CLINICAL RISK INDEX FOR BABIES (CRIB) II SCORE AS A PREDICTOR OF NEONATAL MORTALITY AMONG LOW BIRTHWEIGHT BABIES AT KENYATTA NATIONAL HOSPITAL

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DECLARATION

I declare that this dissertation in part fulfilment of M.Med (Paediatrics and Child Health) is my original work and has not been presented to any other university or forum.

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DEDICATION

To my parents for showing clear direction in life

To my son Wesley, and his dad for always being there for me

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OPERATIONAL DEFINATIONS.

1. Illness severity - the total CRIB II score for each baby.
2. LBW - Birthweight below 2500g.
3. VLBW - Birthweight between 1000g and 1499g.
4. ELBW - Birthweight equal to or less than 999g.
5. Neonatal outcome - Refers to hospital neonatal mortality or survival.
6. Neonatal mortality - Death of an infant within 28 days of birth, who after delivery breathed or showed any other evidence of life.

LIST OF ABBREVIATIONS

APACHE	- Acute physiology and chronic health evaluation
APGAR score	- Appearance, pulse, grimace, activity, respiration -score
ARM	- Artificial rupture of membranes
BGA	- Blood gas analysis
CRIB	- Clinical risk index for babies
ELBW	- Extremely low birth weight
G	- Grams.
Kg	- Kilograms.
KNH	- Kenyatta National Hospital
LBW	- Low birthweight
MPM	- Mortality probability model
NBU	- Newborn unit
NPV	- Negative predictive value.
PPV	- Positive predictive value.
P_{O2}	- Partial pressure of oxygen.
P_{CO2}	- Partial pressure of carbon dioxide.
PV	- Predictive value.
PROM	- Premature rupture of membranes
ROC	- Receiver operating characteristics
SAP	- Simplified acute physiology
SNAP	- Score for neonatal acute physiology.
VLBW	- Very low birthweight

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ABSTRACT

Background: Neonatal deaths, especially among the LBW babies, are of major concern in the Newborn unit of Kenyatta National Hospital. Several instruments have been developed to predict initial mortality among the LBW babies. Among them is CRIB II score. It has been evaluated in several countries but not in Kenya.

Objective: To evaluate CRIB II score as a predictor of neonatal mortality among the LBW babies at KNH.

Methodology: A prospective cohort study was carried out in the NBU at KNH. CRIB II score was assigned to all LBW babies admitted to the newborn unit between 8am and 8pm during the study period who met the selection criteria until a sample size of one hundred and thirty five was achieved. Data on other neonatal mortality predictors such as APGAR score, maternal age and parity was collected and analysed.

Results: One hundred and thirty five newborns were enrolled. Birthweight ranged from 600 – 2500g, with a median of 1600g. Total CRIB II score ranged from 1 – 15, with a median of 5.5. Gestational age ranged from 26 – 38 weeks. Total mortality was 45.9%. Birthweight <1500g, gestational age <30 weeks, base excess <-12mmol/l, temperature at admission >37.5 or <35 and total CRIB II score of > 4 were all found to be significantly associated with hospital neonatal mortality. Using a cut off point of 4, CRIB II score was found to have a sensitivity of 80.6%, specificity of 75.3%, and a predictive value of 77.7% compared to 72.5%, 71.2%, and 71.8% respectively for birthweight. Gestational age was found to have even lower figures; 56%, 75%, 66% for sensitivity, specificity and predictive values respectively. Areas under ROC curve were found to be 0.692, 0.608, and 0.682 for CRIB II score, birthweight and gestational age respectively.

Discussion: The sensitivity, specificity and predictive value of CRIB II score were found to be better than any of the traditional models independently. The area under the receiver-operating characteristic (ROC) curve for predicting death was greater for CRIB II score than for birthweight or gestational age alone. CRIB II cut off point of 4 was found to be optimal for predicting mortality.

Conclusion: CRIB II score is a better predictor of hospital neonatal mortality among LBW babies at KNH than birthweight and gestational age independently. Based on these findings, we recommend that CRIB II score be included in the routine assessment of newborns admitted at the newborn unit of Kenyatta National Hospital.

CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

Infant mortality rates are important public health indicators that are seen as proxy measures of health of the population[1]. Neonatal mortality is the major component of infant mortality accounting for approximately 60% of all infant deaths worldwide[2]. Infant mortality rate has remained relatively high in the developing as compared to developed countries. WHO reports of 2004 have shown a wide discrepancy with 136 per 1000 live births in Liberia compared to 3 per 1000 live births in Ireland[3]. In Kenya, trends in infant and child mortality have been shown to be on the increase with infant mortality rate of 73 per 1000 live births in 1998 compared to 77 per 1000 live births in 2003[4]. Neonatal mortality however was found to contribute to 40% of all the infant mortality with a neonatal mortality rate of 33 deaths per 1000 live births reported in 2003[4]. Half of the neonatal deaths can be attributed to low birthweight, acute perinatal asphyxia, congenital anomalies and perinatal infections[1]. The prevalence of low birthweight worldwide is 19% and approximately 9% of all newborns require special or neonatal intensive care[2].

Studies done in Kenya have also shown LBW to be a common problem and a major cause of neonatal mortality[5, 6, 7, 8, 9] Birthweight specific neonatal diseases such as intraventricular haemorrhage, severe group-B streptococcal pneumonia and pulmonary hypoxia have also contributed to poor outcome[2]. The highest risk of neonatal mortality occurs among infants who weigh less than 1000g at birth and those less than 30 weeks gestation. As birthweight increases from 500g to 3000g, a logarithmic decrease in neonatal mortality occurs. Low birthweight is probably the single most important factor in neonatal mortality[10].

Disparities however exist in birthweight specific mortality between geographical regions, between nations and also between different neonatal units. Due to these disparities, simple scoring methods for mortality risk have been formulated to take into account the other risk factors[11]. Examples include: clinical risk index for babies

(CRIB) II, simplified acute physiology (SAPS), score for neonatal acute physiology (SNAP), and mortality probability model (MPM) [11].

Jukka Rautonen assessed the performance of the scoring systems and found CRIB score to be a more accurate tool[12]. William Tarnow-Mordi's investigated the clinical variables that predict death in VLBW babies and this formed the basis of the CRIB score development. Logistic regression analysis was used to identify the variables that were independently associated with mortality. These included: fraction of inspired oxygen, LBW, short gestational age, respiratory distress, male-sex and mean PH[13]. The scoring system was then validated by comparing its value as a predictor of hospital neonatal deaths with that of birthweight in a separate cohort of similar infants[14]. It was found to be more accurate than birthweight alone. This was later modified to a five factor score (CRIB II). That is birthweight, Gestational age, body temperature, base excess and sex of the baby.

Prematurity can be classified into: non-viable (less than 26 weeks), very immature (26 to 29 weeks), preterm (30 to 33 weeks) and slightly preterm (34 to 37 weeks) [15]. The highest risk of neonatal mortality occurs in babies with gestational age less than 30 weeks.

There are clinical consequences for environments that are too hot or too cold. The very immature neonate is particularly vulnerable to high or low thermal challenges. This is due to their diminished subcutaneous fat, large surface to mass area, underdeveloped intrinsic temperature control mechanisms and intercurrent illnesses. Core temperature should be maintained within arrange of 36.1 to 37.5 degrees centigrade. Hyper or hypothermia can be fatal hence indicator of poor neonatal outcome[15]. Base excess is used to estimate the level of acidaemia, which commonly results from asphyxia. This can occur during or after delivery if respiration is delayed. Asphyxia leads to hypoxia and hence bradycardia. This leads to low P_{O2} hence anaerobic respiration and metabolic acidosis[16]. Base excess is inversely related to metabolic acidosis with poor results noted with base excess less than 12 mmol/l. Male sex was found to be a risk factor for neonatal mortality.

The details of CRIB II score are shown in appendix IV. The total CRIB II score ranges from 0 to 27.The scores have further been classified into four levels as follows:

- Level 1 0 to 5
- Level 2 6 to 10
- Level 3 11 to 15
- Level 4 above 15

The higher the score, the poorer the prognosis, with worst prognosis in level 3 and 4. Previous studies have shown optimal cut off point based on receiver operating characteristic to be at 4[17]. CRIB II score provides a recalibrated and simplified scoring system that avoids the potential problems of early treatment bias[18].

In Warsaw Medical University in Poland, Kornacka evaluated CRIB score and his results revealed that it was correlating strongly with hospital neonatal mortality, the cost of hospitalization per day and quite good predictor for days on ventilator and length of hospital stay[19]. He concluded that CRIB score was a better predictor of mortality than APGAR score with CRIB score being more significant than any of its variable independently i.e. birthweight, gestational age, base excess, and temperature at admission in predicting severity of illness.

In Padova University (Italy), Lago attempted to validate the CRIB score as a tool in predicting neuro-development outcome in ELBW infants. He confirmed CRIB score as a valid tool of initial risk assessment even in ELBW in predicting hospital outcome (death or major brain lesions) more accurately than birthweight or gestational age alone. However he found that adjustment of CRIB score for gestational age might enhance its positive predictive value in relation to short-term developmental outcome in this particular population[16].

CRIB II score is a validated measure of initial mortality risk and illness severity within 1 hour of admission that contains only 5 variables. It is simple to calculate and non subjective. It is useful in identifying high-risk

neonates, auditing of neonatal units and also provides a standardized mortality rate for performance comparison among neonatal units. However, it is important to note that the validation and evaluation of the score system were done in level three neonatal intensive care units. No evaluations have been done in a unit that has a mixture of very sick neonates and those who are not very sick in the absence of neonatal intensive care facilities, as is the case at Kenyatta National Hospital.

CHAPTER 2

2.1 PROBLEM STATEMENT

Developing countries are still lagging behind in terms of neonatal intensive care hence the high mortality rate. Neonatal mortality is a major component of infant mortality accounting for 60% of all infant deaths[2,4] Developing countries still have very high neonatal mortality compared to the developed countries[3]. Low birthweight has been identified as the commonest cause of admission to the newborn unit of Kenyatta National Hospital with a high mortality among them. For a long time, low birthweight has been used as one of the admission criteria to the Newborn unit admitting all LBW babies < 2000g. However the assumption that populations defined by birthweight and gestational age are comparable in terms of outcome is questionable. What other factors contribute to the death of a newborn admitted to the Newborn unit of KNH? The existing admission criteria to the Newborn unit are not accurate in predicting the high-risk neonates. Therefore a more superior criteria is desirable.

2.2 STUDY JUSTIFICATION

Currently, there is no criteria of identifying high-risk neonates among the LBW babies admitted to the Newborn unit at Kenyatta National Hospital. It is important to identify high-risk babies at the time of admission to the newborn unit to ensure rational allocation of the limited resources and manpower, which is the case at KNH. This will help reduce mortality in our unit by giving more attention to those babies in more need. This would be used as a form of triage at admission to the unit.

CRIB II score has been validated and used in several countries to identify high-risk neonates and found to be more accurate compared to the traditional models in predicting neonatal mortality in the neonatal intensive care units. No such studies have been done in a unit that has a mixture of very sick babies and those not very sick in

the absence of neonatal intensive-care facilities as is the case of Kenyatta National Hospital. This study is meant to test the performance of CRIB II score in predicting neonatal outcome in such a setting. This will go along way in reducing neonatal mortality which has been found to be > 50% among the LBW babies[7].

OBJECTIVE

To validate CRIB II score as a predictor of neonatal mortality among low birthweight babies at the newborn unit, Kenyatta National Hospital.

CHAPTER 3

METHODOLOGY

3.1 STUDY DESIGN

This was a prospective cohort study.

3.2 STUDY AREA

The study was carried out in the newborn unit and Labour ward of Kenyatta National Hospital, a teaching and national referral hospital located in the capital city of Kenya. This was done in the period between December 2004 and April 2005. On average, 150 newborns are admitted, per month of whom 20% are referral cases while 80% are born within the hospital. Out of all the admissions, about 60% are LBW babies with an average of 53% mortality rate among them[7].

3.3 STUDY POPULATION

All LBW (Birthweight of less than 2500g) babies delivered at KNH during the study period were eligible for the study.

3.3.1 Selection criteria

All LBW babies admitted to the Newborn unit at KNH between 8am and 8pm were seen within one hour of admission. Those whose mothers gave informed consent were included in the study. Babies whose mothers declined or were unable to give informed consent were excluded from the study. Babies born before arrival to KNH were also excluded.

3.3.2 *Recruitment procedure and sampling method*

The investigator visited the newborn unit and labour ward every morning at 8 am and was available up to 8.00 pm on weekdays during the study period. A request was made to the doctors and nurses on duty in the two units to inform the investigator whenever a LBW baby or a mother in preterm labour is admitted. For babies who met the selection criteria, their mothers were informed about the study and an informed consent was obtained. For mothers in preterm labour, consent was obtained in advance. Babies who fulfilled the inclusion criteria during the study period were enrolled into the study. The babies were evaluated within 1 hour of admission to the Newborn unit. Babies admitted at night or those who for logistical reasons were not seen within 1 hour of admission were excluded.

3.3.3 *Sample size calculation*

From a previous study entitled *CRIB II score, birthweight and gestational age in neonatal mortality risk evaluation*[21] sensitivity of low birthweight as a predictor of hospital neonatal mortality was found to be about 75%. Therefore, taking 10% to be the minimum acceptable difference between CRIB II and LBW in sensitivity,

Pa- hypothesized sensitivity of CRIB II—85%
Po- sensitivity of birthweight ---------- 75%
α-- Level of significance---------- 5%
1-β--assumed power of test --------- -90%
Pa-Po=10% the minimum acceptable difference between CRIB II and birthweight in predicting mortality risk.

Using the above values, the following formula was used for 1-sided test of proportions[21].

$$N = \frac{\{(z\ 1-\alpha\sqrt{(Po\ (1-Po)}] + z\ 1-\beta\sqrt{[Pa\ (1-Pa)]}\}^2}{(Po-Pa)^2}$$

N = 131.

3.4 CLINICAL PROCEDURES.

A quick assessment was performed to determine the need for emergency resuscitation. General physical examination was then done. This included counting the respiratory rate over one minute. Temperature was taken using a mercury bulb thermometer. The thermometer was placed in the rectum and left for about one minute before reading. The baby was then weighed using a top pan balance (Zy-20 Baby scale model). The weight was recorded to the nearest 50g. Gestational age assessment was done using the Dubowitz method (Appendix I). Arterial blood sample was obtained for blood gas analysis. Temporal artery puncture was done to obtain the sample. Puncture site was cleaned using 70% alcohol swabs. A two millilitre syringe and a 25 –gauge butterfly needle were used after flushing with heparin. The temporal artery was then located by palpation anterior and superior in the pre – auricular area. The butterfly needle was then used to puncture the artery with the needle directed against the flow of blood (towards the neck). Blood was then collected into the syringe by applying slight negative pressure. The needle was then removed and detached from the syringe and syringe sealed. Firm pressure was then applied on the puncture site for about 5 minutes. The specimen was then labelled and transported to the laboratory immediately. The above procedures were necessary in order to assign a CRIB II score to the baby within 1 hour of admission to the Newborn unit. This was done with the help of the CRIB II score chart (Appendix IV). For babies with

gestational age of >32 weeks, the score was 0 for birthweight and gestational age. For temperature and base excess, the values were read directly from the values in Appendix IV. Total CRIB II score was calculated by summing up the 3 values and the higher the score, the poorer the prognosis. It is worth noting that the parameters used are objective rather than subjective hence reducing the chances of intra-observer bias.

3.5 SPECIMEN ANALYSIS

The samples were analysed using an automated electrode (Rapidlab) blood gas analyser. Using the measured parameters (PaO_2, $PaCO_2$), the value of the base excess was automatically derived by the machine.

3.6 PATIENT FOLLOW-UP

The babies were then reviewed every morning thereafter until discharge, death or up to 28 days of life, whichever came first. During the follow up, weight gain, mode of feeding and the presence of any other morbidity were noted. The mothers' and babies' notes from maternity and antenatal clinic were also reviewed.

3.7 DATA MANAGEMENT

All the data generated from the clinical procedures described earlier was recorded into a worksheet (appendix ii) and then entered into an IBM personal computer. This included maternal demographic data, events surrounding labour, the babies' details – the components of CRIB II score, and the outcome of the baby – alive or dead. All the information was stored securely by the investigator with due respect for the patient confidentiality.

3.7.1 Data analysis

Data was entered into an Epi Info 6 data sheet and exported to SPSS Statistical software package for analysis. The data is presented in frequency tables, bar graphs, line graphs and pie- charts as appropriate. ROC curve has been used to compare the predictive value of birthweight, gestational age and total CRIB II score for hospital neonatal mortality. Pearson chi – square, fischer exact and chi-square for linear trends were used as tests of significance. P values below 0.05 were considered as significant. The outcome in the study was defined as neonatal death or survival to 28 days.

3.7.2 Dissemination of results

The results of the study will be distributed to the university library and the Department of Paediatrics and Child health. The results will also be presented in scientific conferences and published into scientific journals as relevant.

ETHICAL CONSIDERATION

Approval to carry out the study was obtained from Kenyatta National Hospital Ethical Review Committee (Appendix v). The objectives and procedures of the study were explained to the mothers before enrolling their babies into the study. A written informed consent was obtained (Appendix III). Aseptic techniques during procedures were followed. Pressure was applied on the site of arterial puncture for about 5 minutes to ensure no bleeding and no haematomas. Used materials especially sharps were disposed carefully to avoid needle prick injuries.

Recruited children were identified using a study number and their in–patient number for confidentiality. The data obtained was stored carefully and regular feedback given to the parents and with their

consent relevant clinical information and laboratory findings were passed on to the caring clinician to help with decision making during patient management.

The investigators fully participated in the management of these children. Emergency care and resuscitation took priority during the study. No major complications attributable to the study procedures were recorded during the study period.

CHAPTER 4

RESULTS

Study demography

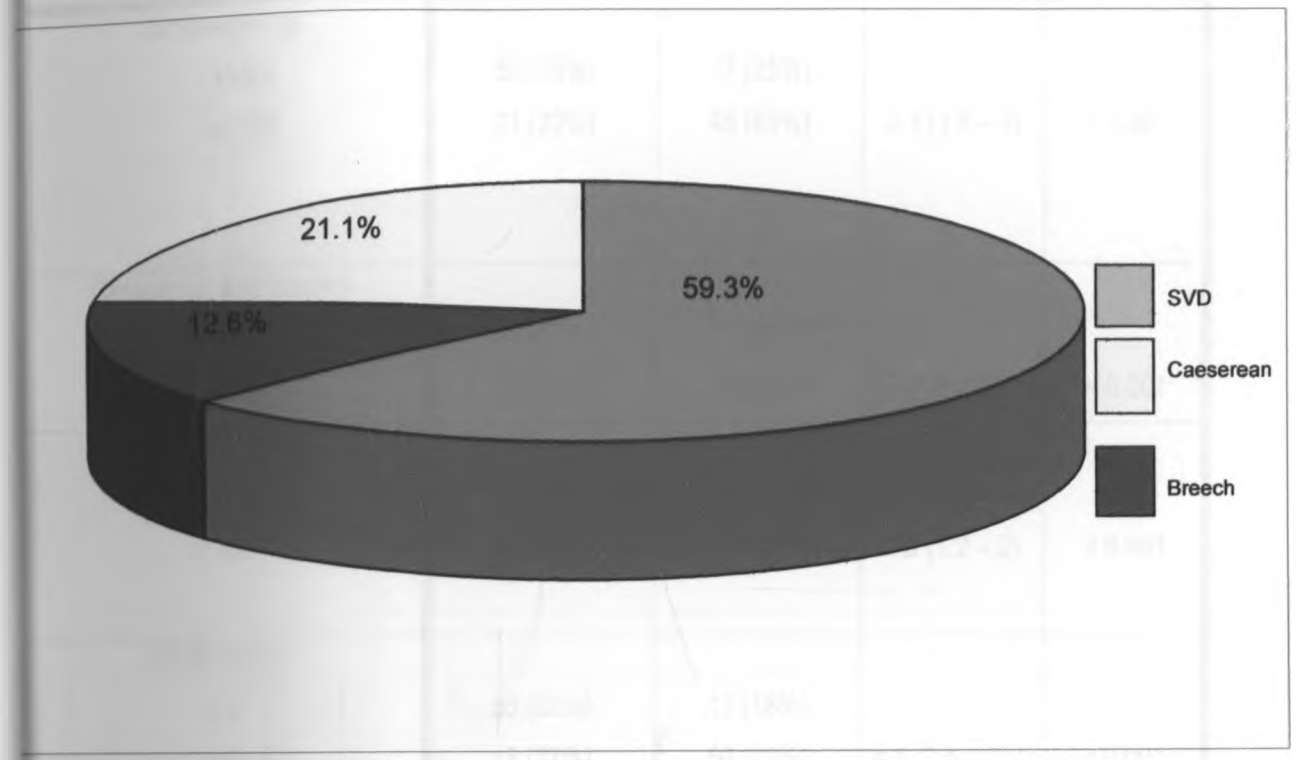
135 children were enrolled into the study between December 2004 and March 2005. 71 (52.6.%) were males and 64 (47.4%) were females. The birth weights of the study subjects ranged from 600g to 2500g with median weight of 1600g. Maternal age ranged from 16 years to 41 years with a median of 23 years. Maternal parity ranged from 0 to 12 with a median of 1(table 1). Most of the babies were delivered via spontaneous vertex delivery (59%) (Figure1). Overall mortality rate was 45.9%.

Table 1. **Other characteristics of the study population**

Characteristics	Range	Median
Birthweight (g)	600-2500	1600
Gestational age (weeks)	26 - 38	32
Temperature (^{0}C)	33.4 - 38.4	36.2
Base excess (mmol/l)	- 24 to –2.1	- 8.2
Apgar score (at 5 min)	3 -10	8
Maternal age (years)	16 - 41	23
Maternal parity	0 -12	1

There were 22 (16%) small for gestational age babies, 4 (3%) large for gestational age babies and 109 (81%) appropriate for gestational age babies.

gure 1. **Distribution of infants according to mode of delivery**



Most babies (59.3%) were delivered by spontaneous vertex delivery. Breech delivery had the highest mortality rate (88.%) followed by SVD (44%) and finally caesarean deliveries (32%).

Table 2. **Factors associated with neonatal mortality among LBW babies**

Characteristics	Alive	Dead	RR (CI 95%)	P value
Birthweight (g)				
>1500	52 (75%)	17 (25%)		
≤1500	21 (32%)	45 (68%)	2.7 (1.8 – 4)	< 0.001
Gestational age (weeks)				
>30	55 (67%)	27 (33%)		
<30	18 (34%)	35 (66%)	2 (1.3 – 3)	< 0.001
Base excess (mmol/l)				
< -12	14 (33%)	28 (67%)		
≥ -12	59 (63%)	34 (37%)	1.9 (1.2 – 2)	< 0.001
CRIB II score				
≤ 4	55 (82%)	12 (18%)		
> 4	18 (27%)	50 (73%)	4.1 (2.4 – 7)	< 0.001
Temperature (°C)				
36 – 37	58 (67%)	29 (33%)		
< 36	15 (33%)	31 (67%)		< 0.001
> 37.5	0 (0%)	2 (100%)		< 0.001
Marital status				
Married	49 (80%)	12 (20%)		
Single	24 (43%)	35 (57%)		0.03
AGA	59 (54%)	50 (46%)		
LGA	3 (75%)	1 (25%)*		< 0.001
SGA	12 (55%)	10 (45%)*		0.142
Mode of delivery				
SVD	45 (56%)	35 (44%)		
Breech	2 (12%)	15(88%)*		< 0.001
C/S	26 (68%)	12(31%)		0.022

Test of significance by Chi square and Fischer exact* tests

SVD – Spontaneous Vertex Delivery, CS – Caesarean Section, AGA - Appropriate Gestational Age, SGA – Small for Gestational Age, LGA – Large for Gestational Age

There was significant association between neonatal mortality and birthweight <1500g, gestational age <30 weeks, base excess < -12, temperature below or above normal, CRIB II score >4, breech and Caesarean section deliveries; with P values < 0.05. However, no significant association was found between neonatal mortality and maternal parity (P value 0.11), maternal age (P value = 0.13) and APGAR score (P value = 0.142).

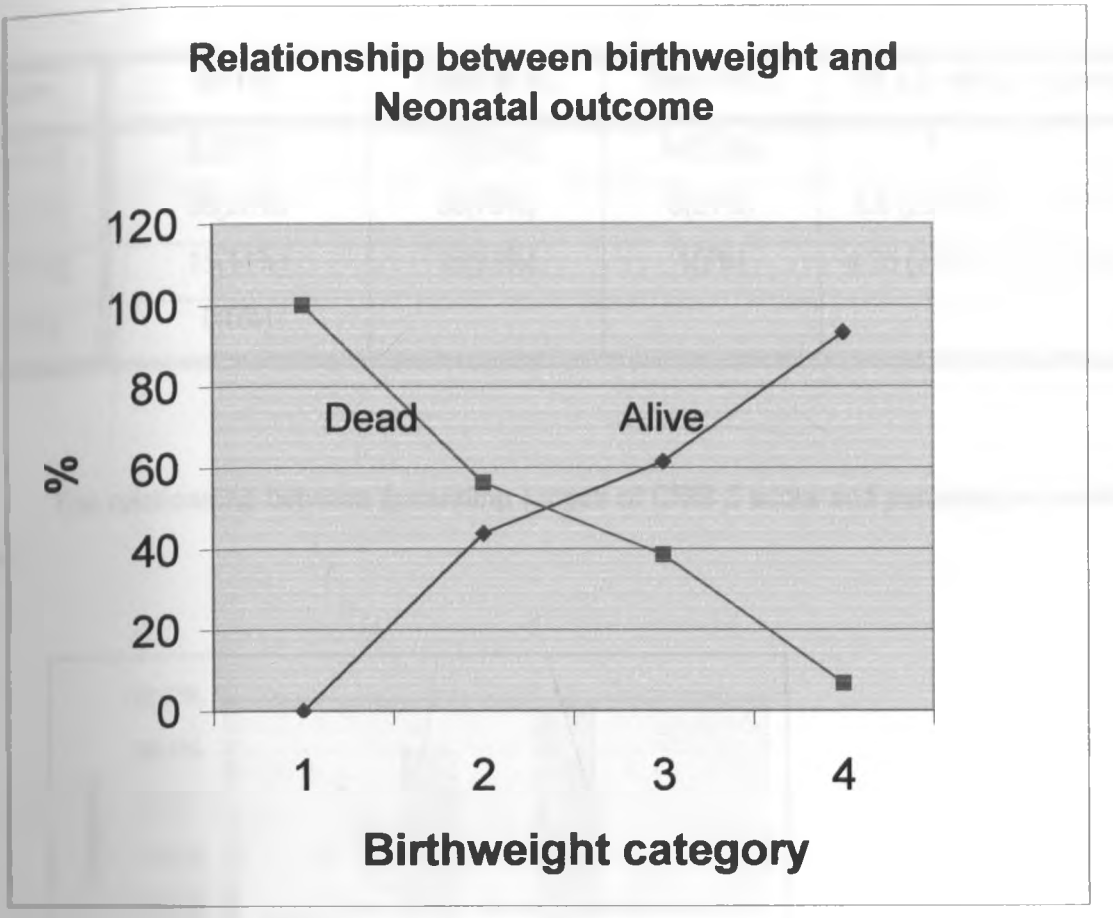
Table 3. **Distribution of infants according to birthweight and related outcome**

	Birthweight category	N	Alive	Dead
1	0 – 1000g	18	0 (0%)	18 (100%)
2	1001 – 1500g	48	21 (44%)	27 (56 %)
3	1501 – 2000g	39	24 (62 %)	15 (38%)
4	2001 – 2500g	30	28 (93%)	2 (7%)

Test of significance –chi square for linear trends

Mortality among babies less than 1000g was 100% compared to 7% among those weighing 2001 – 2500g. This difference was found to be statistically significant (p< 0.001).

gure 2.



Legend: ***Birthweight category***:

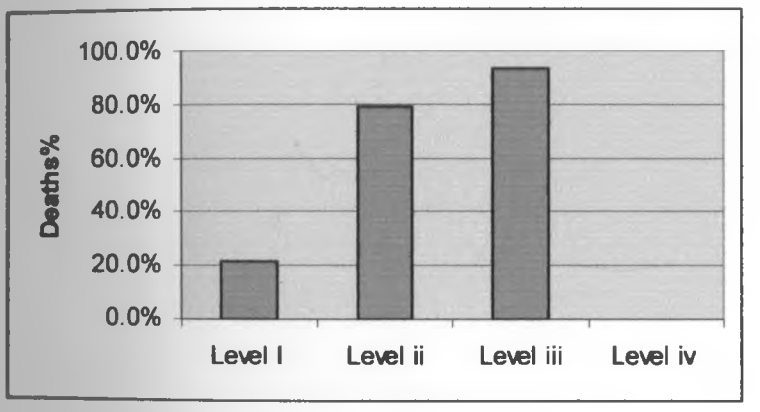
1 – 0 to 1000g
2 – 1001 to 1500g
3 – 1501 to 2000g
4 – 2001 to 2500g

There is a linear correlation between outcome and birthweight, with a positive correlation for survival and a negative correlation for death. Correlation co-efficient (r) for mortality was found to be 0.7 while that for survival was 0.8.

ble 4. Distribution of infants into different levels of CRIB II score

CRIB II score	N=135	Dead N=62	Alive N=73	RR (CI= 95%)	p-value
Level I (0 –5)	82(61%)	18(22%)	64(73%)	1	
Level II (6 –10)	38(28%)	30(79%)	8(21%)	3.6 (2.3- 5.8)	<0.01
Level III (11–15)	15(11%)	14(93%)	1(7%)	4.25 (2.8- 6.5)	<0.01
Level IV (>15)	0(0%)				

ure 3. The relationship between ascending ranges of CRIB II score and percentage mortality each level



Note: Level II and III were compared to level I assuming level I is the standard.

There were no babies who scored more than 15 hence no mortality noted in level IV. These babies were either too sick and died before arrival to the newborn unit or were admitted to the intensive care unit. The higher the CRIB II score the higher the mortality.

Table 5. **Distribution of infants into two categories of CRIB II score (using a cut off point of 4)**

CRIB II score	Dead N=62	Alive N=73	Relative risk	95% CI	p-value
≤ 4	12 (18%)	55 (82%)			
> 4	50 (73%)	18 (27%)	4.1	2.4 - 7	<0.001

Those babies with a score > 4 had higher mortality (73%) compared to those with a score of less than or equal to 4 (18%). Relative risk =4.1 (95% CI 2.4 – 7) p< 0.001.

Table 6 **Relationship between CRIB II score and mean duration of hospital stay among the survivors and non-survivors**

	Median duration of hospital stay (days)	
	CRIB II Score ≤ 4	CRIB II Score > 4
Non-survivors	5	2
Survivors	2	26

P value = 0.001 (using the Fisher exact probability test of significance)

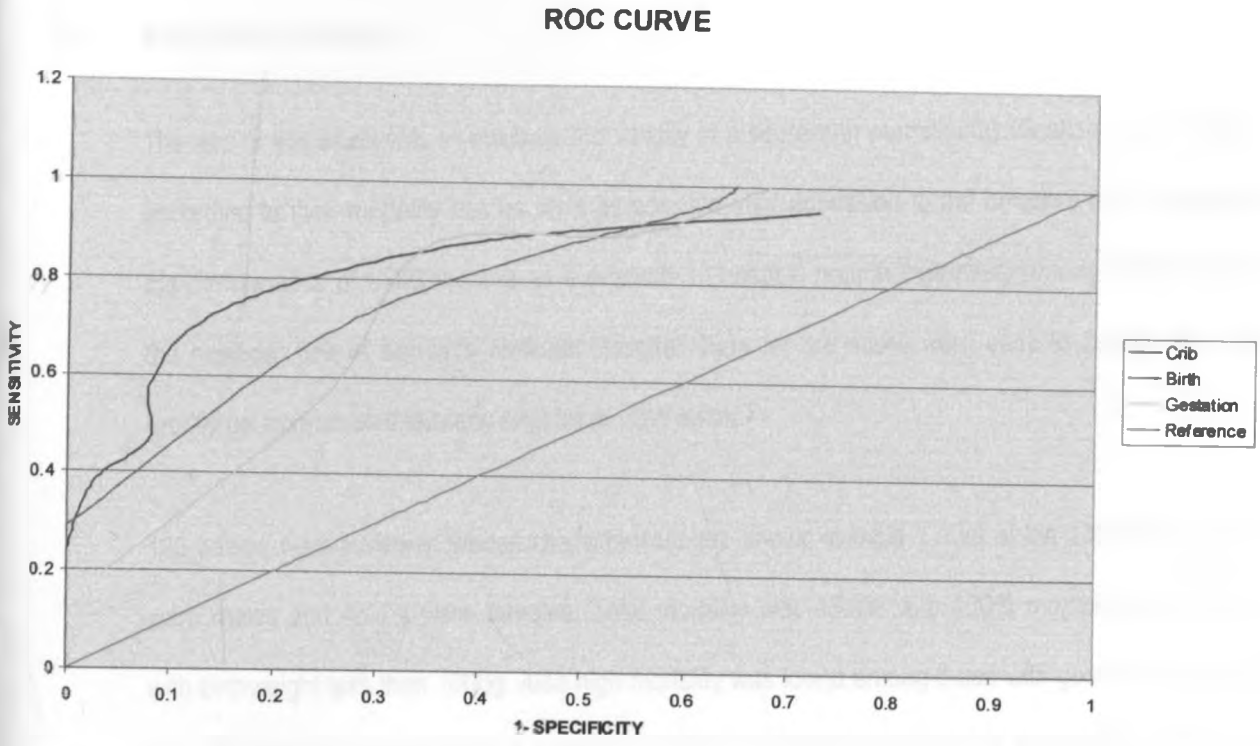
The non-survivors who scored favourably (≤ 4) had a longer duration of hospital stay compared to those who scored unfavourably (>4). This is because they were more sick and died earlier. For the survivors, those who scored unfavourably spent more time in the hospital compared to those who scored favourably. The latter were less sick hence discharged home earlier.

Table 7. **Some of the characteristics of CRIB II score as a predictor of neonatal mortality compared to the traditional models (birthweight and gestational age)**

Model	Sensitivity (%)	Specificity (%)	Predictive value (%)	PPV (%)	NPV (%)
Bithweight	72.5	71.2	71.8	68.1	75.3
Gestational age	56.4	75.3	66.6	66.0	67.0
CRIB II (cut off of 4)	80.6	75.3	77.7	83.3	82.1
CRIB II (cut off of 10)	32.3	98.6	68.1	95.2	63.2

CRIB II score is noted to have the highest sensitivity and predictive value at a cut off point of 4. At a cut off of 10 CRIB II seems to have a very high specificity (98.6%) but very low sensitivity (32.3%)

Figure 4. **ROC curve for prediction of hospital neonatal mortality by CRIB II score, birthweight and gestational age**



Area under the ROC for CRIB II, birthweight and gestational age were 0.692, 0.608 and 0.682 respectively.

CHAPTER 5

DISCUSSION

5.1 PRINCIPLE FINDINGS

The aim of this study was to evaluate the validity of a score that permits classification of LBW infants according to their mortality risk as soon as possible after admission to the newborn unit. It evaluates the performance of CRIB II score as a predictor of hospital neonatal mortality among LBW babies at the newborn unit of Kenyatta National Hospital. Data for the score were easy to collect and could readily be incorporated into any register of LBW infant.

135 babies were reviewed whose characteristics are shown in table 1. Out of the 135 babies, 52.6% were males and 47.4% were females. Total mortality was 45.9% with 100% mortality among those with birthweight less than 1000g. Also high mortality was found among those with gestational age less than 30 weeks (68%) and CRIB II score >10 (93%). Other factors found to be associated with hospital neonatal mortality include temperature at admission and mode of delivery (Breech). No significant association was found between mortality and baby's sex, maternal illness, maternal age, parity and type of gestation (multiple or single).

5.2 COMPARISON WITH OTHER STUDIES

Like other studies done in Kenya previously, our study showed low birthweight to be a common problem contributing to 62% of total admissions in the newborn unit during the study period. Kasirye reported 59.8% contribution to total admissions [7]. Total mortality among the LBW was noted to be quite high (45.9%), with 100% mortality among babies weighing less than or equal to 1000g.

Mukhwana found overall mortality of 53% and 100% mortality among babies less than 1000g [6]. There was a negative linear correction between weight and mortality, and the other studies at KNH showed similar finding [5,6,8,9]. Like Kornacka, the study found the highest risk of death among babies with gestational age less than 30 weeks (68%) [19].

This study also found a significant relationship between body temperature at admission and the neonatal outcome. There was 100% mortality among babies whose body temperature was more than 37.5°C and 67% mortality with temperature less than 36°C. Gordon in his study of low birthweight infants found high mortality among babies with abnormal temperatures [15].

Other factors found to be significantly associated with mortality include breech delivery and base excess < - 12. No significant association was found between sex of the baby, maternal age and maternal parity with outcome of the baby. William Tarnow – Mordi found a significant association between outcome and sex of the baby, with male sex being associated with poor outcome [13].

5.3 APPLICATION OF CRIB II SCORE

In emergency cases we need to define urgent, emergent and life threatening conditions to the primary care physician. The CRIB II score is a measure of illness severity (initial risk) based on abnormalities found at admission and laboratory assessment [14].

During the study we verified that CRIB II score was easy to apply as most of its components form part of the routine care of preterm babies in our newborn unit except for base excess estimation. No subjective parameters are used hence it can easily be reproduced even in inexperienced hands. However, it is worthy noting that its application is limited to facilities where arterial blood gas analysis

is possible. In Kenya, its application may be limited to referral hospitals. A simpler score system is necessary for the health facilities where arterial blood gas analysis is not routinely done.

Our study had several limitations that could have contributed to different results compared to previous studies. The study considered all babies less than 2500g since this was found to have high mortality (53%)[7]. In the study originating the CRIB II score, only babies less than 1500g were included[14]. This may have affected accuracy levels of CRIB II score as shown by the lower ROC values compared to previous studies[12,14,22].

Due to logistical reasons, the investigator was not present in the unit for 24 hours hence an important group of babies born at night was left out. This may also have affected the accuracy of the results. A large group of babies born by emergency Caesarean section was also left out because their mothers were not in a position to give an informed consent within 1 hour of admission to the Newborn unit.

In this study the mean CRIB II score at admission was 5.5 (Range 1 –15). Overall mortality was found to be 45.9%. Survivors had a mean CRIB II score of 3.7, while non-survivors had a mean CRIB score of 7.7. This study compares well with a study by Lucia in 2002 which found a mean CRIB II score of 4, range of 0 –19 [23]. However no babies had a CRIB II score of more than 15 in this study. This could be due to the fact that babies in this category are too sick and die before arrival to the newborn unit or end up in the intensive care unit instead of the newborn unit. It is worth noting that these studies though were done in a neonatal intensive care setting they compare well to this study, which was done in a level II setting at KNH.

The quantitative expression of CRIB II score as a mortality predictor was assessed using the area under ROC curve. CRIB II score was confirmed to positively predict mortality and to have a better performance than birthweight and gestational age independently. Area under ROC curve for CRIB II, birthweight and gestational age were found to be 0.692, 0.608 and 0.682 respectively. However, the

accuracy was found to be lower than the study that originated it (0.900 for CRIB II) [14]. Other validating studies also found lower ROC values for example the Scottish neonatal consultant collaboration study group found a value of 0.89 [22] while Rautonen found a value of 0.89 [12].This differences can be explained by the limitations mentioned earlier.

Sensitivity, specificity and predictive value were calculated for CRIB II score at two different cut off points and compared to those of birth weight and gestational age as predictors of hospital neonatal mortality. CRIB II score with cut off point of 4 was found to be most sensitive (80.6%) with the best predictive value (77.7%) compared to birthweight and gestational age. However its specificity was equal to that of gestational age alone. This compares well to a study by Brito which found a sensitivity of 79.4% [17].

The results of the comparative analysis between the four levels of CRIB II score for hospital mortality are comparable with those proposed in the original study [14]. That is the higher the score, the higher the mortality rate. Similar results were published in several other studies [23,24,25].

In our study no baby was admitted with a score above 15. Level III was found to have very high mortality (93.3%), which was not comparable to the original study, which had mortality of less than 80% in this category [14]. This shows that we need to put more effort to improve the outcome of this specific group.

Based on the study, it is noted that CRIB II score is a better predictor of neonatal mortality compared to birthweight and gestational age independently. It is also found to be applicable and therefore should replace the traditional models as the predictor of neonatal outcome. This is in agreement with other studies [15,17,19,22].

CHAPTER 6

6.1 CONCLUSION

1. Neonatal mortality among LBW babies still remains very high (45.9%) in the Newborn unit of Kenyatta National Hospital.
2. CRIB II score is superior to birthweight and gestational age in predicting neonatal mortality at KNH newborn unit. As shown by the sensitivity and specificity.
3. CRIB II score had the best sensitivity and predictive value at a cut off point of 4.
4. CRIB II score can be applied to low birthweight babies admitted in the newborn unit of Kenyatta National Hospital.

6.2 RECOMMENDATIONS

1. CRIB II score should be included in the routine assessment of neonates admitted at KNH, to help rationalise care for the sick babies.
2. LBW neonates admitted to the Newborn unit of KNH with a CRIB II score of > 4 should be accorded more attention and if possible nursed in the intensive care unit.

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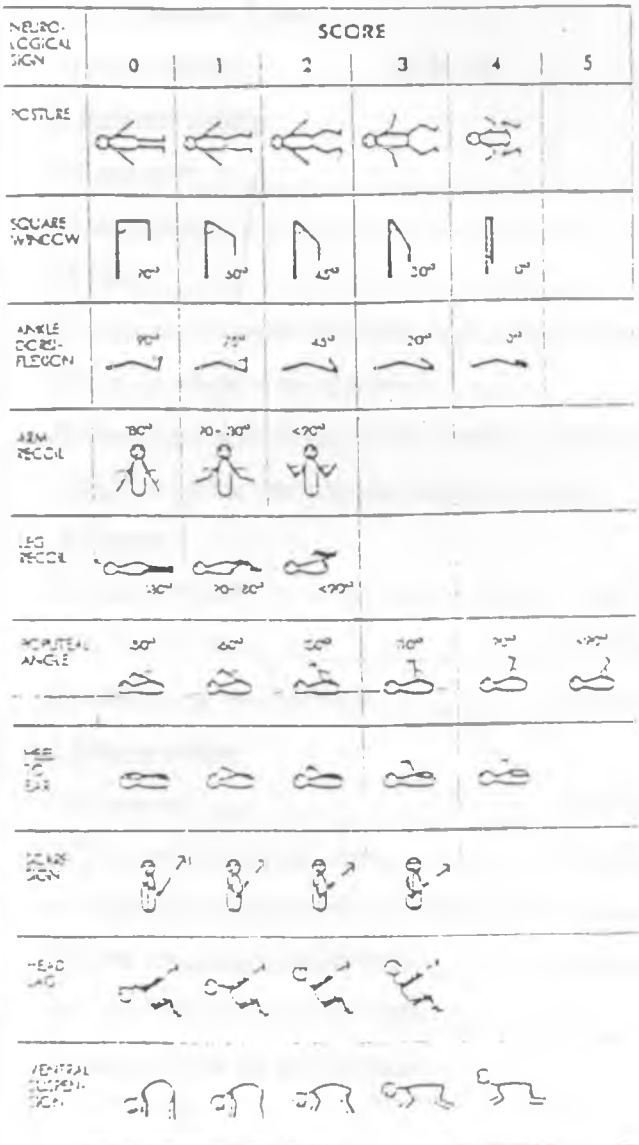
APPENDIX I

Dubowitz's method of gestational age estimation

External sign	0	1	2	3	4
oedema	+ hands and feet pitting over tibia	No obvious oedema ;pitting over tibia	No oedema		
Skin texture	Very thin gelatinous	Thin and smooth	Smooth medium thickness rash o superficial peeling	Slight thickening superficial cracking and peeling especially hands and feet	Thick and parchment – like; superficial or deep cracking
Skin colour	Dark red	Uniformly pink	Pale pink variable ove body	Pale. Only pink over ears ,lips, palms or soles	
Skin opacity	Numerous veins and venules especially ove abdomen	Veins and tributaries seen	A few large vessels clearly seen over abdomen	A few large vessels seen indistinctly over abdomen	No blood vessels
Lanugo	none	Abundant ;long and thick over whole back	Hair thinning especiall over lower back	Small amounts of lanugo and bald areas	At least half of the back devoid of lanugo
Plantar creases	none	Faint red marks over anterior half of the sole	Definite red marks ove more than anterior hal	Indentations over more than anterior third	Definite deep indentations over more than anterior third
Nipple formation	Barely visible no areola	Nipple well defined smooth areola flat diameter less than0.75cm	Areola stippled ,edge not raised diameter less than 0.75cm	Areola stippled, edge raised diameter more than 0.75cm	
Breast size	No palpable tissue	Breast tissue on one side or both sides less than 0.5cm	Breast tissue both sides; one or both o.5 1cm	Breast tissue both sides; one or both more than 1cm	
Ear form	Flat shapeless pinna	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	
Genitalia male	Neither testis in scrotum	At least one testis high in scrotum	At least one testis righ down		
Female (with hips half abducted)	Labia majora widely separated, labia minora protruding	Labia majora almost covering labia minora	Labia majora completely cover labia minora		

After Farr et al. (1966) and Dubowitz et al. (1970).


NEURO-
LOGICAL
SIGN
SCORE
0
1
2
3
4
5
POSTURE
SQUARE
WINDOW
ANKLE
DORSI-
FLEXION
ARM
RECOIL
LEG
RECOIL
POPLITEAL
ANGLE
HEEL
TO
EAR
SCARF
SIGN
HEAD
LAG
VENTRAL
SUSPEN-
SION


Gestational
age
in weeks

APPENDIX II

Data Collection Sheet

01serial number: _____ 02 IP. No. _____date ----------

A Maternal details

01 Age (yrs)_____ 02 Residence _____

03 Marital status ---------- 04 Level of education (yrs) _____

05 Parity_____ 06 Employment _____

07 presencesof medical illnesses (e.g. diabetes, hypertension, asthma, HIV ,etc) _____

08 Did she attend antenatal clinic? _____

09 Events in the antenatal period (bleeding, hypertension, febrile illness) _____

10 Has the mother had previous neonatal deaths? _____

B Labour

01 Date of delivery ---------- 02 Time of delivery ----------

03Duration of labour _____ 04 When did the membranes rupture? _____

05 What colour was the liquor _____06 What was the mode of delivery? _____

C Baby,s details

01Baby,s sex _____ 02 APGAR score_____

03 Was any resuscitation done _____ 04 Birthweight(g) _____

05 Gestational age estimation in weeks by the investigator (Dubowitz method) _____

06 Body temperature at admission _____07 Estimated base excess

08 Total CRIB II score for the baby_____

D Baby,s follow up and outcome

					OUTCOME	ON DAY 28	DAY 28
DATE REVIEWED	Weight	Modeof feeding	Total duration of stay	Still alive in the unit	Discharged home	dead	

APPENDIX III

CONSENT FORM FOR PARTICIPATION IN THE STUDY

Study Title: Clinical risk index for babies (CRIB) II score as a predictor of neonatal mortality among low birthweight babies at Kenyatta National Hospital.

Investigators

Dr. Marete I. Kagwiria, *Postgraduate student, University of Nairobi.*

Prof. Aggrey Wasunna, *Supervisor, Associate professor of paediatrics and child health, University of Nairobi.*

Dr. Phelgona Otieno, *Supervisor, Senior Research Officer, Centre for Clinical Research, Kenya Medical Research Institute, Nairobi.*

Investigators' statement

We are asking you and your baby to participate in a research study. The purpose of this consent form is to give you information you will need to help you decide whether to participate in the study. Please read this form carefully. You may ask questions about the risks and benefits of the procedures to be done on your baby.

Introduction

Low birthweight has been one of the reasons babies get admitted in our Newborn Unit. However, we find that among babies of the same weight, some die while others survive. What could be the other determinant of this? Could the severity of the illness at admission be a contributing factor? Our study sets out to find out this. Our resources and manpower as we all know are limited and rational allocation is paramount. If the severity of illness were found to be a good predictor of the outcome, then more attention would be given to those at higher risk for death. This would hopefully reduce the high mortality rate in our Newborn Unit.

The benefits of the study

The investigator will be available to answer any questions that may arise during the study. Your participation in this study will help us identify those factors that contribute to death of our low birthweight babies, therefore improving treatment.

The risks

Drawing the blood sample may be a little bit uncomfortable to the baby and bleeding may occur. Dressing at the site will be applied immediately to minimize the risk of bleeding. The equipment used to take the temperature and the weight of the baby is **not invasive** and thus will cause **no** harm to your baby.

Information about confidentiality

All the information obtained will be held in strict confidence. No information of any kind will be released to any other person or agency without your permission expressed in writing. We will not publish or discuss in public anything that could identify your baby and you. You are free to withdraw from the study if you so wish without any penalty.

Do you have any questions? Yes ------- no ---------- Do you agree to participate? Yes--------- no----------

_____ _____ _____

Investigator's signature Investigator's name Date

Subject statement (Mother)

The study described above has been explained to me. I agree to have my baby participate in the study. I have had a chance to ask questions about the research to which satisfactory answers have been given. I have further been assured that if I have future questions about the research or my rights and those of my baby, I can ask the investigator. I understand that I can withdraw from the study at my wish without any penalty.

_____ _____ _____

Mother's signature Printed Name of Mother Date

_____ _____

Left thumbprint of the Mother Date

_____ _____ _____

Witness's signature (or thumbprint) Printed Name of the Witness Date

Cc: Subject's file

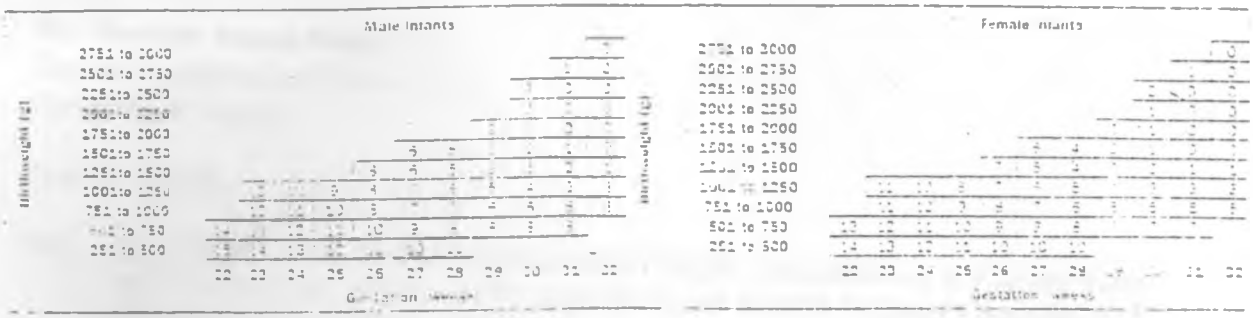
Investigator's file

APPENDIX IV

CRIB II SCORE

Birthweight (g) and gestation (weeks):

The maximum (worst) score for birthweight and gestation is 15, which is obtained for a 22 week male infant of less than 501 g birthweight



Temperature at admission (°C)	
≤29.4	5
29.5 to 31.1	4
31.2 to 32.8	3
32.9 to 34.4	2
34.5 to 36	1
36.1 to 37.5	0
37.6 to 39.1	1
39.2 to 40.7	2
≥40.8	3

Base excess (mmol/L)	
≤ -28	7
-27 to -25	6
-24 to -22	5
-21 to -19	4
-18 to -16	3
-15 to -13	2
-12 to -3	1
-2 to 2	0
≥3	1

Total score = 0 – 27.

APPENDIX V

KENYATTA NATIONAL HOSPITAL
Hospital Rd. along, Ngong Rd.
P.O. Box 20723, Nairobi.

Tel: 726300-9
Fax: 725272
Telegrams: "MEDSUP", Nairobi.
Email: **KNHplan@Ken.Healthnet.org**

Ref: KNH-ERC/01/2478 **Date: 6th December, 2004**

Dr. Marete Irene Kagwiria,
Dept. of Paediatrics and Child Health
University of Nairobi.

Dear Dr. Marete,

RE: CLINICAL RISK INDEX FOR BABIES (CRIB) 11 SCORE AS A PREDICTOR OF NEONATAL MORTALITY AMONG LOW BIRTH WEIGHT BABIES AT KENYATTA NATIONAL HOSPITAL (P137/10/2004)

This is to inform you that Kenyatta National Hospital Ethics and Research Committee has reviewed and **approved** your above cited research proposal for the period 6th December. 2004 – 6th December 2005. You will be required to request for a renewal of the approval if you intend to continue with the study beyond the deadline given.

On behalf of the Committee, I wish you fruitful research and look forward to receiving a summary of the research findings upon completion of the study.

This information will form part of database that will be consulted in future when processing related research study so as to minimize chances of study duplication.

Yours sincerely,

Prof. A. N. GUANTAI
SECRETARY – KNH-ERC

Cc: Prof. K. M Bhatt, Chairperson, and KNH-ERC
The Deputy Director (C/S), KNH
The Dean Faculty of Medicine, UON
The Chairman, Dept. of Paediatrics, UON
CMRO
Supervisors: Prof. Aggrey O. Wasunna, Dept. of Paediatrics and Child Health
Dr. Phelgona A. Otieno, Centre for Clinical Research, KEMRI, Nairobi.