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FACTORS ASSOCIATED WITH SEVERITY OF NEONATAL SEPSIS ON ADMISSION IN KENYATTA NATIONAL HOSPITAL PAEDIATRIC WARDS, KENYA: A DESCRIPTIVE CROSS-SECTIONAL STUDY

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FACTORS ASSOCIATED WITH SEVERITY OF NEONATAL SEPSIS ON ADMISSION IN KENYATTA HOSPITAL PAEDIATRIC WARDS, KENYA: A DESCRIPTIVE CROSS-SECTIONAL STUDY

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ABSTRACT

Background: **Neonatal sepsis is a major cause of neonatal mortality. In the year of 2012, it accounted for 44% of all deaths of under five years old children globally. Statistics indicate that 98% of the global, one million deaths as a result of neonatal sepsis occur in Africa. Neonatal sepsis contributes to 69% of neonatal mortality in Nigeria and 28% of neonatal mortality in Kenya.**

Objective: **To establish factors associated with severity of neonatal sepsis among patients admitted in Kenyatta National Hospital Paediatric Wards.**

Design: **The study adopted a descriptive cross-sectional design.**

Setting: **The study was carried out in paediatric wards of Kenyatta National Hospital (KNH), Kenya.**

Subjects: **Data was obtained from consenting mothers whose neonates had been admitted with neonatal sepsis and healthcare workers who worked within the paediatric wards. A total of 107 respondents were selected by systematic sampling method in which every alternate participant was selected. A semi-structured questionnaire was used to gather data on maternal and neonatal characteristics and environmental factors. In addition, three focused group discussions comprising nurses, doctors and clinical officers were conducted. Chi-square test was used to determine the factors associated with severity of neonatal sepsis (NNS) during admission.**

Results: **Binary logistic regression analysis was performed to determine predictors of severe NNS. Of the 107 patients with neonatal sepsis, 37.4% had severe neonatal sepsis during admission. After multiple logistic regression analysis, the following factors were found to be independently associated with severe NNS: Neonates aged 8 to 28 days [AOR=2.89; 95%CI=1.07-7.99; P=0.047] compared to those neonates aged less than 8 days; Mothers with primary level of education [AOR=4.57; 95%CI=1.18-**

17.67; P=0.028] compared to those with tertiary education; primipara mothers [AOR=4.64; 95%CI=1.74-12.37; P=0.002] than multipara mothers and greenish amniotic fluid during labor [AOR=3.11; 95%CI=1.05-9.24; P=0.041] compared to clear amniotic fluid.

Conclusion: **The study found that severity of NNS was still high. The factors associated with severe NNS were; primiparity, maternal low economic status and poor antenatal clinic attendance. The study thus recommends that newborns at risk of developing severe neonatal sepsis should get prophylactic treatment and mothers be included in specialized programs geared towards reduction of the severity of NNS.**

INTRODUCTION

Neonatal sepsis is a systemic infection occurring in infants during the first 28 days of life and is an important cause of morbidity and mortality of new-borns(1). The chances of survival are slim for newborns with a serious infection, whether hospitalized or in the community due to their weak immune status. Many more newborns who survive have brain insults resulting in severe disabilities such as convulsive disorders, cerebral palsy, cognitive impairments (2), thus adding to the burden to healthcare, social systems and home environment (3).

Neonatal sepsis is a major cause of neonatal mortality. It accounted for 34% of all deaths of under five year old children globally in year 2011 (4). Over 98% of the estimated four million neonatal deaths occur in developing nations with highest rates in Africa (5). More than one-third of the estimated four million neonatal deaths around the world each year are caused by severe infections, one million of which are due to neonatal sepsis alone (6). Kenya is not spared either of the high incidences of neonatal mortality mainly due to neonatal sepsis. Kenya was ranked sixth among the African countries with highest newborn mortality in a study on African newborns (7). The study concluded that 28% (43,600 neonatal deaths) of the neonatal deaths in Kenya are due to neonatal sepsis (7). This implies that a lot of Government resources are required in the management of neonatal sepsis.

Although there was a decline in under-five year old mortality rates globally, the neonatal mortality was noted to be on the rise accounting for 44% of the under-five year old deaths in year 2012 (8) as compared to 37% in 1990 (8). A longitudinal study done on the burden of neonatal admissions in a Rural District Hospital-Kilifi showed that close to 60% of under five year old children`s death occurred during the neonatal period (3).

Despite previous studies on neonatal sepsis, the neonatal mortality from severe neonatal sepsis remains high. This necessitated the study with an emphasis on factors contributing to severity of neonatal sepsis. The study was aimed at identifying factors contributing to severity of neonatal sepsis. The information generated would be useful in development of strategies to reduce neonatal mortality from severe forms of neonatal sepsis.

METHODS

Study design and setting: This was a mixed method whereby both quantitative and qualitative cross sectional descriptive study carried out within paediatric wards at Kenyatta National Hospital, Nairobi, Kenya. This is a National Referral Hospital with a bed capacity of 2000, located in Nairobi, the country's capital city. It offers both preventative and curative services for a

variety of illnesses to patients from all over Kenya with an average of 600,000 outpatient visits and 89,000 inpatients annually. The paediatric department has eight inpatient wards where general medical patients, orthopaedic, oncology and surgical paediatric patients are admitted. The medical paediatric bed capacity was 256 and bed occupancy of not less than 150%. Patients suffering neonatal sepsis were admitted in the four medical paediatric wards (mainly term newborns) through the paediatric emergency unit. Medical wards admit patients in a rooster whereby a ward admits every fourth day.

Sample size: The study participants consisted of mothers to patients aged 0-28days. The sample size was calculated using the formula of Fishers et al. (1998):

$n=Z^2_{\alpha/2} P (1 - P)/d^2 = (1.96)^2 (0.5) (0.5)/ (0.05)^2= 385$

Where Z = standard normal distribution curve value for 95 % CI which is 1.96

P = proportion of severe NNS during admission was taken as 50%

d = absolute precision (0.05)

However, sample size adjustment was made since the target population was <10,000 using the following formula: $nf = n/(1+n/N) = 385/ (1+385/145) =107$

Where: nf = the desired sample size for population <10,000; N = Total population (number of neonates admitted to K.N.H paediatric wards per month suffering neonatal sepsis is about 145); n= the calculated sample size (107).

Therefore, the minimum sample size of the study was 107respondents.

Sampling technique: Systematic sampling method was used to select the study sample. The first study participant was selected by simple random among mothers with neonates suffering from neonatal sepsis. The mothers were allowed to pick a folded numbered paper from a basket. The mother who picked the paper numbered 001 was the first respondent. Thereafter every alternate mother to neonate diagnosed with neonatal sepsis was included in the study sample.

Data collection and data quality control: A pretested semi structured questionnaire was used to collect information on the mothers` socio-economic and demographic characteristics, neonatal characteristics, maternal characteristics as well as environmental factors.

Severity of neonatal sepsis was determined based on the presenting clinical manifestation on admission. Symptoms including either refusal to feed, hotness of body or yellowness of body were classified as mild neonatal sepsis. However, one or more of the aforementioned symptom(s) plus at least one of the following systemic involvement and organ dysfunction symptoms including convulsion, lack of urine, skin eruptions/rashes, gangrene, bloody vomitus, abdominal distension, difficulty in breathing, bloody urine and dehydration were classified as severe neonatal sepsis during hospital admission.

The study instrument was pre-tested with 10% of the study's sample size in Mama Lucy hospital. It is a public hospital like KNH and serves a population with similar characteristics to those in KNH. One research assistant who was a registered BscN nurse was trained on data collection process. Moreover, the principal investigator was monitoring the data collection on daily basis.

Data analysis: Data collected was entered into a Microsoft excel spread sheet and analysed using Statistical Package for Social Sciences (SPSS) version 20.0(IBM Corporation, Armonk, NY, USA). Pearson's chi-square test was used to establish the association between the dependent variable (severity of NNS) and independent variables in order to determine which ones had significant association. Binary logistic regression was used to model severity of neonatal sepsis using factors identified to be

significant at P<0.05 during bivariate analysis. *Backward LR* method was specified with removal at P<0.05.

Ethical Considerations: Study approval was sought from the Kenyatta National Hospital/ university of Nairobi Ethics and Research committee (KNH/UON-ERC). Written informed consent was sought from all study participants after they were given participant information, before they were interviewed. Participation was purely on voluntary bases. Privacy and confidentiality were maintained while handling participants' information.

RESULTS

Socio-demographic characteristics of neonates stratified by severity of NNS on admission: A total of 107 mothers with babies of neonatal sepsis participated in the study. Of the total, 37.4% neonates were presented to the hospital with severe NNS.The findings show that majority (72.0%) were between 8-28 days whereas the remaining (28.0%) were below 8 days. More than half (57.9%) of the neonate were males. Most of the neonates were born at full term (91.6%) with 84.1% weighed more than 2.5kg. Most 96 (89.7%) were fed breast milk after delivery while 11(10.3%) were initiated with formula feed (Table 1).

Neonates aged 8 to 28 days were significantly (*p=0.02*) more likely to present with more severe form of NNS during admission (44.2%) compared to those neonates aged less than 8 days (20.0%). Similarly, the proportion of severe NNS was significantly (*p=0.011*) more among neonates who were formula fed after delivery (72.7%) as compared to those neonates who breast fed (33.3%) after delivery (Table 1).

Table 1

Socio-demographic characteristics of neonates stratified by severity of NNS

Variables	Total n (%)	Severe NNS, (N=40) n (%)	Mild NNS, (N=67) n (%)	X2 test p value*
Baby's age				
0 -7 days	30(28%)	6(20%)	24(80%)	0.020
8 - 28 days	77(72%)	34(44.2%)	43(55.8%)	
Baby's gender				
Male	62(57.9%)	22(35.5%)	40(64.5%)	0.634
Female	45(42.1%)	18(40%)	27(60.0%)	
Gestational age in weeks				
33-36	9(8.4%)	3(33.3%)	6(66.7%)	0.794
37 and above	98(91.6%)	37(37.8%)	61(62.2%)	
Birth weight of the baby				
1-2.5Kg	17(15.9%)	4(23.5%)	13(76.5%)	0.170
2.6-5Kg	90(84.1%)	36(40%)	54(60%)	
Feeding initiation after delivery				
< 1 hour	57(53.3%)	20(35.1%)	37(64.9%)	
1-2 hours	26(24.3%)	7(26.9%)	19(73.1%)	0.205
2-4 hours	8(7.5%)	5(62.5%)	3(37.5%)	
>4 hours	16(15%)	8(50%)	8(50%)	
Type of feed that the new-born fed on after delivery				
Breast milk	96(89.7%)	32(33.3%)	64(66.7%)	0.011
Formula feed	11(10.3%)	8(72.7%)	3(27.3%)	

Abbreviations: NNS= Neonatal Sepsis; * Significant p value

Socio-demographic and socio-economic characteristics of mothers classified by severity of NNS: Table 2 shows the socio-demographic and socio-economic characteristics of mothers stratified by severity of NNS. The study demonstrated a significant association between mothers' level of education and the severity of neonatal sepsis (*p=0.021*). There were an increased proportion of neonates with severe NNS among mothers with primary level of education (55.0%) and secondary school (42.3%) as compared to those who had attained tertiary education (20.0%). Households' income per month was statistically significantly associated with the severity of neonatal sepsis (*p=0.018*). Households whose monthly earnings was less than KShs 10,000 per month had higher proportions of neonates with severe NNS (50.0%)than households with income of above KShs 20,000 (13.6%).Kind of toilet was significantly associated with severity of neonatal sepsis (*p = 0.030*) where mothers who use pit latrines had more neonates with severe NNS (50.0%) than mothers using flush toilets (29.2%).

Table 2

Socio-demographic/economic characteristics of mothers and severity of NNS

Variables	Total n(%)	Severe NNS (40) n(%)	Mild NNS (67) n(%)	X2 test p value*
Age in years				
Below 26	60(56.1%)	24(40%)	36(60%)	
26-30	23(21.5%)	9(39.1%)	14(60.9%)	0.638
30-49	24(22.4%)	7(29.2%)	17(70.8%)	
Residence				
Mid-level urban setting	83(77.6%)	32(38.6%)	51(61.4%)	0.196
Urban slum area	15(14%)	3(20%)	12(80%)	
Rural area	9(8.4%)	5(55.6%)	4(44.4%)	
Religion				
Protestant	64(59.8%)	27(42.2%)	37(57.8%)	
Catholic	34(31.8%)	11(32.4%)	23(67.6%)	0.390
Others (SDA, Muslim)	9(8.4%)	2(22.2%)	7(77.8%)	
Mother's marital status				
Single	20(18.7%)	8(40%)	12(60%)	
Married	84(78.5%)	31(36.9%)	53(63.1%)	0.957
Separated/Divorced	3(2.8%)	1(33.3%)	2(66.7%)	
Mother's level of education				
Primary level	20(18.7%)	11(55%)	9(45%)	
Secondary level	52(48.6%)	22(42.3%)	30(57.7%)	0.021
College/University level	35(32.7%)	7(20%)	28(80%)	
Mother's occupation				
Self employed	29(27.1%)	9(31%)	20(69%)	
Informal employment	27(25.2%)	10(37%)	17(63%)	0.666
Not employed	51(47.7%)	21(41.2%)	30(58.8%)	
Gross household income				
Below 10,000	40(37.4%)	20(50%)	20(50%)	
10,000 - 20,000	45(42.1%)	17(37.8%)	28(62.2%)	0.018
Above 20, 0000	22(20.6%)	3(13.6%)	19(86.4%)	

Availability of specific food preparation room				
Yes	54(50.5%)	23(42.6%)	31(57.4%)	0.261
No	53(49.5%)	17(32.1%)	36(67.9%)	
Kind of toilet				
Pit latrines	42(39.3%)	21(50%)	21(50%)	0.030
Toilet (flushable)	65(60.7%)	19(29.2%)	46(70.8%)	
Source of water				
Borehole/well/vendors	19(17.8%)	8(42.1%)	11(57.9%)	0.639
Tap water	88(82.2%)	32(36.4%)	56(63.6%)	
Abbreviations: NNS= Neonatal Sepsis; * Significant p value				

Maternal/obstetric characteristics and severity of NNS on admission: Parity and severity of neonatal sepsis were significantly associated (p = 0.003). Primipara mothers tended to have neonates with more severe NNS (50.9%) than multipara mothers (23.1%). Moreover, mothers who reported to have drained greenish liquor (amniotic fluid) during labor had neonates with more significantly (*p=0.006*) severe form of neonatal sepsis (63.6%) compared to those mothers who had drained clear liquor (31.2%) (Table 3).

Table 3

Maternal/obstetric characteristics and severity of NNS on admission

Variables	**Total**	**Severe NNS, (N=40)**	**Mild NNS, (N=67)**	**χ2 test**
	n(%)	**n(%)**	**n(%)**	**p value***
Frequency of ANC attendance				
>3 times	23(21.5%)	12(52.2%)	11(47.8%)	0.098
4 times or more	84(78.5%)	28(33.3%)	56(66.7%)	
Parity				
Primipara	55(51.4%)	28(50.9%)	27(49.1%)	0.003
Multiparous	52(48.6%)	12(23.1%)	40(76.9%)	
Duration of the labor (102∞)				
Less than six hours	39(38.4%)	20(51.3%)	19(48.7%)	
6-10 hours	34(33.3%)	10(29.4%)	24(70.6%)	0.102
More than 10hours	29(28.4%)	9(31%)	20(69%)	
Time taken from the time membranes ruptured to delivery (102∞)				
Less than 4 hours	70(68.6%)	27(38.6%)	43(61.4%)	
4-6hours	17(16.7%)	4(23.5%)	13(76.5%)	0.222
More than six hours	15(14.7%)	8(53.3%)	7(46.7%)	
Color of the liquor (102∞)				
Clear	80(78.4%)	25(31.2%)	55(68.8%)	0.006
Greenish	22(21.6%)	14(63.6%)	8(36.4%)	
Frequency of vaginal examinations done during labor				
2 times and less	55(51.4%)	18(34.5%)	31(65.5%)	
3 to 4 times	26(24.3%)	11(42.3%)	15(57.7%)	0.79
More than 4	26(24.3%)	10(38.5%)	16(61.5%)	
Whether given any health information on prevention of infection to the newborn				
Yes	73(68.2%)	30(41.1%)	43(58.9%)	0.245
No	34(31.8%)	10(29.4%)	24(70.6%)	
Abbreviations: NNS= Neonatal Sepsis; ∞5 delivered through Cesarean; *Significant p value				

Factors associated with severity of NNS on admission: Multivariable analysis was performed in order to identify factors independently associated with severity of NNS during admission. Seven (7) variables with p-value <0.05 in the bivariate analysis were considered together in the multiple regression analysis. Upon fitting these factors using binary logistic regression and specifying *'backward LR'*method with removal at P<0.05, four (4) factors retained in the final model (Table 4).

Neonates aged 8 to 28 days were about 3 times more likely to have severe NNS during admission [AOR=2.89; 95%CI=1.07-7.99; P=0.047] compared to those neonates aged less than 8 days. Mothers with primary level of education had 4.5 times more likely to have neonates with severe NNS [AOR=4.57; 95%CI=1.18-17.67; P=0.028] compared to those with tertiary education. Similarly, primipara mothers tend to have about 4.5 times more neonates with severe NNS [AOR=4.64; 95%CI=1.74-12.37; P=0.002] than multipara mothers.Mothers who indicated the liquor (amniotic fluid) during labor was greenish had 3 fold more neonates with severe NNS during admission [AOR=3.11; 95%CI=1.05-9.24; P=0.041]compared to those mothers who indicated clear.

Table 4

Factors associated with severity of NNS on admission

Variables	AOR	(95%CI)		*p value
		Lower	Upper	
Baby's age				
0 -7 days	1.00			
8 - 28 days	2.89	1.07	7.99	0.047
Mother's level of education				
Primary level	4.57	1.18	17.67	0.028
Secondary level	2.48	0.81	7.62	0.114
College/University level	1.00			
Parity				
Primipara	4.64	1.74	12.37	0.002
Multiparous	1.00			
Color of the liquor				
Clear	1.00			
Greenish	3.11	1.05	9.24	0.041
AOR = Adjusted Odds Ratio; CI= Confidence Interval; *Bolded Significant P value				

DISCUSSION

The study revealed the alarming prevalence of severe neonatal sepsis (37.4%) at the time of admission. This figure indicates that there is dire need to explore ways of mitigating the factors contributing to severe neonatal sepsis. The weak immune system of the neonates further complicates the severity of sepsis. This further translates to more complications resulting from the sepsis such as organ failure (acute kidney injury, neurological implications resulting from metabolic derangements and many more). Poor immune response, complications from sepsis are more likely going to result in poor prognosis and high neonatal mortality.

Neonates aged 8 to 28 days were about 3 times more likely to have severe NNS during admission compared to those neonates aged less than 8 days.This could be related to the compounding effect of events during labour, delivery, after delivery and home environment since neonates aged less than 8days were home longer than those <8days. It could also be related lack of continuity in care after discharge from hospital in early postnatal period given that 51.4% of the mothers were first-time mothers with little exposure to newborn care. The study finding on the significantly higher proportion of severe NNS [P=0.020] among neonates who developed LONNS could also be attributed to the compounding effect of community-acquired LOS risks which include poor hygiene, poor cord care, bottle-feeding, and prelacteal feeds (9). Mothers who used pit latrines tended to have neonates with more severe NNS than mothers who were using flush toilets. This could be due to the environmental effects in the home setting. In their study (10) confirmed this when they concluded that an improved standard of living, education and empowerment of women and increased provision of basic social amenities would go a long way in reducing the morbidity and mortality of neonatal sepsis in the environment.

Parity was independently associated with severity of NNS in a multivariate analysis where primipara mothers tend to have about 4.5 times more neonates with severe NNS than multipara mothers. This reflected the impact being a first-time mother has towards prevalence of neonatal sepsis mainly due to lack of experience on newborn care.

Mothers with primary level of education had 4.5 times more likely to have neonates with severe NNS compared to those with tertiary education. This finding supports previous findings in a study in Nigeria which found that mothers with no formal or with only primary education had high proportions of culture proven sepsis (41.1% and 58.8% respectively) (11). This implies that lower level of education could have led to inability to offer appropriate newborn care, lack of awareness that the baby was unwell and probably seek healthcare when the sepsis was severe. This could also amount to poor prognosis of the neonates who were brought to hospital in severe sepsis thereby result in high mortality of the neonates born to mothers with primary education and below.

Mothers who indicated the liquor (amniotic fluid) during labor was greenish had 3 fold more neonates with severe NNS during admission compared to those mothers who indicated clear.This concurs with previous study which found that factors which carried a significant risk for development of neonatal sepsis were premature rupture of membrane, meconium stained amniotic fluid among others (12). The study findings imply that neonates born through meconium stained liquor had an odds of 3.85 of developing neonatal sepsis than those born through clear liquor. This could be related to the possibility of aspiration as well as contamination of the cord stump which is an important portal of entry of pathogens.

Similar to other studies, the study demonstrated the role of antenatal care in the occurrence of late onset neonatal sepsis (LONNS). A study conducted in Brazil demonstrated that LONNS was much lower among neonates whose mothers adhered to at least six (the recommended in Brazil) antenatal visits (38%) than the average rate of 61% (13).

The study however, didn`t demonstrate significant association between the healthcare provider practice and severity of NNS during admission. This however does not negate the role healthcare practice has in the prevention and control of occurrence of neonatal sepsis.

CONCLUSION

Severity of neonatal sepsis is higher among neonates who develop neonatal sepsis between 8-28days, those born to first time mothers and to mothers with low level of education. Poor socio-economic status was also associated with development of severe neonatal sepsis.

The study therefore recommends that prophylactic treatment should be instituted for neonates at risk of severe neonatal sepsis. The study further recommends development of strategies to include at risk mothers in program geared towards newborn care.

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