and care as per treatment protocols and then obtained a written informed consent from the mother of neonate then assigned a study number and Inpatient number to each neonate. A face- to –face interview with mothers was conducted and data obtained on date of birth, age in (hours and days) and sex. A data was also obtained on neonatal symptoms: fever, refusal to breast feed, vomiting, jaundice, difficulty in breathing, excessive crying, convulsions, bleeding, others like premature delivery, failure to cry immediately after birth, skin lesions and their duration. The obstetric history sought included number of times attended antenatal clinics, place and who conducted delivery, mode of delivery, length, premature rupture of membranes as well as pregnancy and intrapartum complications like maternal fever, eclampsia, APH and HIV status and neonatal perinatal events included birth weight, gestational age, Apgar score and time for initiating breast feeding by the researcher using a structured questionnaire.

General physical examination was performed on each neonate and vital and systemic examinations completed.

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Patient Management

Standard treatment protocols were designed trained all staff members and placed in neonatal unit for uniformity in the care of patients. If a patient had difficulty in breathing, respiratory rate above or equal to 60cycles per minute and cyanosed was given oxygen therapy by nasal prongs delivered by concentrator at 0.5L per minute for preterm and 0.5 -1L per minute for term neonates. Neonates with axillary temperature less or equal to 36-37 degrees Celsius were warmed in incubators or warmers (children > 24hours). Neonates with poor suckling reflex, and neonates deemed moderate to very preterm were first fed on expressed breast milk by NGT according to protocol. Blood transfusion with packed cells according to neonate`s blood group was done when hemoglobin level was less or equal to 10g/dl. Intravenous dextrose 10 percent was given as bolus at 5ml/kilogram body weight and maintenance as indicated in the protocol. Plain normal saline was used for dehydration, shock at 20mls per kilogram body weight as bolus. For neonates with seizures regardless of etiology, intravenous phenobarbitone was given to convulsing neonates at 20mg/kilogram body weight slow bolus and maintained at 5mg/ kilogram body weight once a day till three days convulsion free. Preterm neonates between 24 - 30 weeks of amenorrhea were given intravenous Aminophylline at 6 -8mg/ kilogram body weight slow bolus and maintained at 2.5mg/ kilogram body weight twice a day till 31 -32 weeks post conceptual age or spontaneous breathing was sustained. Phototherapy was initiated when the total serum bilirubin levels were according to protocol. Used intermittent at an interval of 2-4 hours. Pharmacological treatment was administered according to clinical diagnosis made and included intravenous ampicillin, gentamicin, cloxacillin, ceftriaxone and metronidazole as described in the protocol.

Monitoring clinical progress

Stable neonates (no symptoms and signs) were monitored daily and management plan reviewed. Unstable neonates were monitored two- three times per day in line with hospital protocols for clinical progress and management plan reviewed where necessary. Neonates enrolled on kangaroo mother care in addition, feeding was strictly monitored. However due to lack of standard equipment, there where challenges in monitoring for apneas, serum bilirubin levels. All

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study neonates were observed for two weeks for final outcome or whichever came first. Final outcome was categorized into survived or died.

Data Management

Data from pre-coded and completed questionnaires were entered using statistical computer package software Microsoft excel 2010, it was cleaned, checked for errors, corrected and was then exported to STATA version 14, for analysis. Reasons for hospital admission were presented as proportions. The incidence of neonatal mortality was obtained as the proportion of those who died over total participants per 1000 live births. To describe the factors associated with neonatal mortality, used a Generalized Linear Model at Confidence interval of 0.05 was used. Performed bivariate regression analysis followed by multivariate general linear model regression analysis. Factors with a p-value less than 0.2 on bivariate regression analysis were subjected to multivariate general linear model regression. The 95% confidence interval was determined and factors with p-value of less than or equal to 0.05 were considered statistically significant. The anticipated associated factors for neonatal mortality were obstetric factors which included antenatal care attendance, place and who conducted delivery, mode of delivery, gestational age, length of labor, premature rupture of membranes and maternal fever as well as neonatal factors: age, sex, birth weight and Apgar score. Other independent variables studied include maternal age, level of education, occupation and marital status which other studies reported to be associated with neonatal mortality.

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Results

During study period, a total of 291 neonates were admitted at KIU-TH, of these 276 were included in the study, 15 were excluded due to different reasons (nine neonates died before information was obtained, three neonates came in dead and three mothers refused to participate). Over 237 were discharged, 19 ran away, 1 referred and 19 died.

Socio-demographic characteristics of neonates and mothers

Table 1 below shows the socio-demographic characteristics of the participants.

Of 276 neonates, 153(55.4%) were male. The median age (IQR) was 1(0 – 3.75) days. The median age (IQR) of mothers was 25 (22 -28) years. 141(51.1%) were from Bushenyi district, district within which KIU-TH is located. Overall 154(55.8%) of mothers had completed primary level of education and 183(66.3%) were peasants.

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Table 1: Socio-demographic characteristics of neonates and mothers.

Characteristics	**Frequency (%)**
Median Neonatal age (IQR)	1(0-3.5)
Neonatal sex n (%)	
Female	123(44.6)
Male	153 (55.4)
Median Maternal age (IQR)	25(22-28)
Residence n (%)	
Bushenyi	141(51.1)
Rubirizi	55(19.9)
Mitooma	48(17.4)
Others	32(11.6)
Marital status (%)	
Married	269(97.5)
Separated	6(2.2)
Single	1(0.36)
Education level n (%)	
None	6(2.2)
Primary	154(55.8)
Secondary	75(27.2)
Tertiary	41(14.8)
Occupation n (%)	
Peasants	183(66.3)
Business	50(18.1)
Formal employment	43(15.6)

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The distribution of morbidities

A total of 276 neonates was studied, 273(98.9%) had identifiable morbidities. Diagnosis could not be ascertained in three neonates (1.1%) due to lack of diagnostics. For three neonates morbidity was not identified due to lack of diagnostic investigations. Three neonates had two identified co morbidities, hypoxic ischemic encephalopathy and presumed neonatal sepsis. Presumed neonatal sepsis 107(38.8%) and prematurity and related complications 87(31.5%) accounted for 194(70.3%). Other morbidities included hemolytic disease of new born 1 (0.36%) meconium aspiration syndrome 7 (2.53%), cyanotic congenital heart defect 1(0.36%)), genetic syndrome 3(1.08%), neonatal pneumonia 6 (2.17%).

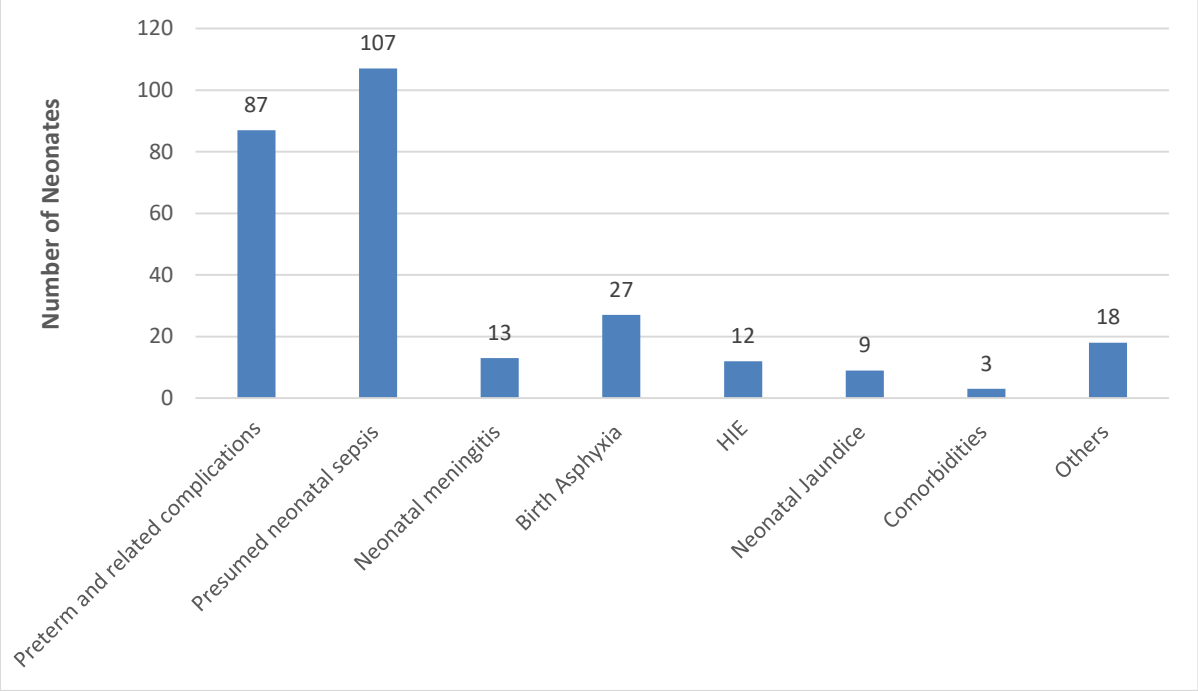

Figure 1: Distribution of morbidities

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Incidence of neonatal mortality.

Overall, 19 (68.8 neonatal deaths per 1000 live births were recorded during the study period accounting for 6.88 percent of the admissions with the percentage of neonates who ran away19 (6.9%) and referred 1(0.4%) inclusive. The incidence of neonatal mortality was 68.8 per 1000 live births (95%, CI = 44.2 – 105.7). 11 (57.9%) were in neonates aged 0 – 24 hours of life, 18(94.7%) were in neonates in the first seven days of life, 13(68.4%) were out born.

Bivariate analysis of socio- demographic characteristics.

There was no significant association between gender and neonatal mortality (P= 0.77) table 2. Neonates of mothers aged 18- 20years had a 17% higher fold risk compared to those whose mothers were 35- 48 years (95% CI = 1.04 -1.32, P-valve = <0.001) table 2. Other factors analyzed at bivariate level included mother`s level of education, occupation and marital status. The findings of study showed no significant association between mother`s level of education and occupation and neonate`s survival table 2. The risk of neonatal death was higher among neonates whose mothers were separated and single table 2.

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Table 2: Bivariate analysis of Socio –demographic characteristics

Variable	Alive	Died	CRR	95 %CI	P-valve
Neonatal Age					
0-24hours	94(89.52)	11(10.48)	1.00	-	-
1-7days	121(94.53)	7(5.47)	0.95	(0.89-1.02)	0.13
8-28days	42(97.67)	1(2.33)	0.92	(0.84-1.01)	0.08
Neonatal Sex					
Male	112(92.56)	9(7.44)	1.00	-	-
Female	143(93.46)	10(6.54)	0.99	(0.93 -1.05)	0.77
Education					
Tertiary	40(97.56)	1(2.33)	1.00	-	-
Secondary	70(93.33)	5(6.67)	1.09	0.88 -1.35	0.42
Primary	141(91.56)	13(8.44)	1.07	0.87 – 1.32	0.54
None	6(100.00)	0(0.00)	1.02	0.82 – 1.27	0.83
Occupation					
Formal Employment	42(97.67)	1(2.33)	1.00	-	-
Business	48(96.00)	2(4.00)	1.02	0.92 – 1.13	0.75
Peasant	167(91.26)	16(8.74)	1.07	0.98 – 1.16	0.14
Marital Status					
Married	253(94.05)	16(5.95)	1.00	-	-
Separated	4(66.67)	2(33.33)	1.32	1.08 – 1.603	0.007
Single	0(0.00)	1(100.00)	2.56	1.58 -4.14	< 0.001
Maternal Age					
35- 48years	29(100.00)	0(0.00)	1.00	-	-
21-34 years	196(93.78)	13(6.22)	1.06	0.97 -1.17	0.21
18-20years	32(84.21)	6(15.79)	1.17	1.04 – 1.32	0.01

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Bivariate analysis of obstetric factors

Majority, 143(51.8%) were out born most of whom 13(68.4%) died table 3. Delivery by caesarian section in this study had lower risk of neonatal death (95% CI = 0.88 -1.00, P = 0.05) table 3. A quarter of neonates delivered at home by TBA died 3(25%). Delivery by TBA had a significant effect on neonatal mortality (P = 0.012) table 3. Complications during pregnancy which included length of labor, Premature Rupture of Membranes (PROM) were not statistically associated with neonatal mortality table 3. However, neonates of mothers who had maternal fevers were at 1.09 risk compared to those whose mothers had no fever (95% CI= 1.02 -1.17, P= 0.02) table3. Neonates of mothers who had attended antenatal care less than four times had a 1.05 risk of dying compared to those whose mothers attended four or more times but had no statistical significance (95% CI = 0.96 -1.15) table 3.

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Table 3: Bivariate analysis of obstetric factors

Variable	Death		CRR	CI	P-valve
	No	Yes			
Number of ANC visits					
More than four	36(37.30)	1(2.70)	1.00	-	-
Less than four	220(92.44)	18(7.56)	1.05	0.96 – 1.15	0.28
Pregnancy Complications					
Length of labor					
More than 18hours	20(90.91)	2(9.09)	1.00	-	-
Less than 18hours	237(93.31)	17(6.69)	0.98	0.87 -1.09	0.67
PROM					
More than 24hours	37(92.50)	3(7.50)	1.00	-	-
Less than 24hours	220(93.22)	16(4.51)	0.99	0.91 -1.08	0.87
Maternal fever					
No	190(95.19)	10(4.81)	1.00	-	-
Yes	59(86.76)	9(13.24)	1.09	1.02 – 1.17	0.02
Place of delivery					
KIU-TH	127(95.49)	6(4.51)	1.00	-	-
Outside KIU-TH	130(90.91)	13(9.09)	1.05	0.99 -1.11	0.13
Mode of delivery					
SVD	168(91.30)	16(8.70)	1.00	-	-
Assisted delivery	5(83.33)	1(16.67)	1.08	0.88 -1.33	0.45
Caesarian section	84(97.67)	2(2.33)	0.94	0.88 – 1.00	0.05
Who delivered					
Doctor	103(97.17)	3(2.83)	1.00	-	-
Midwife	138(92.00)	13(8.00)	1.05	0.99 – 1.12	0.10
TBA	12(80.00)	3(20.00)	1.88	1.04 -1.36	0.012
Other(self)	1(100.00)	0(0.00)	0.97	0.60 -1.58	0.91

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Bivariate analysis of neonatal factors

Neonates with birth weight less than 2.5 kilogram had 1.05 times risk of dying (95% CI = 0.99-1.11) compared with birth weight above or equal to 2.5kilograms table 4, however not significantly associated with mortality table 4 below. Only 98(35.5%) of the total admissions were preterm out of whom 10(52.6%) died. Birth between 24 – 28 and 29- 32 weeks of amenorrhea had higher risk of mortality compared to 33 to 37 and above weeks table 4. Having Apgar score of less than seven at five minutes was not associated with neonatal mortality (95% CI = 0.94 -1.18) table 4.

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Table 4: Bivariate analysis of neonatal factors

Variable	Death		CRR	CI	P-valve
	No	Yes			
Gestational age					
37 weeks and above	163(94.94)	9(5.06)	1.00	-	-
33-36 weeks	53(98.15)	1(1.85)	0.97	0.90 -1.04	0.40
29- 32 weeks	31(83.78)	6(16.22)	1.12	1.03 – 1.22	0.012
24-28 weeks	4(57.14)	3(6.88)	1.46	1.21 – 1.76	<0.001
Birth weight					
Less than 2.5 kg	154(95.55)	8(4.94)	1.00	-	-
2.5kg and above	103(90.35)	11(9.65)	1.05	0.99 – 1.11	0.13
Apgar score					
Less than 7 at 5 minutes	88(93.62)	16(93.62)	1.00	-	-
Above 7 at 5 minutes	188(88.46)	3(11.54)	1.05	0.94 – 1.18	0.38

Multivariate analysis of factors associated with neonatal mortality

Neonates delivered between 24 -28 and 29 - 32 weeks of amenorrhea were more likely to die within two weeks after birth (adj RR = 1.48, 95% CI = 1.24 – 1.76, P = < 0.001, adj RR = 1.13, 95% CI = 1.04 – 1.23, P = 0.004) respectively table 5 below. Furthermore, both separated and single women are at a higher risk of neonatal death compared to married women (adj RR= 1.33, 95% CI = 1.10 – 1.61, P = 0.004, adj RR= 1.33, 95% CI = 1.56 – 3.97, P = 0.001) respectively table 5. However maternal age was not statistically significant risk factor independently for neonatal mortality (adj RR= 1.10, 95% CI= 0.98 – 1.24) table 5.

Table 5: Multivariate analysis of factors associated with neonatal mortality.

Variable	aRR	95%CI	P –valve
Gestational age			
37 weeks and above	1.00	-	-
33 – 36 weeks	0.99	0.92 – 1.06	0.76
29- 32 weeks	1.13	1.04 - 1.23	0.004
24- 28 weeks	1.48	1.24 - 1.76	< 0.001
Maternal age			
35 – 48 years	1.00	-	-
21 -34 years	1.04	0.95 – 1.14	0.37
18- 20 years	1.10	0.98 – 1.24	0.10
Marital status			
Married	1.00	-	-
Separated	1.33	1.10 -1.61	0.004
Single	2.49	1.56 - 3.97	0.001

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Discussion.

Common morbidities

Presumed neonatal sepsis, prematurity and related complications were the common morbidities. The study findings were consistent with findings reported by (19) and close to (13)who found RDS (21.9%) followed by septicemia/ Pneumonia/ Meningitis 19.0% and (14) who reported prematurity 26.8% followed by Birth Asphyxia 23.7%. However different from (12)found Birth Asphyxia as major morbidity. Presumed neonatal sepsis was the commonest morbidity 108(38.8%). This is similar to findings from other studies (5)**,** (15)**,** (16) **.** Close to findings in developing countries (13) where Neonatal sepsis was second to RDS and (17) at Kenyatta National Hospital where suspected sepsis followed after RDS and Apneic attacks. This could be attributed to the fact that the study was carried out in rural area where the level of infection control during delivery, referral and handling of neonates is compromised as well as the cord care practices by mothers. The higher percentage of presumed neonatal sepsis may also be attributable to the number of out born 143(52%) of the participants. Prematurity and its related complications may be explained by several factors associated with premature delivery which include; maternal infections, hypertensive disorders, multiple pregnancy, fetal infections as well as chromosomal abnormalities among others.

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Incidence of neonatal mortality

The incidence of neonatal mortality within two weeks of admission at Kampala International University –Teaching Hospital in new born care unit was found to be 68.8 per 1000 live births. This was higher than the national average of 27 per 1000 live births (5)**.** It`s close to what was observed in Burkinafaso of 79 per 1000 live births (18)**.** However was much lower than 203 per 1000 live births found at University of Benin Teaching Hospital by Sadan WE *et al* 2014, 109 per 1000 live births found at Mulago National Referral Hospital (12). The higher incidence may be explained by the fact that 13(68.4%) of neonatal deaths occurred among out borns which may have hindered early access to medical care. Secondary the study was conducted in rural area where understaffing, lack of life saving equipments and unskilled deliveries still contribute to neonatal deaths whereas national average include both urban and rural areas. This indicates that neonatal mortality may be higher in rural than urban areas. Other studies done in low income

countries like Pakistan have also indicated in adequate care, low staff competence as contributing factors to neonatal mortality (5)**.**

Factors associated with neonatal mortality

Over 18(94.7%) of neonatal deaths occurred within the first seven days of life of whom 57.9% occurred within the first 24hours of life. These findings are in agreement with other studies (5)**,** (12)**,** (15)**,** (19) and (21) in study done at Mulago NICU had a high neonatal death (50%) within first 24hours of life**.** This is consistent with the evidence that early neonatal period is highly vulnerable time for the neonate completing the physiological adjustments for extra uterine life as well as the immunological immaturity in the first 24hours and first seven days of life (WHO report 2006). Therefore this indicates that critical care should be provided to neonates in the first seven days of life. Premature delivery between 24-28 and 29-32 weeks of amenorrhea had a higher risk of neonatal death. Preterm birth correlates with risk of hypothermia due to low subcutaneous fat and hair for insulation, infections related to immunological immaturity and hypoglycemia due to low glucose stores, impaired glucose production among others. This increases their chance of dying compared to term neonates. Study findings are consistent with other studies (5)**,** (10)**.** Thus special care should be provided to these preterm neonates. These may include; warmth, infection control during and after delivery, nutrition as well as timely referral to higher health facilities with more advanced neonatal care to support their survival. In our study neonates of both separated and single women are at a higher risk of neonatal death compared to those of married women. This is consistent with other studies done in developing countries like Burkina Faso, Sierra Leone and Burundi reported by C. Izugbara 2016 but differ from findings by Bennett. T *et al* 1994 who found being separated or single did not have an effect on the risk of neonatal mortality among neonates born to college education mothers. This could be explained by the fact that separated and single women are likely to lack socio-economic support during pregnancy, child birth as well as postnatal period. It may also be due to the fact that insufficient attention has been given to understand the relationship between maternal marital status and neonatal mortality.

In our study maternal age was not an independent factor for neonatal mortality however (14) found a higher maternal age significantly associated with lower risk of neonatal mortality. This could be explained by the small number of mothers who are less than 20 years of age 32(11.6%).

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A quarter of neonates delivered at home by TBA died 3(25%). Delivery by TBA had a significant effect on neonatal mortality. This was similar to findings by (11) who found being delivered at home and assisted by TBA had significant association. This could be attributable to the unhygienic conditions under which deliveries are conducted and unskilled personnel. There was no difference in neonatal death among those delivered by doctor and midwife, this was consistent with findings by (5). Being out born was associated with 1.05 risk of dying compared with inborn, 13(68.42%) died. This was similar to (13), more out born died than inborn. This could be contributed by several factors which include but not limited to, delay to seek medical care, delay in transportation, and poor referral system among others. In addition, a study report by (5) there was no different among neonates delivered at a health facility and home in rural areas. This was explained by the poor quality of newborn care in health facilities of rural areas.

Neonates of mothers who had maternal fevers were at 1.09 risk of death compared to those whose mothers had no fever but maternal fever was not independently associated with neonatal mortality. This was consistent with other studies Lee *et al.,* 2008 who found maternal fever increased risk for birth Asphyxia. However different from Imtiaz Jehan *et al.,* 2008 who found maternal fever was not associated with neonatal death. This could be explained by the fact that raise in maternal body temperature may be due to several factors including; extra uterine infections, raised metabolic rate due to anxiety and stress of labor. Other factors like exposure to poorly ventilated and overheated delivery room or transient bacteremia during vaginal delivery may lead to infection – related neonatal mortality. Delivery by caesarian section in this study had lower risk of neonatal death, consistent with other studies (21), (10) however (22) found if done too late is associated with high risk of neonatal mortality. This could be explained by the fact that caesarean section provides safe and effective intervention to minimize both neonatal and maternal mortality. However this contradicts with scientific literature about neonatal mortality and mode of delivery (10), hence need to reduce unnecessary caesarean section. Neonates of mothers who had attended antenatal care less than four times had a 1.05 risk of dying compared to those whose mothers attended four or more times but had no statistical significance. Findings are consistent with (21) but (22) found highest risk among those with only one visit. However (5) found antenatal attendance less than four times was significantly associated with neonatal mortality. This could be explained by the fact that with less than four antenatal visits, mothers may be not reinforced with health education, screened and promptly treated for infections and

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other pregnancy related complications may go undetected. The complications during pregnancy which included length of labor, Premature Rupture of Membranes (PROM) were not statistically associated with neonatal mortality. This was not consistent with findings from other studies like Saira Dars *et al* 2010 who found preterm PROM associated with 40-75% of neonatal mortality and Laughon *et al* 2015 who found prolonged second stage significantly associated with neonatal deaths. Having Apgar score less than seven at five minutes was not associated with neonatal mortality. However other studies found Apgar score less than seven associated with increased risk of neonatal death (4), (11) as well as Ondoa- Onama at Mulago Hospital. This could be attributed to the inconsistencies in the application of Apgar score especially in rural settings where understaffing and unskilled deliveries still take place.

Other factors analyzed at bivariate level included mother`s level of education, occupation and marital status. The findings of study showed no significant association between mother`s level of education and occupation and neonate`s survival. This was consistent with other studies (18) found occupation not significant. However different from other studies like (19) found education significant while (21) found formal employment protective.

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Conclusions and Recommendations

The common morbidities were presumed neonatal sepsis, prematurity and its related complications. The incidence of neonatal mortality was higher than the national value. Gestational age between 24-28 and 29-32 weeks of amenorrhea and being of separated and single marital status were the factors associated with neonatal mortality. Stakeholders should encourage infection control measures like hand hygiene, disinfection of delivery surfaces and high level disinfection as well as sterilization of re-usable equipments to reduce the levels of sepsis. Preventive measures for premature delivery where preventable causes like infections (malaria) by providing chemoprophylaxis - Fansidar and Insecticide Treated Mosquito Nets to all pregnant women.

Abbreviations

CI: Confidence Interval; CRR: Crude risk ratio; aRR: adjusted Risk Ratio, HIE: Hypoxic Ischemic Encephalopathy; KIU-TH: Kampala International University – Teaching Hospital; SVD: Spontaneous Vaginal Delivery; TBA: Traditional Birth Attendant; WHO: World Health Organization.

Consent for publication

Not Applicable

Available data

All data has been included in the manuscript. Data for individual patients are not shared due to ethical reasons.

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Competing interests

Authors have declared no competing interests.

Authors` contributions

MP designed the study, carried out data collection, analysis as well as writing a manuscript with contribution from other authors. KP participated in the supervision and reviewing manuscript. AB participated in conceiving the study and general guidance. NH participated in general guidance and reviewing manuscript. AC participated in reviewing and analyzing data. All authors read and approved the final manuscript.

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Ethical Considerations

Ethical approval for the study was obtained from research and Ethics committee of Kampala International University Teaching Hospital / Mbarara University Ethical Review boards and department of paediatrics KIU-TH. Written and informed consent was obtained from each mother before the interview was conducted both in English and local language (Runyankole). There were no painful procedures except for treatment purposes. A mother was free to withdrawal at any time from the study. Not consenting to the study did not jeopardize treatment or care of the neonate while on ward. Mothers also got timely information about their neonates` progress.

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