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PERINATAL MORTALITY IN THE SPECIAL CARE NURSERY OF MOI TEACHING AND REFERRAL HOSPITAL, ELDORET, KENYA
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ABSTRACT

Objectives: **To determine the mortality rate and causes of death of all infants admitted to the Special Care Nursery (SCN) of a tertiary referral hospital in rural Kenya.**
Design: **Prospective and Cross-sectional study**
Setting: **Special Care Nursery, Moi Teaching and Referral Hospital, Eldoret, Kenya.**
Subjects: **All infants admitted to the Special Care Nursing (SCN).**
Main Outcome measures: **Survival status at seven postnatal days; major causes of mortality and morbidity.**
Results: **Three hundred and thirty five babies were studied between February and September 1999. Out of these 167(49.9%) were male. There were 50(15%) preterm and 124(37.3%) low birth weight babies. There were 198(76.2%) appropriate for gestational age (AGA), 46(17.7%) small for gestational age and 16(6.2%) large for gestational age babies. The seven day mortality rate of infants admitted to the Special Care Nursery was 66(19.7%). Birth asphyxia and respiratory distress accounted for most deaths. Infants who were admitted primarily because the mother remained under general anesthesia generally did well. Logistic factors, including inadequate training for neonatal resuscitation in ward cadre of staff, unavailability of trained paediatricians and obstetricians, and inadequate operating theatre supplies were all found to delay treatment and likely to increase mortality.**
Conclusion: **Morbidity and mortality of infants born at the MTRH remain high. The most common cause of mortality remains birth asphyxia. Some causative factors, such as lack of resources or personnel, are logistic and could be rectified. Antenatal care had a significant positive impact on both morbidity and mortality.**

INTRODUCTION

Perinatal and neonatal mortality are important health statistics, reflective of the general adequacy of health care delivery in a population(1). Unfortunately, there is a paucity of data on these mortality rates in the developing world, the very populations where they would be most useful(2,3). Many factors contribute to this, including the lack of adequate data gathering and analysis, infrastructure, home deliveries, and unreported deaths. These factors lead to inaccuracies in both the numerator and denominator of the resultant perinatal or neonatal mortality statistics for many impoverished populations.

This is true for the Republic of Kenya, located in equatorial East Africa. Several studies have attempted to define the Infant Mortality Rate in Kenya, and have generated estimates of 60-80/1000 births(4,5). These studies have been plagued by the problems mentioned above(6-11). To overcome this problem, we have analysed the outcome of infants born at the Moi Teaching and Referral Hospital through the first seven days of life. This does not result in a true PMR, as it does not include third trimester foetal deaths. Also, it is not a true NMR, as it does not include deaths between seven and 28 days. However, it is a population in which both deaths and total numbers can be prospectively defined very precisely. Mortality in the first seven days has been shown to constitute 90% of total infant mortality(7). The study was undertaken in a prospective manner, assuring that the mortality in all births would be accurately recorded, as would the total number of births. In addition, the prospective nature of the study enabled us to examine factors intrinsic to the infant, such as low birth weight and prematurity, as well as infrastructure and logistic issues which contribute to mortality.

The results of the present study will not define PMR or IMR for Kenya(12-14). The results will, however, give an estimate of the expected mortality rate

of infants born in similar referral hospitals throughout Africa, and suggest areas for infrastructure and logistic improvement which will improve overall PMR.

MATERIALS AND METHODS

Study site: The study was conducted at the MTRH Special Care Nursery (SCN), affiliated to the Moi University Faculty of Health Sciences. It is the teaching facility for medical, nursing, and environmental health students, one of two medical schools in Kenya. The hospital serves as the tertiary referral hospital for Western, Nyanza and North Rift Valley Provinces, serving an estimated total population of five million.

Study population: All infants admitted to the newborn special care unit at Moi Teaching and Referral Hospital were included. Only infants born at MTRH were admitted to this unit. Infants delivered at MTRH with no physiologic problems in either mother or infant were not admitted to the SCN, and hence not included in the study. All infants born before arrival (BBA) were excluded.

Data collection: Data were collected on all SCN admissions. The infants were examined within 24 hours of admission by a paediatric service physician and/or principal investigator (SA). The infants were assessed by a full clinical examination for gestational age and birth weight; the National Centers for Health Statistics (NCHS) charts were used to classify the intrauterine growth as small, normal, or large for gestational age. All medical problems and diagnoses were recorded. A questionnaire was used to record socio-demographic data, antenatal care, and details of labour and delivery. Reasons for delay in examination or treatment of the mother or infant were recorded.

All medical problems upto and including the seventh day of life were recorded. The outcome of the infant on the seventh day was recorded as alive or dead. An infant discharged home prior to the seventh day was recorded as alive. The cause of death was determined from the patient's notes, as postmortem examination were not performed.

Data analysis: Data were analysed using SPSS. Results are presented as means ± SD or as frequency (%). Correlations were estimated using Pearson's 2-tailed correlation. Correlations were assumed to be statistically significant if $p < 0.05$.

Ethical considerations: Verbal consent was obtained from parents of all infants. Permission to carry out the study was granted by the hospital medical superintendent. Patients participating in the study were managed according to the standards of SCN. Confidentiality was assured by not including any patient identifiers on study documents or reports.

RESULTS

Study was conducted between February and September 1999. A total of 335 babies were studied, of whom 167(51.7%) were male. Of the admitted babies, 66(19.7%) had died by the seventh day of life. There were 50(15%) preterm and 124(37.3%) low birth weight babies.

Maternal demographic data are given in Table 1. About half (53.2%) of mothers had up to eight years of education, 11(3.5%) had no education, the range was 0-16 years and the mean was 9.6 years. The majority of the mothers were married. Most of the mothers were housewives while most of the fathers were farmers.

Most women 304 (90.7%) had at least one antenatal clinic visit during the pregnancy, 25(7.6%) did not attend while for 6(1.8%) it was unknown if they attended as shown in Figure 1. The number of attendances ranged from zero to fifteen with an average of 2.3. The largest number of mothers 112(33.4%) had three clinic visits. There was no cut-off point for the appropriate number of visits. The rural health centres were the most frequent site of antenatal care, although many of the mothers had been seen in the clinics of MTRH. The mean gestational age of first clinic attendance was 23 ± 5 weeks. Most women 154(67%) began antenatal visits between the 15th and 25th weeks of gestation, while 9(4%) began before 15 weeks and 69(30%) began after 26 weeks. Table 2 shows that 53(15.8%) mothers had bad obstetric history (BOH). The most common type of BOH was abortion 28 (52.8%). The most common previous mode of delivery was breech 175 (46.5%). In addition to routine antenatal counseling, 80 women were treated for intercurrent diseases. Table 3 demonstrates that malaria was the most common disease 33(34%), followed by pre-eclampsia 1(12%), anaemia 9(10%), brucellosis 6(6%), UTI 5(5%), APH 4(4%), eclampsia 3(3%) and 24(25%) treated other diseases (25%). About 162(49.7%) of the mothers had received some drugs during pregnancy. Haematinics were the most frequent medication prescribed 78(48%), followed by analgesics (16.1%), anti-malarials (12.3%), antibiotics (7.2%), and anti-hypertensive drugs (3.8%) during the antenatal period. Of the 36 mothers who had investigations other than antenatal profile done, 18(50%) had prenatal ultrasound performed.

The time taken by mothers from home to hospital was 0.5 - 88.5 hours with a mean of 9.49 ± 56.4 hours. Public means of transport were utilised by 73%, private vehicle by 10%, ambulance by 10%, and other means, primarily bicycle or walking, by 6%.

There was great variability in the time from presentation at the labour ward to examination by an obstetrical physician. Ninety (27%) of women were examined immediately and 208(62%) between one to four hours. However, 37(11%) of all women were not examined by five hours. The mean time of first examination was 1.95±3.1 hours, with a range of 0 - 26 hours.

Average duration of labour was 15.73±11.3 hours for first stage, 40 ± 40 minutes for second stage, and 30.1±48 minutes for the third stage. Membranes had ruptured before delivery in 146 (48%) of cases. Duration of ruptured membranes exceeded 20 hours in 25(17%) of these women.

Of all infants admitted to the SCN 192(58%) were delivered by lower uterine segment Caesarian section, 118(36%) by spontaneous vaginal delivery, and 12(4%) by breech vaginal extraction, and 8(2.4%) by vacuum extraction. The indications for Caesarean section are shown in Figure 2, with previous Caesarean section being the most frequent indication.

The time that elapsed from decision to perform a Caesarian section to carrying out the procedure ranged from 0.3 to 140 hours with a mean of 5.34±14.5 hours. 163(84.7%) of Caesarian sections were performed within five hours of the decision, but there were instances of delay greater than 10 hours. Only 29(8.7%) of the mothers had their Caesarian sections done within the acceptable time of one hour. The delays were due to physician unavailability 46(38%), unavailability of operating theatre 24(20%), delays in obstetrical consultations 15(12.5%), lack of theatre supplies 6(5%), delays in obtaining consent 3(2.5%) and other reasons 20(24%).

Table 1

Parental demographic data

Variable	Frequency (%)	Mean (range)
Maternal age (years)		23.75 (14-48)
Maternal education (years)	n=316	
0-8	168 (53.2)	
9-12	120 (38)	
13-16	28 (8.9)	
Marital Status		
Married	250 (75.1)	
Single	83 (24.9)	
Occupation	Mother (n=331)	Father (n=243)
Housewife/househusband	197 (59.5)	2 (0.9)
Trader	28 (8.5)	53 (22.7)
Student	19 (5.7)	1 (0.4)
Teacher	12 (3.6)	19 (8.2)
Housegirl/boy	8 (2.4)	19 (0.4)
Farmer	6 (1.8)	85 (36.5)
Other	56 (16.9)	37 (15.9)

Table 2

Past obstetric history

Variable	Frequency	(%)
Bad obstetric history	53	
Abortion	28	52.8
Still birth	14	26.4
Neonatal death	5	9.4
Perinatal death	3	5.7
Infant death	3	5.7
Previous deliveries	376	
Breech	175	46.5
SVD	99	26.3
LUSCS	82	21.1
Abortion	20	5.3

Table 3

Maternal illness during antenatal period

Illness (n=80)	Frequency	(%)
Malaria	33	33.7
Pre-eclampsia	11	11.6
Anaemia	9	9.5
Brucellosis	6	6.3
Urinary tract infection	5	5.3
Ante partum haemorrhage	4	4.2
Eclampsia	3	3.2
Other	24	25.3

Table 4

Delivery room and SCN management

Intervention	Frequency	(%)
Delivery Room		
Airway suction	240	33.8
Oxygen	156	21.6
Glucose	142	19.6
Sodium bicarbonate	117	16.2
Positive pressure ventilation	30	4.1
Aminophylline	25	3.5
External cardiac massage	13	1.8
SCN		
Oxygen	117	24.1
Glucose	63	13
Sodium bicarbonate	30	6.2
Antibiotics	82	16.9
IV Fluids	76	15.7
Anticonvulsants	20	4.1
Other	40	8.2

Table 5

Factors which were correlated with seven day outcome

Positive	Negative
Antenatal care (r= 0.228, p=0.01)	Premature labour (r= -0.359, p=0.01)
Antenatal profile performance (r=0.178, p=0.01)	10 minute Apgar (r=-0.329, p=0.01)
Antenatal haematinics (r= 0.196, p=0.05)	Birth Weight (r=-0.343, p=0.01)
Diagnosis of CPD (r= 0.126, p=0.01)	Prematurity as admission diagnosis (r= -0.335, p=0.01)
Repeat C-section (r= 0.121, p=0.05)	Asphyxia (r= 0.337, p=0.05)
	Need for antibiotics (r= -0.346, p=0.01)
	Need for Oxygen in SCN (r= -0.427, p=0.01)
	Need for aminophylline in SCN (r= 0.486, p=0.01)

Correlations were by two tailed Pearson's test, and significant at $p<0.05$.

Figure 1

The number of mothers attending antenatal clinics at various sites is shown in the main graph. The gestation ages at which clinic attendance was begun is shown in the inset figure

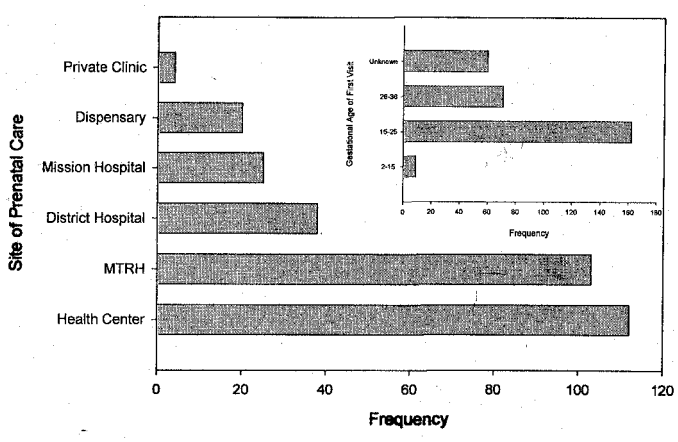


Figure 2

The number of admission in each birth weight category is shown in the top panel. The bottom panel shows the intrauterine growth classification

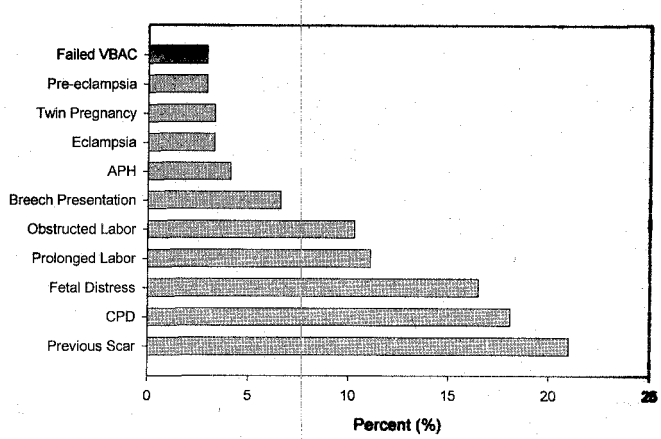
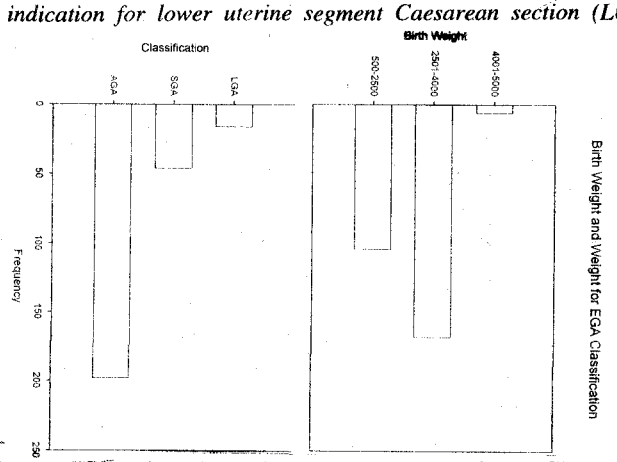


Figure 3

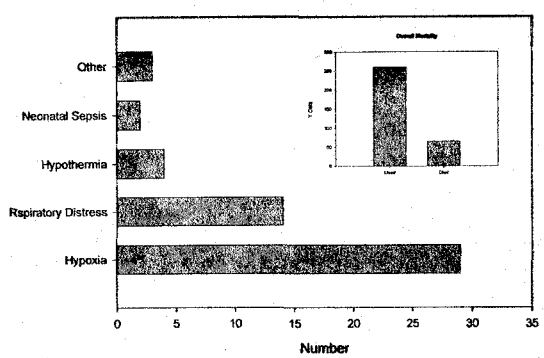
The frequency of indication for lower uterine segment Caesarean section (LUSCS) is shown



VbAC= Vaginal Birth after Caesarean Section, APH=Ante partum haemorrhage, CPD= Cephalopelvic Disproportion

Figure 4

The number of infants dying secondary to various causes is shown in the main figure. The total numbers surviving and dying is shown in the inset figure



The Apgar scores of the admitted infants were three or less at one minute in 63 (19%), in 27(8.1%) at five minutes, and in 13(3.9%) at ten minutes. One hundred and eighty six (56 %) of infants had one minute Apgar score of seven or more, 230(69.1%) at five minutes, and 265(79.6%) at 10 minutes. Apgar scores between four and six were observed in 83(25%) at one minute, 76(22.8%) at five minutes and 55(16.5%) at ten minutes.

Delivery room management and resuscitation was primarily by midwives 249(95%). Medical students 9(3.4%), medical officers 3(1.1%), and anaesthetists 1(0.4%) also resuscitated some infants. Low Apgar scores were the primary reason for resuscitation, but aspiration, respiratory distress and need to clear the airway were additional indications. The frequencies of specific delivery room interventions are given in Table 4.

The primary indication for admission to the SCN was the mother remaining under anaesthesia after Caesarean section, thus unable to care for the infant. This accounted for 167 (40%) of all admissions followed by birth asphyxia 119 (28.5%), prematurity 76(18.2%), respiratory distress 13(3.1%), and other miscellaneous indications 42(10.3%). The mean duration of stay in the SCN was 2.74 ± 3.99 days, with a range of 1-42 days. The frequencies of specific SCN interventions are given in Table 4. The birth weights and intrauterine growth classifications are shown in Figure 3. The birth weights were 500-2500 gm in 105 (37.4%), 2501 - 4000 gm in 170 (60.5%) and over 4000 gm in six 6(2.1%). There were 198(76.2%) AGA, 46 (17.7%) SGA and 16 (6.2%) LGA babies.

The overall seven day mortality and immediate causes of death are shown in Figure 4. Hypoxia and respiratory distress were the most common causes of mortality. The immediate causes of death were associated with a number of logistic factors also. These included delay in clinical assessment 23(37.1%), lack of resuscitation facilities nine (15.5%), lack of drugs five (8.6%), abrupt change in the infant's condition three (5.2%), and other miscellaneous problems 17 (29%).

Since asphyxia was such a prevalent cause of death, correlations with other factors were sought. Asphyxia was positively correlated to mode of delivery, resuscitation with sodium bicarbonate, resuscitation with 50% dextrose, with aminophylline, with oxygen,

and with external cardiac massage (p<0.01). Low Apgar scores at one and five minutes, and need for oxygen in the SCN were also positively correlated with birth asphyxia (p<0.01) .

Factors which correlated, either positively or negatively, with a good seven day outcome are listed in Table 5. Birth asphyxia was a significant negative predictor of outcome, while admission to the SCN because of prolonged maternal anaesthesia was a significant positive predictor.

DISCUSSION

In this study, we have identified the major reasons for referral of gravidas to a tertiary health care facility in Kenya, the causes for admission of the neonate to the SCN, and the survival outcome of these infants. Causes of death and potential areas for improvement of care have been identified.

In this study, 90% of mothers attended at least one antenatal clinic; such attendance had a significantly positive effect on neonatal seven-day outcome as has been shown in other studies. Most mothers began attending antenatal clinic between 16-30 weeks of gestation. We did not find any association between earlier antenatal clinic attendance and outcome; however, this may be due to small numbers and lack of statistical power. On the other hand, mothers who had no antenatal care or did not receive antenatal treatments, including haematinics, had a poor neonatal outcome, again as has been seen in other studies(9,10). The administration of haematinics to most mothers who received drugs during the antenatal period was consistent with Government policy and also justified by the low average haemoglobin found in the subjects of this study. Our finding of the association of previous history of abortion with mortality was similar to Were's study(11). It is our belief that the poor antenatal management given to mothers in this region could result in even higher mortality rates for mothers who are not referred to a tertiary facility.

The most common diagnosis for the mothers in labour was foetal distress followed by previous uterine scar. This is because the MTRH is a National Referral Hospital mandated to admit high risk pregnancies. A physician reviewed 27% of the women immediately upon admission; the remainder of the women was examined at a later time, and this may also have contributed to poor outcome.

The most common mode of delivery was Caesarian section. The most common reasons for Caesarean section were previous Caesarean section, CPD, foetal distress, and prolonged or obstructed labour. Previously it had been believed that foetal distress was the most common indication for Caesarean section, and this continues to be borne out. However, as Caesarean section becomes more available in East Africa, previous Caesarean section is becoming an important indication. It is unknown whether vaginal birth after Caesarean section (VBAC) is safe in a setting where foetal and maternal monitoring is less sophisticated than in Europe or North America. Our data suggest this may be an important research question.

The time that elapsed from decision to performance of Caesarean section was quite variable and unacceptably long (more than five hours) in most cases. Though the ideal time should be 30 minutes, up to 60 minutes is acceptable.(Nyongesa - personal communication). In most cases, the reasons for delay are addressable with sufficient human and material resources. However, the time that elapsed did not statistically correlate with the outcome. The reasons for this lack of correlation are unknown, but again may be due to small subject numbers.

The indications for SCN admission in the present study were similar to a previous one in the same SCN, although admission for prematurity is now more common(15). Lack of resources limited the specificity of some diagnoses. For instance, asphyxia was diagnosed solely on the basis of a five minute Apgar score less than three, associated with neurological sequelae. This diagnostic criterion may have missed some infants with mild to moderate asphyxia who subsequently did well. The rate of neonatal jaundice was low in relation to the presumed at risk population(1). Population data would suggest that Rhesus sensitisation and ABO incompatibility should be a risk factor in 8% and 16% of the population respectively(16,17). However, infants were screened for jaundice only after visual diagnosis. Also, it is well known from studies in the United States that African-American infants have lower bilirubin levels than do Caucasian or Asian infants(18).

Another factor influencing morbidity and mortality may has been the training and skill levels of resuscitation personnel. The vast majority of delivery room resuscitations were carried out by midwives; none were carried out by trained paediatricians. Again, this reflects the lack of resources even in a tertiary referral hospital.

The number of low birth weight infants in the present study was 37.4%, which was lower than a previous study from Kenyatta National Hospital(7). However, our numbers are skewed by the number of infants who were admitted solely because the mother remained under general anaesthesia. Only 17.7% of admissions were SGA, reflective of the high risk referral population. Abnormal foetal growth patterns were associated with greater mortality. Likewise, premature or post-mature infants (31.1% and 12.3%, respectively) also affected mortality.

The seven-day mortality normalised to 1000 admissions in the present study was 197. While not a true perinatal portality rate, it does represent a minimum estimate of the true rate(12-14). Our data were also specific to the MTRH, and do not necessarily represent Western Kenya in general. However, the data do point out that mortality in newborn infants remains high, even in a tertiary hospital in East Africa. The rate in the

present study can be compared to the KNH estimate of 214/1000 in 1992(7).

We believe our study has identified several factors which are correctable with adequate provision of affordable resources, such as operating theatre supplies and readily available pharmaceuticals. Increased numbers of trained paediatricians and obstetricians would decrease the time delays in evaluation and treatment of patients, almost certainly improving outcomes. Better training of personnel providing primary antenatal care and of midwives in performing resuscitation would also likely improve outcomes.

In conclusion, mortality of infants born at the MTRH remain high, and are associated with factors identified in this study. Some factors are logistic and could be rectified. The most common cause of mortality was birth asphyxia. Antenatal care had a significant positive impact on mortality.

We recommend that adequate resources such as operating theatre supplies and pharmaceuticals should be provided. The number of paediatricians and obstetricians attending to the high risk newborn babies should be increased to decrease delays in evaluation and treatment of patients.

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