T I T L E :

NEONATAL MORBIDITY AND MORTALITY AT KENYATTA NATIONAL HOSPITAL NEWBORN UNIT. A PROSPECTIVE STUDY DECEMBER 1982 - MAY, 1983

BY

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IN

THE UNIVERSITY OF NAIROBI.

I CERTIFY THAT THIS DISSERTATION IS MY ORIGINAL WORK AND HAS NOT BEEN PRESENTED FOR A DEGREE IN ANY OTHER UNIVERSITY

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THIS DISSERTATION HAS BEEN SUBMITTED FOR THE EXAMINATION WITH MY APPROVAL AS UNIVERSITY SUPERVISOR.

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s u m m a r y

A prospective study on the morbidity and mortality pattern of 939 infants admitted at the newborn unit (NBU) at the Kenyatta National Hospital over a six month period is presented. 59.8% of admissions were low birth weight (LBW) and 61.9% were preterm. The overall mortality was 24.6%. Mortality was highest among infants weighing 2000g or less and those below 35 weeks weeks gestation.

Respiratory distress, asphyxia and infections were the main causes of morbidity and mortality. Jaundice, hypothermia and apnoea were the other major problems encountered.

C O N T E N T S

Improvement in obstetric and neonatal care in developed countries, has resulted in a decrease in neonatal morbidity and mortality rates. This has been accompanied by a better prognosis for survivors (1,2). In the United States the neonatal mortality rate declined from 20/1000 live births in 1950 to 11.6/1000 live births in 1975 (1). Figures from the United Kingdom show that the neonatal mortality fell from 40/1000 live births sixty years ago to 10/1000 live births in Scotland and 8/1000 in England by 1976 (3). Usher, Thompson and Reynolds (4) demonstrated that in several centres in the United States, there is an unmistakable trend for lower mortality in hospitals that have developed neonatal intensive care units. Long term follow up of infants weighing 1500 gms or less has shown improved survival, and a lesser incidence of physical or mental handicap over the past twenty years (5,6,7).

In developing countries, neonatal morbidity and mortality figures are very high. Brown and Sandhu (8) found a neonatal death rate of 32.3/1000 live births among infants born at Mulago Hospital Kampala. Musoke (9) in a later study on admissions in the same hospital's special care

baby unit, reported a high mortality among low birth weight infants. Prematurity, infections and respiratory distress were the commonest causes of mortality and morbidity in LBW babies in that study, whereas perinatal hypoxia and birth trauma were common among normal weight infants. Tafari and Manshande (10) in a study of infants admitted to a special care unit in Addis Ababa Ethiopia, found most admissions to be LBW and preterm. Congenital pneumonia, perinatal asphyxia and hypothermia were the major clinical problems encountered. Ebrahim (12) in a review of statistics at Ocean Road Hospital Dar-es-Salaam, reported a neonatal mortality of 14,6/1000 live births. Dawodu and Effiong (11) in their series from Nigeria, reported a relatively low mortality among LBW infants,, comparable to that in developing countries. Low gestation, pulmonary immaturity, congenital malformations and infections were the main causes of mortality among their infants.

In Kenya, most reports have been on LBW infants, Oduori and Kaur (13) reported that 13.6% of babies born at Kenyatta National Hospital were LBW. Meme (14,15) reported a neonatal death rate of 53.3/1000 live births at Kenyatta National Hospital. The majority of deaths

occurred in low birth weight infants and perinatal factors were the major underlying cause. The major factors associated with mortality were immaturity, and anoxic and hypoxic conditions. Njuki (15) in a study of low birth weight infants at Machakos Provincial Hospital in Kenya found 56.7% of infants were preterm, and the overall incidence of deaths was 15.8%. Hyaline membrane disease, intraventricular haemorrhage, congenital malformations, aspiration and immaturity were the major causes of mortality.

The morbidity and mortality pattern at Kenyatta National Hospital is still not clear, and there has been no review for the last six years. It was with that in mind that the author set out to carry out this study with the following objective.

To determine the Neonatal Morbidity and Mortality pattern at Kenyatta National Hospital.

D I A G N O S T I C C R I T E R I A

1. ASPHYXIA :

Asphyxia was diagnosed by an Apgar Score of 5 at 1 minute (17,18,19).

2. INFECTIONS :

The criteria for diagnosis was adopted from the observations of Gotoff and Behrman (20) see appendix (i).

3. HYPOTHERMIA :

Hypothermia was defined as a core temperature $< 35^{\circ}$ C (21).

4. RESPIRATORY DISTRESS*:

Respiratory distress was diganosed according to the observations of Rudolph, Desmond and Pinida (22).

(a) Expiratory grunting
(b) Nasal flaring
(c) Cyanosis in room air
(d) Tachypnoea
(e) Diminished breath sounds on auscultation

(f) X-ray findings of reticulogranular, ground glass appearance with air bronchogram

(g) Extremeties oedematous after several hours.

* a - d respiratory distress

* a - g Idiopathic respiratory distress syndrome

5. LOW BIRTH WEIGHT :

Birth weight of 2500 gms or less (24).

6. PNEUMONIA :

Pneumonia was diagnosed from clinical features of respiratory distress and x-ray findings of patchy opacities and air bronchograms.

A B B R E V I A T I O N S :

NBU	NEWBORN UNIT
LBW	LOW BIRTH WEIGHT
AGA	APPROPRIATE FOR GESTATIONAL AGE
SGA	SMALL FOR GESTATIONAL AGE
LGA	LARGE FOR GESTATIONAL AGE
BBA	BORN BEFORE ARRIVAL (born outside Kenyatta National Hospital labour ward).
IRDA	IDIOPATHIC RESPIRATORY DISTRESS SYNDROME
FTABS	FLUORESCENT TREPONEMA ABSORBENT TEST
ABOHDN	ABO HAEMOLYTIC DISEASE OF THE NEWBORN
KNH	KENYATTA NATIONAL HOSPITAL.

MATERIALS AND METHODS

THE HOSPITAL MTERNITY

The Kenyatta National Hospital Maternity has 110 beds and admits high risk pregnant mothers followed up in the Hospital Antenatal Clinic, or those referred from other hospitals and health centres, Several mothers who do not fall in the above categories, also deliver at the Hospital. A paediatric resident attends high risk deliveries such as ceasarian sections, breach deliveries and vacuum extractions, but not all preterm deliveries.

THE NEWBORN UNIT

The Newborn Unit (NBU) has a total capacity of 30 incubators, and 15 cots. A hostel is available to accommodate mothers who have been discharged from the obstetric wards but who have babies in the (NBU). All babies with a birth weight of 2000 grammes and below are admitted to the Newborn Unit. Babies weighing over 2000 grammes are admitted if they have problems such as respiratory distress, asphyxia, jaundice, suspected infections or major congenital abnormalities. Neonates

of mothers with diabetes mellitus, hypertensive disease of pregnancy or rhesus negative blood group, are also admitted.

Care in The Newborn Unit includes maintenance of warmth in an incubator or cot in a warm room, and feeding within 3 hours of age by cup or nasogatric tube. Infants considered unfit for oral feeds are put on intravenous- 5% or 10% dextrose, and or electrolytes, until their condition is satisfactory to commence oral feeding. Oxygen when required is delivered in the incubator or by face mask, but apnoea monitors and mechanical ventilators are not available. Strict general cleanliness is maintained, infants with suspected infections are isolated and infection treated. Laboratory and radiological investigations are carried out as indicated.

PATIENT SELECTION

All newborn babies admitted to The Newborn Unit over a six month period (December 1982 to May 1983) were included in the study. The attending doctor or midwife gave a score for the condition of the baby at 1 minute and 5 minutes after birth according to the Apgar (17) scoring system. A complete physical examination was carried out by the author within 24 hours of birth to

assess the general condition and to elicit neonatal complications and congenital abnormalities. The gestational age was determined by the method of Dubowitz and Dubowitz (25) and according to maternal dates where available. The Colorado classification of Battaglia and Lubencho (26) was used to categorize infants according to birthweight, gestational age and pattern of intrauterine growth. Infants fell into three groups : small for gestational age (SGA), appropriate for gestational age (AGA) and Large for gestational age (LGA).

All babies in the study were examined daily by the author and followed up until discharge. A maternal obstetric and medical history was obtained from each mother and obstetric notes were also scrutinized. If an infant was born outside hospital, the mother was interviewed for details of the events surrounding labour. Unfortunately, no post-mortems were carried out during the study period, but deaths were analysed according to birthweight, place of birth, gestation and clinical associated cause of death.

RESULTS :

Admissions comprised 939 (30%) of 3126 babies delivered at the Hospital and 169 others born outside Kenyatta National Hospital Labour ward (BBA), but referred within 24 hours of life. 562 (59.8%) infants were of low birth weight (LBW). The majority of low birth weight infants (81%) were appropriate for gestation age (AGA), (19.9%) were small for gestational age (SGA) and (1.8%) were large for gestational age (LGA). 582 (61.9%) infants were preterm deliveries, 344 (36.8%) were term and 16 (1.7%) were posterm. 28 babies who were discharged before the author could examine them were excluded from the study. 231 babies died during the period of study, giving an overall mortality cf (24.6%).

MORTALITY ACCORDING TO BIRTH WEIGHT AND GESTATION :

Table 1 shows the distribution of neonatal deaths by birth weight and place of birth. Mortality was highest in infants weighing 1000 gms and below (96.2%) and lowest in those weighing 3000 gms and above (2.4%). There was no significant difference in mortality between (BBA) and hospital delivered babies when x^2 tests were applied for all weights; $0.05 > P > 0.01$.

TABLE I. NEONATAL MORTALITY ACCORDING TO BIRTH WEIGHT AND PLACE OF BIRTH

BIRTH WEIGHT (g)	NUMBER OF CASES (HOSPITAL DELIVERED) ADMITTED	DIED	% MORTALITY	NUMBER OF CASES (B.B.A.) ADMITTED	DIED	% MORTALITY	OVERALL MORTALITY
≤ 1000	60	59	98.3	20	18	90	96.2
1001-1500	117	63	53.8	33	14	42.4	51.3
1501-2000	148	44	29.7	34	7	20.6	28.0
2001-2500	115	9	7.8	35	2	5.7	7.3
2501-3000	139	10	7.2	31	0	-	5.8
> 3000	191	4	2.0	16	1	6.3	2.4
TOTAL :	770	189	24.5	169	42	24.8	24.6

$(0.05 > P > 0.01)$

TABLE II. MORTALITY ACCORDING TO GESTATION

GESTATION (WKS)	NUMBER OF CASES ADMITTED	DIED	% MORTALITY
∠ 28	69	64	92.8
28-29	63	46	73.0
30-31	70	43	61.4
32-33	69	27	39.1
34-35	139	28	20.1
36-37	172	13	7.6
38-39	240	8	3.3
40-41	104	2	1.9
>42-	14	-	-
TOTAL :	939	231	24.6

Table II depicts mortality according to gestation. Mortality was highest in infants below 28 completed weeks (92.7%) and lowest in infants of 40-41 weeks gestation (1.9%). No post-term infants died.

Table III compares mortality with birth weight and gestation, 221 (95.6%) of infants who died were preterm, while mortality among LBW infants alone was (93.5%). Mortality was greatest among infants weighing 2000 gms or less and below 35 weeks of gestation.

Table IV shows mortality and age at death in the newborn unit. 104(45.4%) of infants died during the first 24 hours, 95 (41.4%) during the next six days and 30(13.2%) in the next 21 days. 2 infants died during the post-neonatal period.

MORBIDITY AND MORTALITY

Table V shows the main associated causes of admission and death; and problems encountered at the NBU. Respiratory distress, asphyxia, infections, prematurity, jaundice, apnoea, hypothermia and prolonged rupture of membranes were the main causes of morbidity and mortality.

TABLE III. MORTALITY ACCORDING TO BIRTH WEIGHT AND GESTATION.

BIRTH WEIGHT (g)	28 Wks	28-29 Wks	30-31 Wks	32-33 Wks	34-35 Wks	36-37 Wks	38-39 Wks	40-41 Wks
≤ 1000	50	20	7	-	-	-	-	-
1001-1500	14	24	21	12	6	-	-	-
1501-2000	-	2	15	13	16	5	-	-
2001-2500	-	-	-	1	6	2	2	-
2501-3000	-	-	-	-	-	5	2	2
> 3000	-	-	-	-	-	1	4	-
TOTAL:	64	46	43	27	28	13	8	2

TABLE IV. NEONATAL MORTALITY ACCORDING TO WEIGHT AND DURATION OF STAY.

N= Total number of deaths within 28 days.

BIRTH WEIGHT (g)	UNDER 24 HRS.	%	1-7 DAYS	%	8-28 DAYS	%	OVER 28 DAYS	%
≤ 1000	43	18.8	30	13.1	3	1.3	1	-
1001-1500	30	13.1	35	15.3	11	4.8	1	-
1501-2000	21	9.2	20	8.7	10	4.4	-	-
2001-2500	5	2.1	4	1.7	2	0.9	-	-
2501-3000	2	0.9	6	2.6	2	0.9	-	-
> 3000	3	1.3	-	-	2	0.9	-	-
TOTAL :	104	45.4	95	41,4	30	13.2	2*	-*

* NOT INCLUDED IN PERCENTAGE CULCULATION.

TABLE V. CAUSES OF MORBIDITY AND MORTALITY AMONG ALL ADMISSIONS.

	1000		1001-1500		1501-2000		2001-2500		2501-3000		3000	
	ADMIT-TED	DIED%	ADMIT-TED	DIED%	ADMIT-TED	DIED%	ADMIT-TED	DIED%	ADMIT-TED	DIED %	ADMIT	DIED
RESPIRATORY DISTRESS	48	46(95.8)	85	36(42.3)	94	32(34.0)	44	1(2.3)	50	-	50	-
INFECTIONS	13	10(76.9)	50	24(48.)	88	13(14.7)	34	5(14.7)	27	5(14.8).	43	1(2.3)
ASPHYXIA	37	21(56.7)	47	17(36.1)	41	4(9.7)	32	4(9.3)	48	5(8.3)	68	4(5.8)
PREMATURITY	80	-	150	-	182	-	138	-	32	-	-	-
NEONATAL JAUNDICE	24	-	65	-	109	-	58	-	48	-	65	-
APNOEA	53	-	49	-	48	-	2	-	2	-	3	-
HYPOTHERMIA	21	-	22	-	26	-	8	1(16.6)	6	-	-	-
PROLONGED RUPTURE OF MEMBRANES.	3	-	17	-	17	-	10	-	8	-	5	-

RESPIRATORY DISTRESS :

Death associated with respiratory distress was greatest among infants weighing 1000 gms or less 95.8% but was uncommon in babies weighing above 2000 gms (Table V). Table VI shows the death rate from different conditions causing respiratory distress. Mortality from pneumonia was 36.8%, suspected idiopathic respiratory distress syndrome 18.7%, suspected meconium aspiration (17.3%). 5 infants had congenital cardiac lesions and one died. 2 infants had congestive cardiac failure unrelated to congenital cardiac lesions and one died. 2 infants had congenital laryngeal stridor and survived, while 2 infants who developed surgical emphysema succumbed. All three infants with x-ray proven IRDS died. Most cause of respiratory distress were undetermined, and 37.5% of infants in this group died.

TABLE VI.

CAUSES OF RESPIRATORY DISTRESS AMONG 939 ADMISSIONS.

	ALIVE	DIED	TOTAL	% DIED
Undetermined	30	18	48	37.5
Pneumonia	12	7	19	36.8
Suspected IRDS	217	50	267	18.7
Meconium aspiration	19	4	23	17.4
Congenital heart disease	4	1	5	20.0
Congestive cardiac failure	2	1	3	33.3
IRDS (X-ray Proven)	-	3	3	100
Surgical emphysema	-	2	2	100
Laryngeal stridor	2	-	2	-

TABLE VII.

TYPES OF INFECTION AMONG 939 ADMISSIONS

	ALIVE	DIED	TOTAL	% DIED
Septicaemia	64	23	87	26.4
Suspected septicaemia	56	23	79	29.1
Gastroenteritis	48	2	50	4.0
Meningitis	4	5	9	55.6
Congenital syphylis	4	1	5	20.0
Necrotizing enterocolitis	1	1	2	50.0
Rubella syndrome	-	1	1	100.0
Conjuctivitis	50	-	50	-
Skin sepsis	19	-	19	-
Oral thrush	12	-	12	-

I N F E C T I O N S:

Infections occurred in all weight groups but were commonest in infants weighing 1500 gms and below; Table (V). Table VII shows types of infections encountered and mortality therefrom. Septicaemia, gastroenteritis and meningitis were the commonest infections seen. 5.4% of babies with septicaemia had meningitis. Mortality from proven septicaemia was 26.4%. That of unproven septicaemia 29%, while 5 (55.5%) of infants with meningitis died. Five infants had congenital syphylis. Three of these infants had positive serology by both Wasserman and Fluorescent treponemal antibody absorbed test (FTA-ABS) whereas two had a positive Wasserman test only. Three mothers had attended antenatal clinic at health centres where serology is not routinely done, while one mother had not attended any antenatal clinic. One had positive Wasserman test during pregnancy but no subsequent tests were done. Her baby was low birth weight and had positive serology by Wasserman and FTA-ABS tests. This infant died from septicaemia at the age of 2 weeks. One infant had clinical signs of rubella syndrome and eventually died.

TABLE VIII.

INCIDENCE AND MORTALITY FROM BACTERIAL PATHOGENS ISOLATED

	% INCIDENCE	%MORTALITY
Klebsiella species	32.3	41.6
Staphylococcus albus	24.4	20.8
Escherichia Coli	10.0	4.2
Streptococcus fecalis	10.0	4.2
Staphylococcus aureus	5.6	4.2
Citrobacter Species	5.6	4.2
Pseudomonas aeruginosa	3.3	8.3
Beta haemolytic streptococci	3.3	4.2
Salmonella typhimurium	2.2	8.3
Actinobacter species	3.3.	---

Table VIII shows the incidence and mortality from bacterial pathogens isolated from infants with septicaemia. The following were the commonest pathogens found : Klebsiella species 32.3%. Staphylococcus albus 24.4%, Escherichia Coli 10% and Streptococcus fecalis 10%. Overall mortality was highest from infection with gram negative organisms (64%), and that from infection with gram positive organisms (36%. Klebsiella organisms accounted for 40% mortality. Klebsiella organisms and Actinobacter were the commonest organisms found in infants with meningitis. Conjuctivitis, oral thrush and skin sepsis, were the other infections seen.

ASPHYXIA :

The highest incidence of asphyxia neonatorum was seen in the infants of weight group 1500 gms and below. It accounted for 56.7% mortality in babies weighing 1000gms and below and 36.1% in babies of birth weight 1000-1500gms. Among babies weighing 2500 gms and above 60% died from asphyxia, Table (V).

JAUNDICE :

Jaundice was a common cause of morbidity but no infant died directly from this condition. Table (IX) depicts the causes of jaundice encountered in the study. In 54% of infants the cause was undetermined. 22.3% had septicaemia, 15.2% suspected physiological cause. Rhesus incompatibility accounted for 3% while ABO incompatibility, and sepsis combined with ABO incompatibility accounted for 2% each.

TABLE IX.

CAUSES OF JAUNDICE AMONG ADMISSIONS

	TOTAL	% INCIDENCE
Unknown	180	54.0
Septicaemia	75	22.3
Physiological	51	15.2
Rhesus incompatibility	10	3.0
Suspected ABO incompatibility	7	2.0
Suspected ABO incompatibility/ septicaemia	7	2.0
Hepatitis	2	0.6
Polycythaemia	1	0.3
Congenital syphylis	1	0.3
Cephalohaematoma	1	0.3

Neonatal hepatitis, polycythaemia, congenital syphlis and cephalohaematoma were uncommon.

APNOEA/HYPOTHERMIA :

These two conditions were commonest in infants weighing 2000 gms and below. One infant who weighed 2030 gms, died from Hypothermia. Table V.

PROLONGED RUPTURE OF MEMBRANES :

There was an overall incidence of 6.3% for this condition among all admissions, the highest occurrence being in LBW infants. Eight babies (13.3%) developed septicaemia.

CONGENITAL ABNORMALITIES :

4 infants were seen with major congenital abnormalities; one had meningomyelocele, another had ectopic vesicae, while the third and fourth had prune belly syndrome, and Pierre Robin syndrome respectively. The minor congenital abnormalities seen were polydactly, talipes equinovarus, hyperextensible limbs, skin tags and mongolian spots. 5 infants with suspected chromosomal abnormalities were seen. 2 had suspected Down's syndrome, 2 suspected Turner's syndrome and one was undetermined. One infant with Turner's syndrome died from septicaemia. None of these babies had obvious associated major congenital malformations.

DISCUSSION:

A study of neonatal morbidity and mortality at Kenyatta National Hospital newborn unit from 1st December 1982 to May 31st 1983 is presented. 30% of deliveries at the hospital were admitted to the NBU. This figure is higher than that reported by Dawodu and Effiong (11) of 8.7% and that by Musoke (9) of 10%. As mentioned before, the hospital admits high risk pregnant mothers but poor screening of newborns could have contributed to the high admission rate. Many infants were sen directly from the labour ward or the Casualty department before being reviewed by a paediatric resident. In this category fell infants born outside hospital, or those a midwife judged to require special attention at the NBU.

There was no significant relative risk in mortality between hospital deliveries and newborns born before arrival to hospital. Dawodu and Effiong (11) Chintu and Sokhani (27) also found no significant risk, whereas Meme (14,15) found a ten-fold increase in mortality among home delivered infants. One would expect to see a difference, considering the poor birth facilities available in the home setting and lack of easy transport to hospital. Provision of adequate neonatal transport, has been shown to significantly reduce mortality(28).

It is possible that many infants cannot reach the major hospitals and may be dying before being attended. However, the number of (B.B.A.) infants in this study was small so that firm conclusions cannot be made.

59.8% of infants admitted to the NBU during the study were LBW, and they accounted for 93.5% of all deaths. The mortality among LBW infants compares well with that of 85.8% reported by Meme (15), but is higher than that of 77% reported by Dawodu and Effiong (11).

The majority of LBW infants were AGA (81%) and 19.9% (SGA). The figures for SGA infants were lower than those reported by Meme (14,15) of 37% and Njuki (16) of 40%. Malan (29) found an incidence of 73% SGA infants in Bantu neonates in South Africa, whereas in Britain 30% of LBW infants were reported as being SGA (30). The relatively low figure in this study may reflect better management of disease in pregnancy at Kenyatta Hospital, or improved maternal nutrition, less intrauterine infection or improved socio-economic status of mothers admitted. Mortality was higher among AGA infants as compared to those who were SGA. This was not a surprising finding, as SGA infants have been reported to have higher survival rates (2,31)..

86% of infants died during the first week of life, a figure which did not differ significantly with that reported by Meme (14,15) of 96%. The deaths which occurred in less than 24 hours of life were 45.4%. This figure, though not quite at a level of statistical significance, was lower than that reported by Meme of 62.4%.

Mortality was highest in infants weighing 1000 gms or less. The mortality of 96% was similar to that reported by Meme (14,15) of 100% Njuki (16) 100% and Musoke (9) 97%. Dawodu and Effiong (12) reported a relatively low mortality of 75% for this weight group among Nigerian infants, which they attributed to a greater maturity for weight.

Mortality decreased with increasing weight among other weight groups, and were significantly higher than reports from developed countries (1,2,5,6,) but compared well with previous reports from East Africa (9,14,15,16). The lower mortality in developed countries has been attributed to the introduction of neonatal intensive care units and improved obstetric and neonatal care (1,2). At Kenyatta Hospital, improvement in obstetric and neonatal care is still at its prime, and this coupled with the admission of high risk

pregnant mothers, may be contributing to the higher mortality. It has been shown that in Nairobi, lack of antenatal care is associated with a four to five fold increase in perinatal mortality (33).

The incidence of preterm infants in the study of 61.9% was similar to that of 59% reported by Tafari et al (10) among Ethiopian infants. 89.5% of LBW infants in the present study were preterm and 43.9% of them died. Meme (14,15) found that 76.4% of LBW infants at Kenyatta National Hospital were preterm, while Njuki (16) reported that 56.7% of LBW babies at Machakos Hospital in Kenya were preterm. Adelusi and Ladipo (34) in Ibadan reported that 61.4% of their LBW infants were preterm. Musoke (9) also found prematurity to be an important cause of morbidity and mortality in Ugandan infants.

It is still not clear why prematurity is common at Nairobi, but Meme (14,15) has suggested that the altitude at Nairobi 5500ft (1800 metres) may be an important factor. Elsewhere, Litchy et al (35) found a higher frequency of prematurity at Colorado. The high risk pregnant mothers admitted to KNH may be a contributing factor.

RESPIRATORY DISTRESS :

Respiratory distress was used in general terms and included a variety of causes. In many cases of respiratory distress the cause remained undetermined, and the highest mortality 37.5% occurred in this group. The biggest drawback in diagnosis were lack of full investigations; in particular X-rays, and carrying out of autopsies.

18.7% of infants with suspected idiopathic respiratory distress syndrome died. Only 3 infants had X-rays compatible with this syndrome and they all died. It is conceivable that many cases with this condition were missed as few X-rays were done during the study and a number of infants also died before roentograms could be taken. Lack of post-mortems also contributed to the small numbers seen. Azubuike et al (36), Dawodu and Effiong (11) reported a low incidence of idiopathic respiratory distress syndrome in Nigerian infants as did Malan (37) among South African Bantu babies. It is to be remembered that the majority of infants in the above studies were SGA. Mati et al have reported an incidence of 10.1% of IRDS among infants during the perinatal period at Kenyatta National Hospital (66).

Mortality from pneumonia was 36.8% but here again, X-ray proof of infection was seen in very few infants. Meconium aspiration was suspected in 19 infants out of whom 4 (17.3%) died. Makomba (38) reported an incidence of meconium aspiration syndrome of 0.82% and a mortality of 44.4%. The figures in the present study are inconclusive as the infants did not fulfill the criteria for the meconium aspiration syndrome (39,40).

There were three deaths due to congestive cardiac failure, one of these associated with congenital heart disease. In developed countries, Liebman and Nadas (41) reported that the commonest cause of death in a paediatric referral hospital, excluding problems concerned with prematurity is a congenital heart defect. It is likely that many infants died from congenital heart disease before the lesion was detected in the present study. Surgical emphysema was a complication of endotracheal intubation.

SEPTICAEMIA :

Mortality from this condition was highest in LBW babies. Gram negative organisms were the commonest pathogens isolated. The percentage isolate for Klebsiella species, Escherichia Coli and staphylococcus albus were similar to that reported by Malenga (42) in an earlier study on infections in newborns at Kenyatta National Hospital.

Mortality was also highest from gram negative organisms. Several workers have reported that gram negative organisms are among the commonest bacterial pathogens isolated in infants with septicaemia in the first week of life (20, 48,56).

Group B beta haemolytic streptococcus were isolated from cerebrospinal fluid in one infant and from blood in another. The infant with meningitis died despite treatment with appropriate antibiotics. This infant had late onset infection, most likely nosocomial in origin, as it developed clinical symptoms during the third week of life in the NBU. The second baby survived and had early onset infection, but a high vaginal swab from the mother was negative on culture. The source of infection could have been the nursing staff or the mothers throat.

Group B beta haemolytic streptococcal infection was not seen by Malenga (42) but has subsequently been reported by Onyango et al (43) in newborns at Kenyatta National Hospital. The majority of these infants were not born at Kenyatta National Hospital and had late onset infection. In developed countries this organisms has emerged as an important cause of infections, especially septicaemia and meningitis in the last few years (44,45).

Two infants had salmonella typhimurium cultured from blood and both died. There has been an increase in the incidence of isolation of this organism at Kenyatta National Hospital during the last ten years (46). Mortality among infants and children has been observed to be very high (76.8%) and there has been an emergence of resistance to currently available antibiotics.

(5.4%) of infants with septicaemia had meningitis mainly from gram negative or aneorobic organisms. It is important to note that not all babies who had septicaemia had a lumbar puncture. Omene (47) reported 17% of Nigerian infants with septicaemia to have meningitis, whereas Kleen and others (48) reported an incidence of 33% for meningitis in babies with septicaemia at Boston City Hospital.

The findings of congenital syphylis in five infants was probably an underestimate as many infants did not a stay long enough to exhibit symptoms, and secondly routine screening of infants for this condition is not carried out at Kenyatta National Hospital. Wafula (49) reported a high prevalence of congenital syphylis at Kenyatta National Hospital and Mombasa Hospital. In Zambia an incidence of 7.5% has been reported among infants admitted to a neonatal intensive care unit (50). Three infants in the present study had seropositivity by Kahn and FTA-ABS tests while two infants had Kahn positive tests alone. The true incidence at Kenyatta Hospital

has not yet been established.

One infant suspected to have congenital syphylis turned out to have a positive rubella antibody titre 1:128. Both mother and child had negative serology for syphylis. Other congenitally transmitted infections were not seen, and probably a higher index of suspicion and better laboratory facilities may aid to determine the presence of infections of this nature.

Gastroenteritis was an uncommon finding. During the early part of the study, a small outbreak occurred, but no bacterial pathogen was recovered from the stools of all infants. The source of infection could have been from the mothers, nursing staff, contaminated milk preparations, or Rotavirus. Murphy et al (51) have reported rotavirus infections among neonates in Britain, Mutanda (52) established that Rotavirus is the commonest cause of diarrhoea at Kenyatta Hospital in infants aged 6 months to 3 years but there have been no reports of this organisms in neonates.

One of the infants with X-ray proven necrotizing enterocolitis died. There was a small outbreak in 1981 at Kenyatta National Hospital (53) and since then there have been a few sporadic cases (53) of this condition.

Master (54) reported an incidence of 0.6% from Kampala, while Stevenson (55) in the United States reported an an incidence of 1.2% among premature infants admitted to a neonatal unit.

The majority of infections in this study were probably hospital acquired. It was common practice to find three or four babies placed in one incubator, There was lack of running water, disposable towels and linen. Nursing staff and doctors did not have a constant supply of gowns to change into before entering the NBU. Mothers too, never changed their hostel gowns when entering the NBU, and this may have contributed to spread of infection to some extent. In the United States, it has been reported that there is little danger of cross infection and no increased incidence of infection, when basic preventive techniques of hexachlorophene skin and cord care and handwashing before handling infants were applied (56,57).

ASPHYXIA :

Asphyxia was associated with a high mortality in the weight group 1500 gms and below. Among infants weighing 2500 gms it was the leading cause of death. Meme (14,15) Musoke (9) found hypoxia to be commonest in LBW infants. Dawodu and Effiong (12) found a mortality of 15% in full term infants while Tafari (10) found asphyxia to have a higher incidence in heavier weight groups. It is not clear why asphyxia is common at Kenyatta National Hospital. During the period of study, a paediatric resident was not always present to carry out resuscitative procedures at birth. This was true in casualty or the gynaecological ward from where many of the low gestation babies were delivered. Resuscitative equipment was also lacking in some areas, Hypothermia could also have contributed. Some infants died from other causes like infections and respiratory distress. Macdolnold (19) in a study of asphyxiated infants in the United States found that socioeconomic status of the mother, presence of hyaline membrane disease, hypothermia, growth retardation and neonatal seizures were associated with a significantly higher risk of dying. These factors were however, not scrutinized in the present study.

In this study, over half (54%) of the causes of jaundice could not be determined. Septicaemia and physiological causes were the commonest identified. ABO haemolytic disease was seen in 4% of infants, half of whom also had septicaemia. Marami (58) found that in full term infants at Kenyatta National Hospital the cause of jaundice could not be established in 43% babies, and ABO haemolytic disease and septicaemia were the commonest causes, Kinoti (59) in an earlier study also found ABO haemolytic disease to be common at Kenyatta Hospital. It is important to point out that in the present study, haemolytic tests and indirect antiglobulin tests were not carried out routinely in all infants with suspected ABO incompatibility. 3% of infants in the study had jaundice due to rhesus incompatibility. All the mothers of these infants had been followed up antenatally at the Kenyatta hospital. The rhesus blood group is rare in the Kenya population (60) and the numbers of infants seen in the study with rhesus incompatibility are a reflection of the fact that high risk pregnant mothers are admitted at the hospital. No G-6-P-D tests were carried out on infants or mothers in the study. Azubuike (61) reported that G-6-P-D was themain cause of jaundice in West Africa.

One infant in the study was born to a mother with hepatitis and was hepatitis B surface antigen positive, The infant developed jaundice a few hours after birth subsequently died, but was B surface antigen negative. There is a high prevalence of Hepatitis B surface antigen carrier among the Kenyan School Children in Nairobi (62) but there have been no reports on the presence of Hepatitis B markers in the serum of neonates of mothers who are carriers of this antigen at Kenyatta Hospital.

HYPOTHERMIA :

Hypothermia was commonest among LBW babies below 2000 gms. Tafari (10) also found the frequency of hypothermia to be highest in preterm LBW infants, and showed an inverse relation with body weight. The infant who died from hypothermia in the present study weighed slightly over 2000 gms and was picked up by police at a bus stage near the hospital. It was not known how long it had been left abandoned there, but it was very cold when brought to the NBU. As mentioned earlier, the mode of transport to the NBU contributed to the fact that many infants arrived in a hypothermic state at the NBU. The practice of placing several infants of different weights and ages in one incubator, made it difficult to set a temperature in the neutral thermal environment for each baby. It has been shown that the survival of immature infants

during the first five days of live is much improved by maintaining them in a neutral thermal environment (63). Hypothermia could have been a manifestation of infection, asphyxia, intracranial haemorrhage or metabolic disturbances in this study.

APNOEA :

Apnoea was seen mainly in LBW infants and was a common cause of morbidity. It was difficult to associate apnoea directly as a primary cause of death during the study. It is likely that many infants died from this condition as there was no constant monitoring of apnoeic attacks. At the NBU, apnoea was observed by a busy nurse looking after ten or more babies. Apnoea was seen in infants with asphyxia, hypothermia, septicaemia, meningitis, and respiratory distress. Intracranial haemorrhage, and metabolic disturbances could also have contributed.

Dawodu and Effiong (11) found the incidence of apnoea to be higher in infants of LBW and also an important factor influencing mortality. Elsewhere apnoeic attacks have been found in almost every infant weighing 1200 gms or less, and the overall incidence in infants of 2000 gms and below has been reported as 30% (63,64). The condition was

treated by physical stimulation,increasing ambient oxygen, or bag and mask, ventilation if apnoea was prolonged. Kattwinkel (65) has recommeded using continuous positive airway pressure, rocking incubators lowering skin temperature or using aminophylline to control apnoea. Promotion of use of these latter methods is advocated in managing apnoea at the NBU,apart from controlling the precipitating factor.

CONCLUSION AND RECOMMENDATIONS

1. The KNH newborn unit admits a high proportion of LBW babies who are also preterm. The lowering of the incidence of low birth weight and prematurity is the most important factor in reducing morbidity and mortality at Kenyatta National Hospital newborn unit.

2. Respiratory distress, asphyxia and infections are the biggest causes of morbidity and mortality. Jaundice, hypothermia and apnoea are the commonest other problems seen.

3. The causes of respiratory distress are not fully investigated, and the autopsy rate is very low. More radiological investigations and autopsies should be carried out to determine the incidence of respiratory distress syndrome, other causes of respiratory distress and death from other conditions.

4. The NBU has no intensive care; mechanical ventilators, cardiac monitors, apnoea monitors and continous laboratory facilities are not available, in contrast to what is found in developed countries, Mechanical ventilation and better laboratory monitoring should be utilized to improve the diagnosis

and management of asphyxia, respiratory distress and apnoea.

5. Gram negative bacteria are still the commonest pathogens isolated in infants with septicaemia, however group B beta haemolytic streptoccal infection is on the increase. Since many of the infections seem to be hospital acquired, a proper programme of bacteriological surveillance should be instituted and supervised by the nurse in charge of the unit, a neonatologist, a microbiologist and active participation of other doctors and nurses.

6. Jaundice is a common problem, but the causes are poorly understood mainly because of inadequate laboratory facilities. Haemolysin and antiglobulin tests should be carried out where possible to rule out ABO HDN, and bilirubin levels should be determined quickly and regularly

7. Many infants arrive at the NBU in a hypothermic state, and this contributes to the worsening of asphyxia, respiratory distress and apnoea. Incubators used to transport babies to the NBU should be supplied with their own source of heat and oxygen.

8. Procurement of adequate numbers of well trained nursing staff for the NBU and the maternity unit, is still a major problem. Positioning of a paediatric resident at all delivery points in the hospital is still impossible. If this can be overcome, management of serious conditions will improve, admission rate to the NBU will decrease, and ultimately improve morbidity and mortality.

9. Neonatal mortality meetings should be held weekly if possible to discuss problems so as to improve the management of infants.

10. Although new diagnostic and therapeutic techniques are recommended, they should not replace skilled personnel, as they are the first prerequisite for the use of the techniques themselves.

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4. Members of staff of labour ward and Newborn Unit.

5. Mrs. F. Thandi for the untiring efforts in typing this work.

6. Last but not least, the German Academic exchange service (DAAD) who offerred me the Scholarship to carry out this work.

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APPENDIX I.

"Not doing well"

Poor temperature control } Fever / Hypothermia

CENTRAL NERVOUS SYSTEM

- Lethargy/irritability
- Jitteriness/hyporeflexia
- Tremors/seizures
- Coma
- Full fontanelle
- Abnormal eye movements
- Hypotonia/increased tone

SKIN

- Rashes/erythema
- Purpura
- Pustules/paronychia
- Omphalitis
- Sclerema

RESPIRATORY SYSTEM

- Cyanosis
- Grunting
- Irregular respirations
- Tachypnea/apnea
- Retractions

HEMATOPOIETIC SYSTEM

- Jaundice
- Bleeding
- Purpura/ecchymosis
- Splenomegaly

GASTROINTESTINAL TRACT

- Poor feeding
- Vomiting (may be bile-stained)
- Diarrhea/decreased stools
- Abdominal distension
- Edema/erythema abdominal wall
- Hepatomegaly

CIRCULATORY SYSTEM

- Pallor/cyanosis/mottling
- Cold, clammy skin
- Tachycardia/arrhythmia
- Hypotension
- Edema

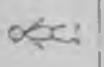
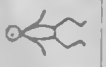
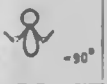
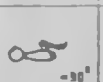
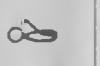
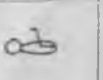
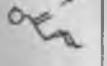
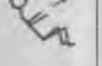
THE CLINICAL PRESENTATION OF INFECTION

APPENDIX II.

EXTERNAL SIGN	SCORE**				
	0	1	2	3	4
Edema	Obvious edema of hands and feet; pitting over tibia	No obvious edema of hands and feet; pitting over tibia	No edema		
Skin texture	Very thin, gelatinous	Thin and smooth	Smooth; medium thickness. Rash or superficial peeling	Slight thickening. Superficial cracking and peeling, especially of hands and feet	Thick and parchment-like; superficial or deep cracking
Skin color	Dark red	Uniformly pink	Pale pink; variable over body	Pale; only pink over ears, lips, palms, or soles	
Skin opacity (trunk)	Numerous veir and venules clearly seen, especially over abdomen	Veins and tributaries seen	A few large vessels clearly seen over abdomen	A few large vessels seen indistinctly over abdomen	No blood vessels seen
Lanugo (over back)	No lanugo	Abundant; long and thick over whole back	Hair thinning especially over lower back	Small amount of lanugo and bald areas	At least $\frac{1}{3}$ of back devoid of lanugo
Plantar creases (Figure 3-3)	No skin creases	Faint red marks over anterior half of sole	Definite red marks over $>$ anterior $\frac{1}{3}$; indentations over $<$ anterior $\frac{1}{3}$	Indentations over $>$ anterior $\frac{1}{3}$	Definite deep indentations over $>$ anterior $\frac{1}{3}$
Nipple formation	Nipple barely visible; no areola	Nipple well defined; areola smooth and flat, diameter $<$ 0.75 cm.	Areola stippled, edge not raised, diameter $\geq$ 0.75 cm.	Areola stippled, edge raised, diameter $>$ 0.75 cm.	
Breast size	No breast tissue palpable	Breast tissue on one or both sides, $<$ 0.5 cm. diameter	Breast tissue both sides; one or both 0.5 to 1.0 cm.	Breast tissue both sides; one or both $>$ 1 cm.	
Ear form	Pinna flat and shapeless, little or no incurving of edge	Incurving of part of edge of pinna	Partial incurving whole of upper pinna	Well-defined incurving whole of upper pinna	
Ear firmness	Pinna soft, easily folded, no recoil	Pinna soft, easily folded, slow recoil	Cartilage to edge of pinna, but soft in places, ready recoil	Pinna firm, cartilage to edge, instant recoil	
Genitals (Male	Neither testis in scrotum	At least one testis high in scrotum	At least one testis right down		
Genitals (Female (with hips $\frac{2}{3}$ abducted)	Labia majora widely separated, labia minora protruding	Labia majora almost cover labia minora	Labia majora completely cover labia minora		

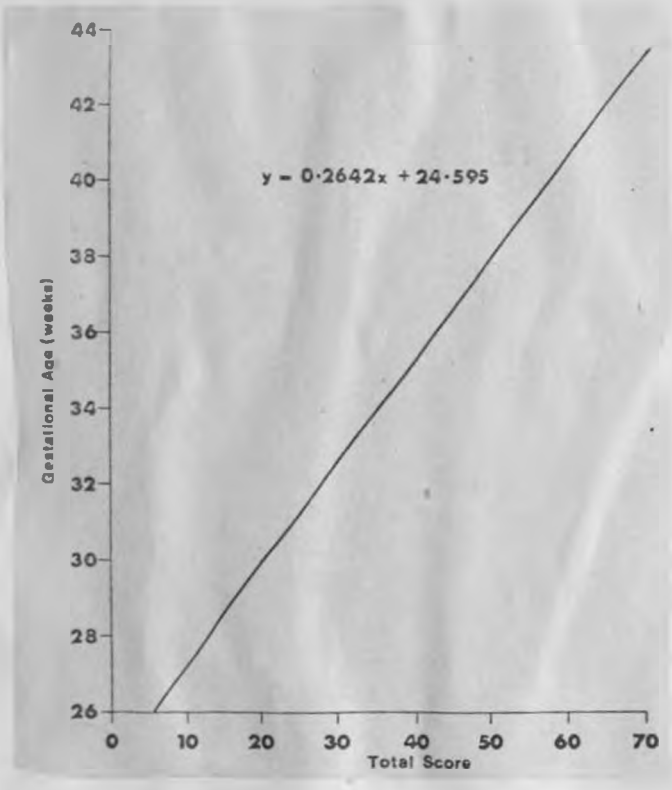
THE SCORING SYSTEM OF EXTERNAL CHARACTERISTICS

APPENDIX III.

NEUROLOGICAL SIGN	SCORE					
	0	1	2	3	4	5
POSTURE						
SQUARE WINDOW	 90°	 60°	 45°	 30°	 0°	
ANKLE DORSIFLEXION	 90°	 75°	 45°	 20°	 0°	
ARM RECOIL	 180°	 90-180°	 <90°			
LEG RECOIL	 180°	 90-180°	 <90°			
POPLITEAL ANGLE	 180	 160°	 130°	 110°	 90°	 <90°
HEEL TO EAR						
SCARF SIGN						
HEAD LAG						
VENTRAL SUSPENSION						

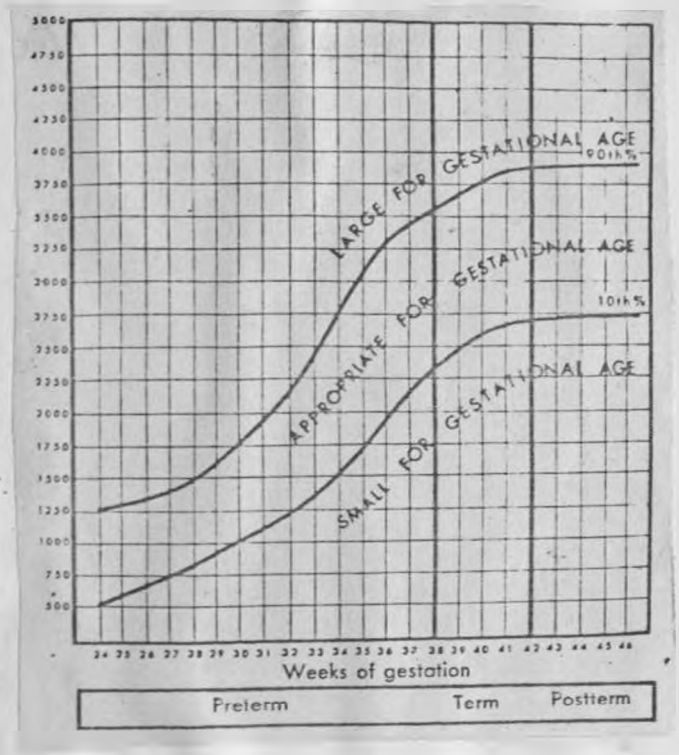
THE SCORING OF NEUROLOGICAL SIGNS

APPENDIX IV.



GRAPH OF ASCERTAINING GESTATIONAL AGE FROM THE TOTAL SCORE OF PHYSICAL AND NEUROLOGICAL DEVELOPMENT.

APPENDIX V.



INTRAUTERINE GROWTH STATUS AS DETERMINED BY BIRTH WEIGHT AT VARIOUS GESTATIONAL AGES.