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Perintal survival of infants weighing more thatn 500g whose mothers died in the puerperium before being discharged: a retrospective descriptive study at Charlotte Maxeke Johannesburg academic hospital from 2003 to 2012

Blaise, Bucyibaruta Joy

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SCHOOL OF CLINICAL MEDICINE

DEPARTMENT OF PAEDIATRICS AND CHILD HEALTH

PERINATAL SURVIVAL OF INFANTS WEIGHING MORE THAN 500 g WHOSE MOTHERS DIED IN THE PUERPERIUM BEFORE BEING DISCHARGED.

A RETROSPECTIVE DESCRIPTIVE STUDY AT CHARLOTTE MAXEKE JOHANNESBURG ACADEMIC HOSPTAL FROM 2003 TO 2012

RESEARCHER: Dr BUCYIBARUTA Joy Blaise

SUPERVISOR: Prof COOPER Peter

MARCH, 2015

DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF REQUIREMENTS FOR A MASTER OF MEDICINE DEGREE IN PAEDIATRICS AND CHILD HEALTH (MMED PAED)

DECLARATION

I, BUCYIBARUTA Joy Blaise, declare that this research report is my own original work. It is being submitted for the degree of Master of Medicine in Paediatrics at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other university.

……

The 28th March, 2015 Place: Johannesburg

ABSTRACT

A growing body of evidence confirms a slow reduction in neonatal deaths, of which the majority occur in the early neonatal period. The burden of perinatal deaths is heavy in developing countries where the perinatal death rate is about five times higher than its rate in developed countries. Similarly, about 99% of maternal deaths occur in developing countries. However, to the best of our knowledge, little is known about perinatal outcomes of infants born to mothers who die from complications of childbirth. This gap in the existing literature motivated us to undertake the study, which aimed to investigate the perinatal outcomes of infants born to mothers who died from complications of childbirth at Charlotte Maxeke Johannesburg Academic Hospital. It consisted of a retrospective study, over a 10 year period, on infants weighing 500 g and more or with gestational age of 22 weeks and above born to mothers who died from complications of childbirth. A sample size of 122 mothers and 128 infants eligible were analysed through quantitative methods. Among these infants, 85 (66.4%) were born alive. The identified top four obstetrical causes of maternal deaths were: non-pregnancy related infections including HIV/AIDS, Hypertensive disorders of pregnancy, pre-existing maternal diseases and postpartum haemorrhage. HIV and hypertension accounted for more than 50% of maternal deaths. The findings revealed that emergency caesarean section was high (70%) and the perinatal survival rate was 55%. Maternal parity, Apgar scores at one minute and mode of delivery were identified as the main predictors which were statistically associated with perinatal survival, with correlation coefficient of + 0.7 (P=0.030), + 0.4 (P=0.000) and + 0.1 (P=0.002) respectively. Concerning infants born alive, early neonatal survival rate was 84%. Apgar score at five minutes and maternal parity were the sole predictors that were statistically associated with neonatal outcomes, with correlation coefficient of +0.3 (P=0.000) and + 0.1 (P=0.019). These findings demonstrated that with appropriate labour monitoring, adequate neonatal resuscitation and good perinatal care, the majority of those infants would be born alive with four out of five surviving to hospital discharge.

DEDICATION

For my wife Clémentine

&

My sons Cedric and Emmanuel

ACKNOWLEDGEMENTS

Beside my personal effort, the completion of this study relied on contribution from different people and institutions: Without their continuous encouragement and unconditional support, the success of this project would have not been possible.

Firstly, I would like to express my deepest appreciation to my supervisor, Prof Peter COOPER not only for accepting to supervise this research, but also his incomparable role and guidance through this process of research despite his busy schedule. He has been indeed a teacher and a role-model.

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To my family and friends, for your moral support and encouragement; thank you for believing in me when I was doubting; thank you for bringing light when I was experiencing darkness and thank you for being there when I needed you the most.

To the Government of Rwanda, I am thankful to the vision of improving the education quality by increasing not only the number but also the quality of Rwandan professionals in all socio-economic layers and by being the sole sponsor of my studies and this research.

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TABLE OF CONTENTS

DECLARATION i
ABSTRACT ii
DEDICATION iii
ACKNOWLEDGEMENTS iv
TABLE OF CONTENTS v
LIST OF TABLES vii
LIST OF FIGURES viii
LIST OF DENITIONS ix
LIST OF ABREVIATIONS x
INTRODUCTION 1
LITERATURE REVIEW 4
OBJECTIVES 9
Aim 9
Specific objectives 9
MATERIAL AND METHODS 10
Design and duration 10
Study Population 10
Inclusion and exclusion 10
Data Collection 11
Data collection sheet checklist (see appendix) 11
Data capturing 12
Data cleaning and coding 12
Descriptive analysis 13
Inferential analysis 13
ETHICS CONSIDERATIONS 14
RESULTS 15
INFANTS' DEMOGRAPHIC AND CLINICAL CHARACTERISTICS 15
Gender 15
Birth weight (g) 15
Gestational age 16
Infant's conditions at birth 17

Mode of delivery....17
Apgar scores for infants born alive....18
MATERNAL DEMOGRAPHIC AND CLINICAL CHARACTERISTICS....19
Maternal age....19
Maternal parity....20
Antenatal clinic care attendance....20
Maternal HIV status....21
CD4 count....21
Patients on HAART....21
Obstetric causes of maternal deaths....22
Final causes of maternal deaths....23
PERINATAL OUTCOMES....24
Perinatal outcomes....24
Early neonatal outcomes....25
Characteristics of infants born alive and then subsequently died....25
ASSOCIATION WITH INFANTS' OUTCOMES....27
Factors associated with perinatal outcomes....28
Factors associated with early neonatal outcomes....32
DISCUSSION....35
LIMITATIONS....39
CONCLUSION....40
RECOMMENDATIONS....41
REFERENCES....42
APPENDIX....49
Medical Ethics Committee Clearance Certificate....49
CMJAH CEO Research Approval....50
Data Collection Sheet & Coding....51
Codes & Description of Obstetric Cause of Maternal Death (version: 2.03)....55
Code & Description of Final Cause of Maternal Death (version: 2.03)....58

LIST OF TABLES

Table		Page
1.	Apgar scores at one minute	19
2.	Frequency of obstetric causes of maternal deaths	22
3.	Final causes of maternal deaths	23
4.	Birth weight, gestational age (GA), Gender, Apgar scores at five minute and presumed causes of death of infants born alive	26
5.	Association between perinatal survival and selected variables	29
6.	Association between perinatal outcomes and selected variables by multivariate analysis	31
7.	Correlation of Apgar's scores at different times	32
8.	Association between early neonatal outcomes and selected variables	33
9.	Association between early neonatal survival outcomes and selected variables by multivariate analysis	34

LIST OF FIGURES

Figure **Page**

1. Birth weight distribution 15
2. Gestational age distribution 16
3. Infants' condition at birth 17
4. Distribution of mode of delivery 18
5. Distribution of maternal age 19
6. Maternal parity distribution 20
7. CD 4 count distribution 21
8. Perinatal outcomes 24
9. Early neonatal outcomes 25

LIST OF DENITIONS

Early neonatal mortality/death: death occurring within the first week of age.

Extremely very low birth weight: birth weight less than 1,000g

Infant mortality rate: annual number of deaths between birth and one year of age, per 1,000 live births.

Late neonatal mortality/death: death occurring after 7 days but within 28 days of age.

Low birth weight: birth weight less than 2,500 g

Maternal mortality/death: death occuring during pregnancy, at delivery or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes.

Maternal mortality rate: annual number of maternal deaths per 100,000 live births.

Neonatal mortality/death: death occuring within 28 days of age.

Neonatal mortality rate: annual number of neonatal deaths per 1,000 live births.

Perinatal care index: measure of quality of care during the perinatal period.

Perinatal mortality/deaths: stillbirths and/or neonatal deaths occurring within the first week.

Perinatal mortality rate: annual number of perinatal deaths per 1,000 total births.

Stillbirths: death of a foetus before delivery, at a gestation age of 22 weeks and beyond or weighing 500 g and above.

Under-five mortality rate: annual number of deaths between birth and five years of age per 1,000 live births

Very low birth weight: birth weight less than 1,500 g

LIST OF ABREVIATIONS

AIDS :Acquired Immunodeficiency Syndrome

ANC: Antenatal clinic

ARV: Antiretroviral

BW: Birth Weight

CIA: Central Intelligence Agency

CHC: Community Health Centre

CMJAH: Charlotte Maxeke Johannesburg Academic Hospital

GA: Gestational Age

HIV: Human Immunodeficiency Virus

ICU: Intensive Care Unit

MDG: Millennium Development Goals

MMR: Maternal Mortality Rate

NMR: Neonatal Mortality Rate

PCI: Prinatal Care Index

PMR: Perinatal Mortality Rate

PPIP : Perinatal Problem Identification Program

UFM: Under-Five Mortality

UFMR: Under-Five Mortality Rate

UN: United Nations

UNICEF: United Nations Children's Fund

WHO: World Health Organization

INTRODUCTION

Despite the global effort in reducing under five mortality rate, perinatal mortality remains a major challenge for many Sub-Saharan countries.[1] Growing evidence highlights that most developing countries have been battling to make significant progress in improving neonatal survival rate compared to successful stories of bringing down the under-five mortality rate (UFMR). Although occuring only within the first 28 days, neonatal deaths account for about 43% of all UFMR globally.[1]

Almost all neonatal deaths (99%) occur in developing countries[2] while they account only for 52% of total births worldwide.[1] Of 3 million neonatal deaths globablly, as estimated in 2011 by United Nations International Children's Emergency Fund (UNICEF),[1] 75% occurred within the first week of live (early neonatal death).[3-5] Thus a number of authorities place emphasis on an urgent need to focus on strategies to decrease perinatal mortality rate.[1, 6] However, the difficulties have been, amongest others, poor or lack of records to guide effective policies and interventions.[1, 6]

As for the maternal mortality rate, it remains a widespred major concern with nearly 400,000 women dying during childbirth every year.[7] On a daily basis, the World Health Organization (WHO) estimates about 800 women die from pregnancy-related complications; that is either during pregnancy, at delivery or within 42 days of termination of pregnancy.[4] Pregnancy–related complications have a significant impact on the fetus and result in poor perinatal outcomes.[8, 9]

Although significant efforts have been made in last few decades to establish audit and feedback on perinatal and maternal deaths, few countries have reliable prevalance data,

particulary on stillbirths and perinatal deaths.[10] In addition, the Millennium Development Goals did not consider the stillbirths as an indicator of progress, and as a consequence, stillbirths have been continued to be documented inconsistently.[11]

As per the recent South African estimates, neonatal deaths represent 34 % of UFMR with a stillbirth rate of 20 per 1000 total births and NMR of 15 per 1000 live births.[12, 13] Despite a high level of deliveries by skilled birth attendants, the figures show that the stillbirths reduction rate in South Africa since 1995 has been only 0.7%.[14] The perinatal care index (PCI) which is a validated measure of quality of care during the perinatal period, is calculated as perinatal mortality rate divided by low birth weight rate. PCI is expected to be below one for community health centres and below two for all hospitals. The quality of neonatal care in South Africa is considered substandard as there is a high perinatal care index above 2.[15] Indeed, about 44% and 22% of early neonatal deaths are respectively associated with health provider and administrative avoidable factors.[16]

The urgency to focus on perinatal mortality globally is explained by the current alarming estimates which highlight that the "failure to improve birth outcomes by 2035 will result in an estimated 116 million deaths, 99 million survivors with disability or lost development potential, and millions of adults at increased risk of non-communicable diseases",[17] as well as the need for effective actions to reduce neonatal mortality rate in sub-Saharan countries. Indeed, it is estimated that it will take more than 150 years for the African countries to reach the current neonatal survival levels of developed countries if the current neonatal mortality reduction rate remains unchanged.[18, 19]

With a ratio of 764 per 100,000 live births, maternal mortality remains high in South Africa, with huge disparities ranging from 102 per 100,000 live births in the Western Cape province

to 1639 per 100,000 live births in the Eastern Cape.[20] It is thought that three conditions, namely non-pregnancy-related infections (mainly HIV-related), obstetric haemorrhage, and complications of hypertension in pregnancy (pre-eclampsia and eclampsia) are responsible for almost two-thirds of potentially avoidable maternal deaths in South Africa.[21]

This study aimed to determine the perinatal outcomes of babies born to mothers who died from complications related to childbirth.

LITERATURE REVIEW

The term “Perinatal mortality” has evolved over time and is currently defined as the death during the first week of life of the foetus after 22 weeks of gestational age or birth weight of 500 g and more, plus the number of stillbirths per 1000 live birth per year. Stillbirth is described as the death of a foetus before delivery, at a gestation age of 22 weeks and beyond or weighing 500 g and more.[22] It is to be clarified that the previous cut-offs were a gestational age of 28 weeks or birth weight of 1000 g. Neonatal mortality, on the other hand, is defined as the death of a live-born infant in the first 28 days of life.[22] Neonatal mortality is divided into early neonatal deaths occurring within the first week of life and late neonatal death occurring after 7 days but within 28 days. As previously stated, perinatal mortality encompasses both stillbirths and early neonatal deaths. Thus, the two periods (perinatal and neonatal) for mortality assessment overlap in the first week of life.

It is believed that the perinatal period is the most vulnerable period in the life of an individual and the risk of death during this period is higher than at any other period of life.[2] This vulnerability decreases as the infant grows. Indeed, about three-quarters of the total neonatal deaths occur within the first week, i.e. early neonatal death and about 45% of early neonatal deaths occur within the first 24 hours of life.[23]

Globally, recent data estimate that about 4 million stillbirths occur each year, of which over 40% are intrapartum-related.[24-26]

Studies showed that nearly half of stillbirths were alive at the start of labour and many of them may be avoided by simple interventions.[27] However, the potentially avoidable factors for perinatal mortality have not been considered in the Global Burden of Disease, nor in

disability-adjusted life-years lost, and they are not part of the United Nations (UN) Millennium Development Goals (MDGs).[27, 28]

Like any mortality estimation, the reliability of perinatal mortality estimates depends on the completeness with which stillbirths and perinatal deaths are reported.[29] It is worth mentioning that the stillbirths (a significant proportion of perinatal mortality) are likely to be underestimated due to inconsistent definitions and classification systems, as well as poor reporting.[26, 28, 30, 31] In some developing countries, over 70% of women are still delivering at home.[32] Evidence shows that the conventional sources of information about births, stillbirths, and early childhood deaths often do not exist or are incompletely recorded in many developing countries.[33-36]

Despite the significant decrease in under-five mortality rates, the neonatal and perinatal mortality rates have been decreasing much more slowly, remained static or even increased in some parts of the world.[37-39] Indeed, the under – five mortality rate has been reduced globally from 90 deaths per 1,000 live births in 1990 to 48 per 1,000 live births in 2012.[40] On the other hand, the contributing proportion of neonatal deaths to under-five mortality rate has increased from 37 % in 1990 to 44 % in 2012, and this trend is expected to continue if nothing is done to improve the management of labour and neonates requiring special care.[40]

The perinatal mortality rate (PMR) is a key outcome indicator for new-born care and directly reflects prenatal and intrapartum care. PMR has also been proposed as a major determinant of maternal health status.[4] Another tool to assess the effectiveness of perinatal care is perinatal care index (PCI) as described in the introduction.

In the same context, the maternal mortality rate (MMR) is unacceptably high.[23] The MMR is defined as the annual number of female deaths per 100,000 live births from any cause related to or aggravated by pregnancy or its management.[23] In 2010, about 287000 women died globally during pregnancy and /or following childbirth. Of these maternal deaths 99% occurred in developing countries, with more than half of deaths (56%) occurring in sub-Saharan Africa, followed by South Asia with 29%. Thus, sub-Saharan Africa and South Asia represent 85% of the global maternal mortality burden.[41, 42] A woman in a developing country is 97 times more likely to die as a result of pregnancy or childbirth complications than a woman in a developed country.[23] It is also estimated that, at global level, one woman dies from complication of pregnancy and / or delivery every two minutes.[43]

Millennium Development Goal 5 (MDG 5) has the target of reducing maternal mortality by 75% and achieving universal access to reproductive health by 2015. Nevertheless, the progress in reducing maternal mortality and providing family planning services in developing countries has been too slow to meet the targets.[44]

In South Africa, scarce and incomplete data on maternal deaths as well as different analytical models used have resulted in different estimates of maternal mortality rates.[45] This MMR is considered to be unacceptbly high.[20] Nevertheless, evidence indicates that maternal deaths in South Africa have been continuously declining from around 2004, due to the treatement of HIV infected mothers and introduction of the programme of Prevention of Mother To Child Transmission (PMTCT).[45, 46] This decline was also due to continuous efforts to improve the quality of those programmes; including the training of staff, counselling and voluntarily HIV testing among pregnant women and early antiretroviral (ARV) initiation for pregnant women.[47]

Despite tremendous progress made in HIV treatment in South Africa with the largest number of people on antiretraviral therapy in the world,[48] HIV and tuberculosis (TB) remain an important cause of maternal deaths accounting for 40% and 28% respectively in South Africa.[45, 46] Other important causes of maternal deaths in South Africa are bleeding (haemorrhage) and high blood pressure (hypertension).[45, 46]

However, data collected in hospitals indicate that 40% of the causes of maternal deaths are preventable in South Africa.[46]

The Charlotte Maxeke Johannesburg Academic Hospital (CMJAH), which was the site of this study, is a teaching hospital with 1088 beds and offers a full range of health care services including highly specialized services.[49] The neonatology unit caters for, among others, babies with health problems such as very low birth weight infants (weighing < 1500 g). The overall survival rate of very low birth weight infants is 70.5% ranging from 34.9% for extremely low birth weight (< 1000 g) to 84.9% for very low birth weight infants 1000-1499 g.[50] On the other hand, the maternal mortality rate (MMR) at the same hospital, was estimated at 476 per 100 000 live births in 2008.[51] In the context of a referral hospital receiving complicated cases, the CMJAH is more likely to have high mortality rates compared to national figures.

The motivation to carry out this research was prompted by the paucity of published studies on perinatal outcomes of babies born to mothers who died due to complications of pregnancy and / or delivery. In fact, PubMed, Cochrane review databases and other related databases include relatively few studies which investigated perinatal outcomes of infants born to mothers who died from complications of childbirth. Indeed, the main study found in the literature, which looked at perinatal outcomes of infants born to mothers who died

from childbirth complications, was the Saleem's study conducted in seven low and middle-income countries. In this study, about 70% of stillbirths occurred intrapartum and neonatal deaths were 7.4 times higher among women who died, in comparison with those who were alive at six week postpartum.[52] Consequently, the lack of adequate data impedes effective interventions to improve the survival of those infants.[10] Therefore, the aim of this study was to contribute in filling the gap on the existing knowledge by exploring the perinatal survival of infants weighing 500 g and more or of 22 week gestational age and above born to mothers who died from childbirth complications

OBJECTIVES

Aim

The overall aim of this study was to investigate the perinatal outcomes of infants weighing 500 g and more or of 22 week gestational age and above born to mothers who died due to complications of pregnancy or delivery before being discharged from CMJAH over the period of 10 years, starting from the 1st January 2003 up to the 31st December 2012.

Specific objectives

This study pursued the following objectives:

1. To describe the demographic and clinical characteristics of infants weighing 500 g and more or of 22 week gestational age and above born to mothers who died due to complications of pregnancy or delivery in the same period at CMJAH and their mothers' characteristics.
2. To determine the perinatal survival of infants weighing 500 g and more or of 22 week gestational age and above born to mothers who died due to complications of pregnancy in the same period at CMJAH.
3. To identify the factors (both maternal and infant) associated with perinatal survival of infants weighing 500 g and more or of 22 week gestational age and above born to mothers who died due to complications of pregnancy or delivery in the same period at CMJAH.

MATERIAL AND METHODS

Design and duration

This was retrospective cohort study of infants born to mothers who died due to complications of pregnancy or delivery. Every infant was followed up for the first seven days of life except when died or discharged before that time. The study extended over a period of 10 years, starting from the 1st January 2003 up to the 31st December 2012.

Study Population

- Infants born to mothers who died due to complications of pregnancy or delivery at CMJAH from 1st January 2003 up to the 31st December 2012.
- Mothers who died due to complication of pregnancy or delivery at CMJAH from 1st January 2003 up to the 31st December 2012.

Inclusion and exclusion

- Included were:
    - Infants (either born alive or stillborn) weighing more than 500 g and above or with 22 weeks gestational age or more, whose mothers died due to complications of pregnancy or delivery before being discharged and within 6 weeks post - delivery.
    - Mothers with gestational age of at least 22 week delivered at CMJAH and died due to complication of pregnancy or delivery before being discharged and within 6 weeks post - delivery.

- Excluded were:
    - Infants born before arrival or transferred to CMJAH after delivery.
    - Infants whose records or their mothers were incomplete for analysis.
    - Mothers transferred to CMJAH from other hospitals or clinic after delivery.

Data Collection

Data collection sheet checklist (see appendix)

A data collection sheet of relevant information was developed in Microsoft Word by the researcher and was used for coding.

Sources

To retrieve the information needed, the following sources were used:

- Perinatal Problem Identification Programme (PPIP) data sheet second version (v2.2) form (see appendix) which gives a list of maternal obstetric and final causes of maternal deaths;
- The patients' files from Medical Record Department, Electronic Medical Record Software (MEDICOM) or maternal registers of CMJAH;
- Compulsory notifications of maternal deaths.

For infants' data, the following sources were used:

- Neonatal/ ICU registers. The department of paediatrics created an electronic neonatal database for clinical audit which includes all neonatal admission.

- The patients' files from Medical Record Department, Electronic Medical Record Software (MEDICOM) and neonatal registers of CMJAH

Data capturing

The following maternal demographic and clinical characteristics were retrieved from the sources mentioned above: age, parity, gravidity, HIV status, antenatal care attendance, antenatal steroids, obstetric and final causes of maternal deaths.

The following characteristics were captured for infants whose mothers met the criteria for inclusion in the study: gestational age, condition at birth (born alive, stillborn, alive on admission, fresh stillborn but dead on admission, stillborn and admission status unknown, macerated stillborn), mode of delivery, gender, birth weight and outcome at 7 days of age (dead or survived).

The researcher captured all information using Microsoft Excel and when the database was completed, it was cleaned and coded before it was imported into analysis package software (Stata.11).

Data cleaning and coding

Data cleaning consisted with double checking the data entry for missing values by the researcher to determine internal consistency of this study. Data coding was suggested by the researcher and approved by the supervisor. To maintain the patients' confidentiality, the patients were given a research code number. All the codes used appear on the data collection sheet. Finally a statistician's help was obtained for further coding and some of inferential analysis.

Data analysis

Data in Microsoft Excel sheet were imported to statistical software (STATA version 11) for descriptive and inferential analysis on demographic and clinical characteristics of the study population.

Descriptive analysis

Categorical variables were presented by frequency and percentage. Means and standard deviations for numerical variables were also described where appropriate.

Inferential analysis

A chi-square test was used to test for association between 2 categorical variables whereas the T-test was used to test association between binary categorical variables and numerical variables. Probability (P) value of less than 0.05 was regarded as significant. To determine association between perinatal outcomes (died or survived) and single individual variable, the Binary Outcomes Logistic Regression analysis was used. To determine association between perinatal outcomes (died or survived) and more than one variable, Multivariate Logistic Regression Model was used.

Kaplan Meier Survival Curve Estimation which was initially planned in our protocol to be used for determining the perinatal survival rate was not used because almost all infants died within the first day of life, except one child who died at day 3 of life.

ETHICS CONSIDERATIONS

This study was approved by the Human Ethics Research Committee of the University of the Witwatersrand which issued the clearance certificate no: M 130822 (Appendix). The CEO of Charlotte Maxeke Johannesburg Academic Hospital also gave approval letter for this project (Appendix).

RESULTS

A total of 142 mothers meeting the criteria for inclusion in the study were identified. Of these, 20 were excluded because they died before delivery and the details of the foetus were not available. This left a total of 122 mothers including six who had twin infants and the total of 128 infants who were eligible for analysis.

INFANTS' DEMOGRAPHIC AND CLINICAL CHARACTERISTICS

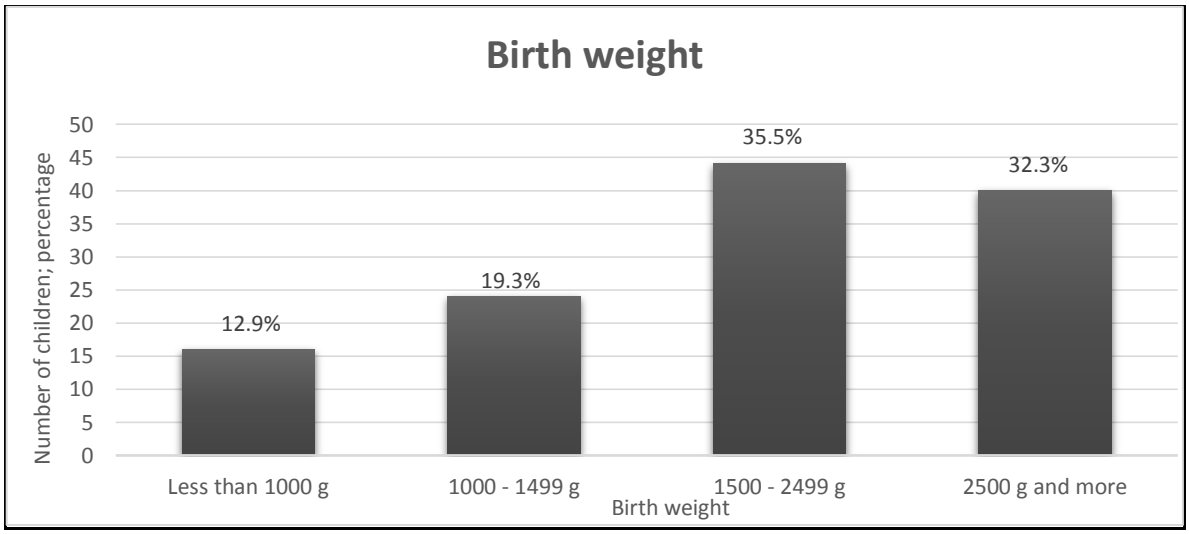
Gender

Out of 128 infants born to mothers who died before discharge from CMJAH, 14 did not have gender recorded. On 114 left, 61% were male and 39% were female.

Birth weight (g)

The birth weights of four infants were missing. Out of 124 remaining observations, the mean birth weight was 1995.4 g and standard deviation of 867.6 with minimum of 500 g and maximum of 3860 g. The birth weight distribution can be seen in Figure 1.

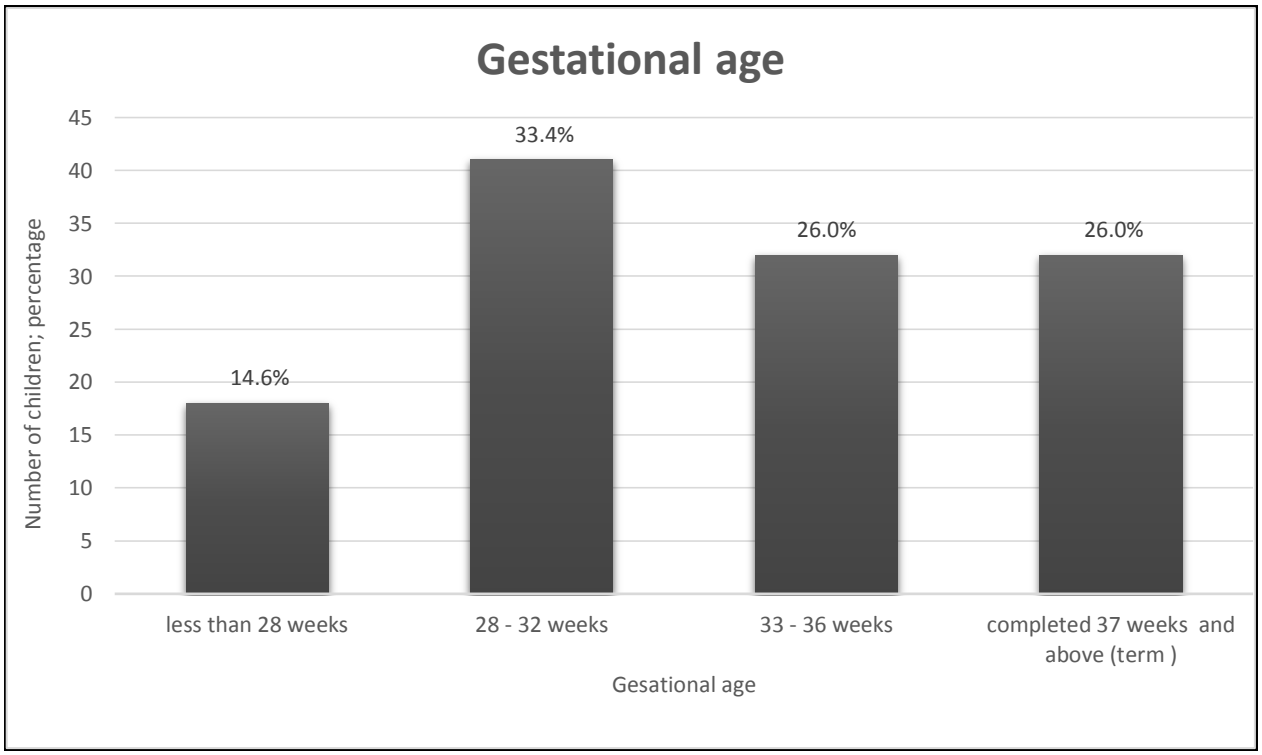
Figure 1.Birth weight distribution



Gestational age

Five infants did not have gestational age recorded but their birth weight was more than 500 g. Almost three-quarters, 91 out of 123 (74%) were preterm infants. The mean gestational age was 32.8 weeks and standard deviation of 4.7 with minimum gestational age of 24 weeks and maximum gestational age of 42 weeks. Antepartum steroid information was very poorly recorded and available only in 24 cases out of 75 women with gestational age < 35. Figure 2 represents the frequency of gestational age distribution.

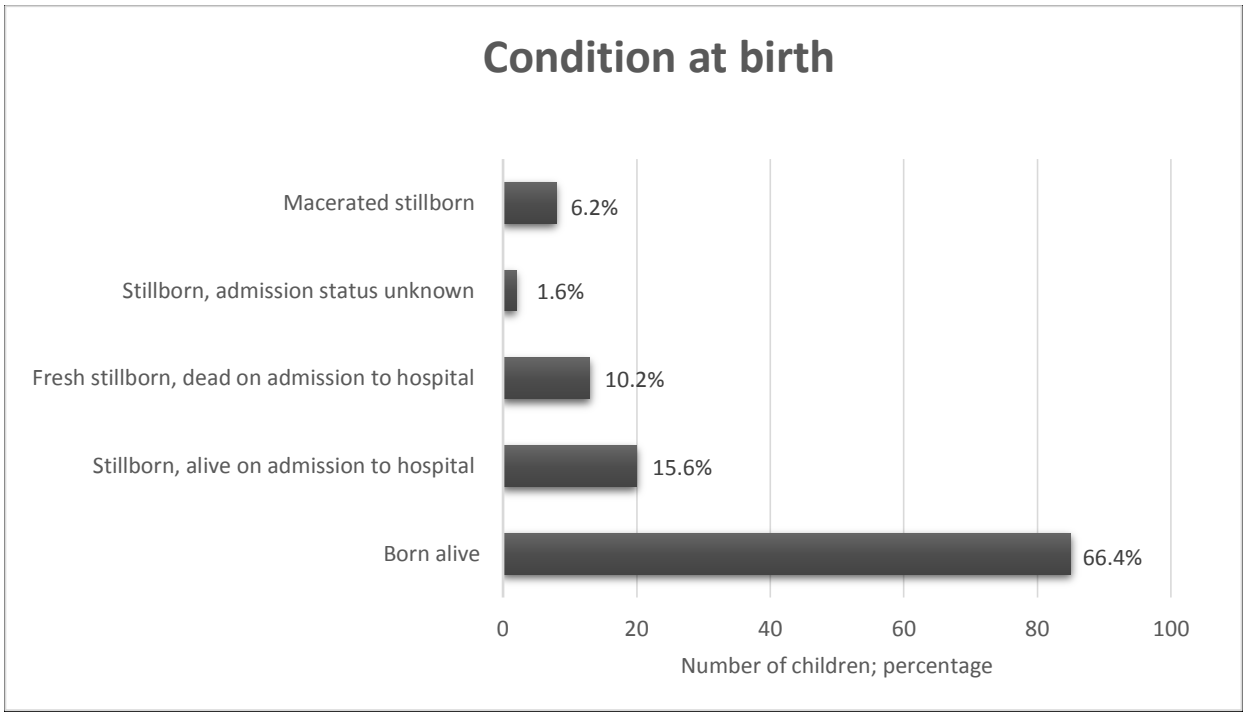
Figure 2.Gestational age distribution



Infant's conditions at birth

Out of 128 infants born, 85 (66.4%) were born alive. With regard to 43 stillborn infants, 8 were bone macerated while 35 infants were fresh stillborn. From fresh stillborn infants, 20 were assessed alive on the mother's admission to hospital, 13 were confirmed dead, and the status of two foetuses were unknown at the time of maternal admission. The status of the infants at birth can be seen in figure 3.

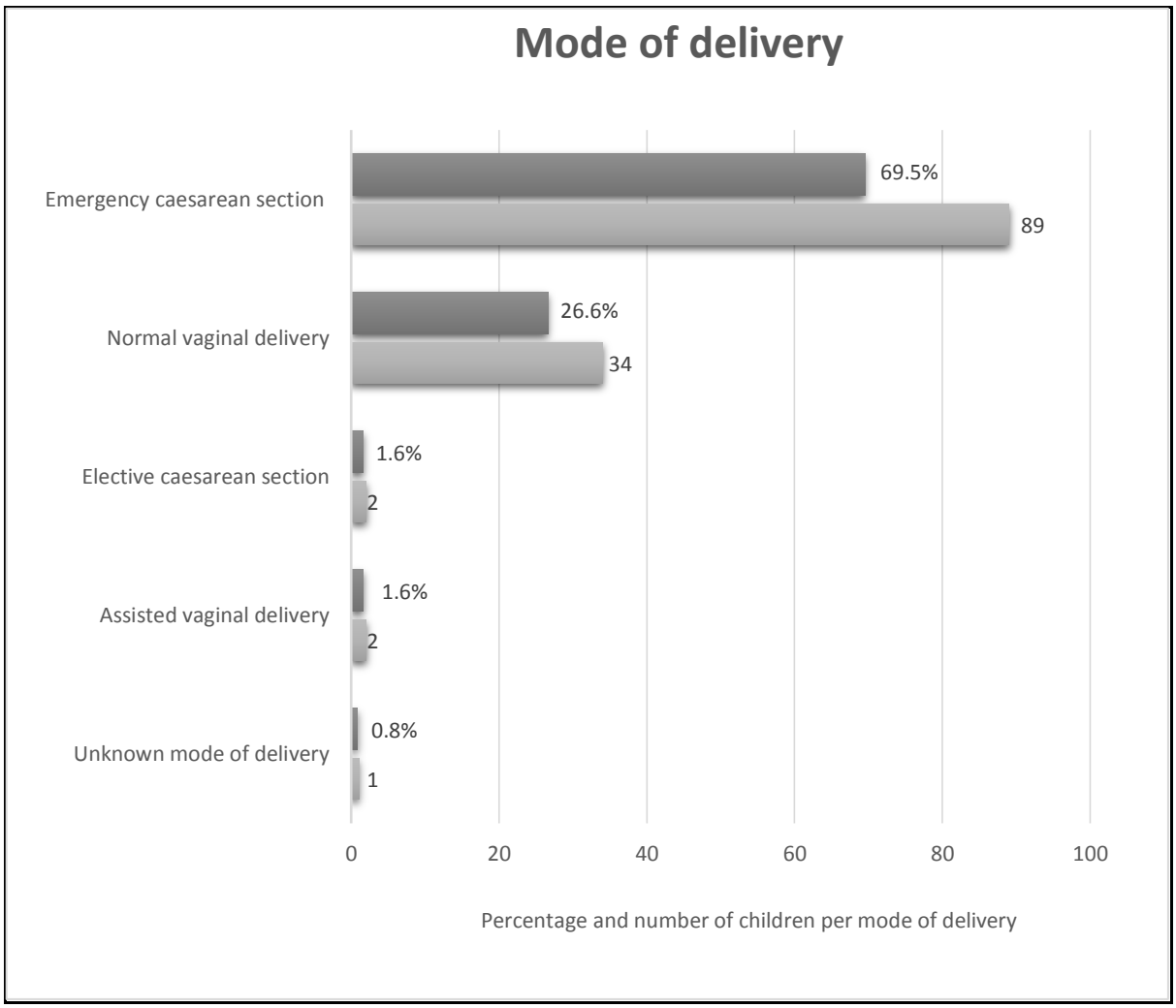
Figure 3.Infants' condition at birth



Mode of delivery

Out of 128 infants, 89 (70%) were born by emergency caesarean. The mode of delivery can be seen in Figure 4.

Figure 4.Distribution of mode of delivery



Apgar scores for infants born alive

Apgar scores at one minute were poorly recorded and missing in 29 cases, while Apgar scores at five minute was better recorded with 77 out of 85 infants (90.6%) having Apgar scores recorded at five minutes. The number of infants with low Apgar scores (≤ 6) at one minute decreased at five minutes from 31 to 23 while the number of infants with high Apgar

scores (7 and above) doubled from one minute to five minute from 25 to 54 respectively. Table 1 represents the Apgar scores at one and five minutes.

Table 1. Apgar scores at one minute

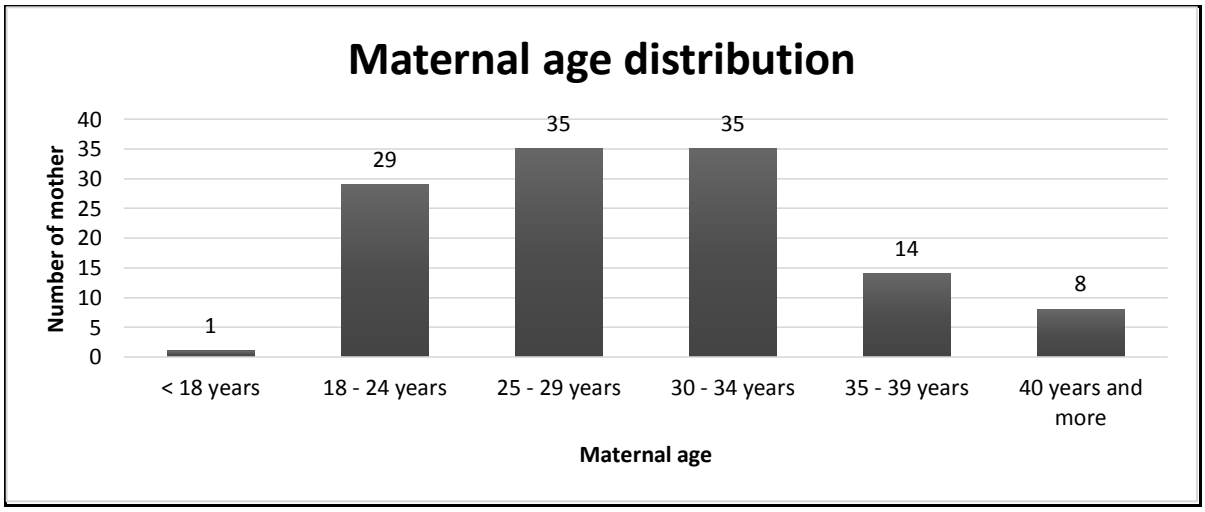
Apgar scores	At one minute		At fifth minute	
	Number	Percent	Number	Percent
1-3	15	26.8	13	16.9
4-6	16	28.6	10	13.0
7 and more	25	44.6	54	70.1
Total	*56*	*100*	*77*	*100*

MATERNAL DEMOGRAPHIC AND CLINICAL CHARACTERISTICS

Maternal age

The minimum maternal age was 15 years and the maximum was 44 years. The majority of women were aged between 25 and 34 years. The age distribution of the mothers can be seen in figure 5.

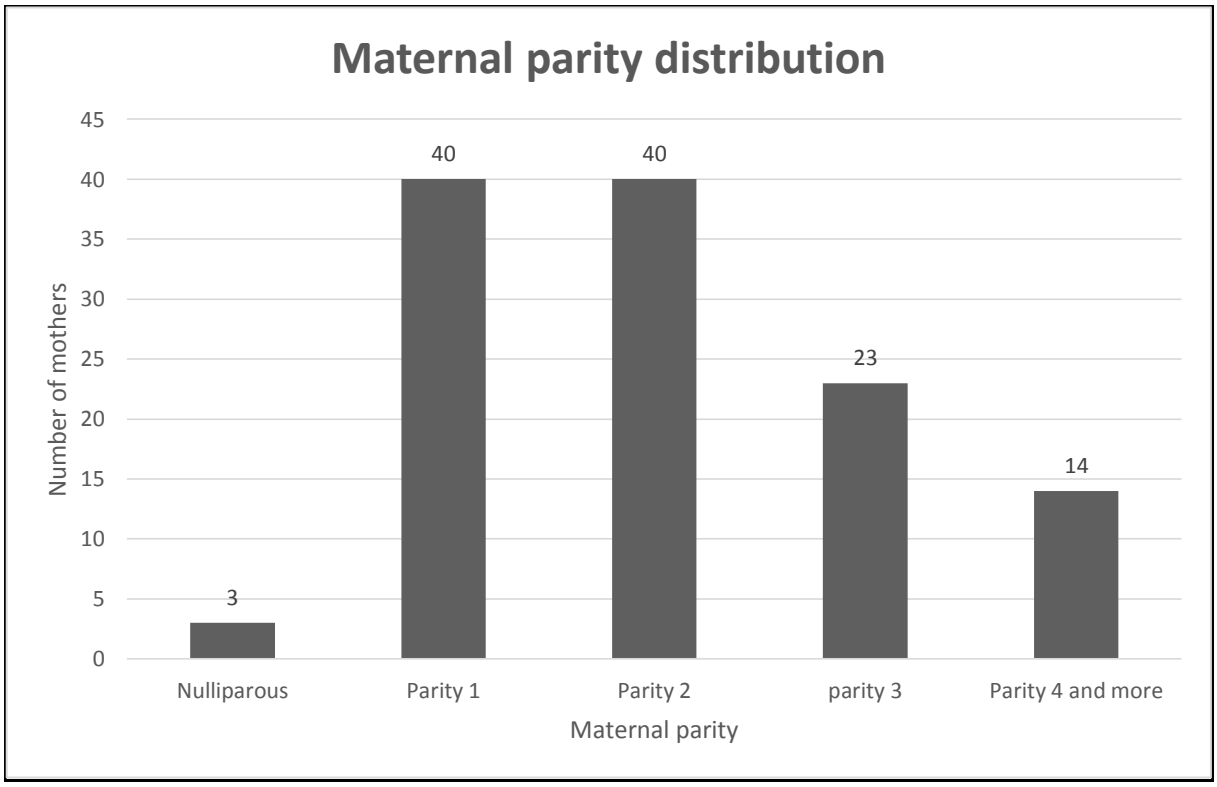
Figure 5. Distribution of maternal age



Maternal parity

Two out of 122 women did not have parity recorded in their files. Figure 6 shows the distribution of maternal parity of 120 remaining mothers.

Figure 6. Maternal parity distribution



Antenatal clinic care attendance

The antenatal clinic attendance was recorded for 119 out of 122 women and 76% were recorded as having attended the antenatal clinics. However the number of antenatal visits was not specified.

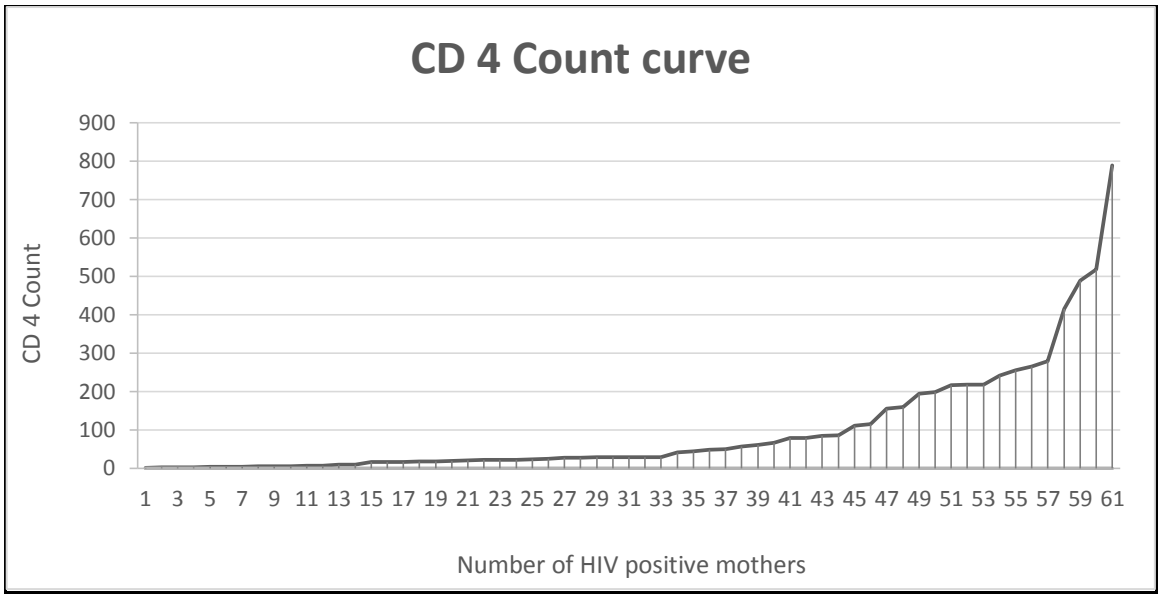
Maternal HIV status

The HIV status was missing for 21 women, of the 101 remaining women, the HIV prevalence was 71%.

CD4 count

CD4 count was recorded for 61 out of 72 mothers confirmed HIV positive. The minimum CD4 count was one and the maximum CD4 count was 789/µL with the median CD4 count of 29/µL. The figure 7 represents CD4 count distribution per person with nearly three-quarters having advanced HIV disease with CD4 count less than 100/µL.

Figure 7. CD 4 count distribution



Patients on HAART

Among patients confirmed to be HIV positive, only 20 (24.3%) were on antiretroviral treatment.

Obstetric causes of maternal deaths

Out of 122 mothers included in the study, 121 had records on obstetric causes. The top four obstetric causes of maternal deaths were non-pregnancy related infections and HIV/AIDS; hypertensive disorders of pregnancy; pre-existing maternal diseases and postpartum haemorrhage accounting for altogether 82.7%. Table 2 shows the frequency of the obstetric causes of maternal deaths.

Table 2. Frequency of obstetric causes of maternal deaths

Obstetric causes of maternal deaths	Number	Percent
Non-pregnancy related infections and HIV/AIDS	42	34.7
Hypertensive disorders of pregnancy	26	21.5
Pre-existing maternal diseases	18	14.9
Postpartum haemorrhage	14	11.6
Other causes:		
Antepartum haemorrhage	*7*	*5.8*
No obstetric causes	*6*	*5.0*
Embolism	*3*	*2.5*
Acute collapse - causes unknown	*2*	*1.7*
Pregnancy-related sepsis	*1*	*0.8*
Anaesthetic complications	*1*	*0.8*
Unknown	*1*	*0.8*
TOTAL	121	100

Final causes of maternal deaths

For the purpose of this study, only one final cause of maternal death, as recorded firstly on the PPIP form, was considered because very few mothers had more than one causes. Table 3 represents the distribution of those causes. The top four in descending order were, namely, respiratory failure including TB, cardiac failure, hypovolemic shock and Immune system failure with HIV/AIDS representing together more than 70% of all final causes of maternal deaths.

Table 3.Final causes of maternal deaths

Final cause of Maternal Deaths	Number	Percent
Respiratory failure	26	21.2
Cardiac failure	26	21.2
Hypovolemic shock	23	18.9
HIV / AIDS	13	10.8
Other causes:		
Liver failure	*9*	*7.3*
Cerebral complications	*9*	*7.3*
Septic shock	*3*	*2.4*
Renal failure	*3*	*2.4*
Disseminated intravascular coagulation	*3*	*2.4*
Multi-organ failure	*1*	*0.8*
Metabolic	*1*	*0.8*
Unknown & other	*6*	*4.8*
TOTAL	123	100.0

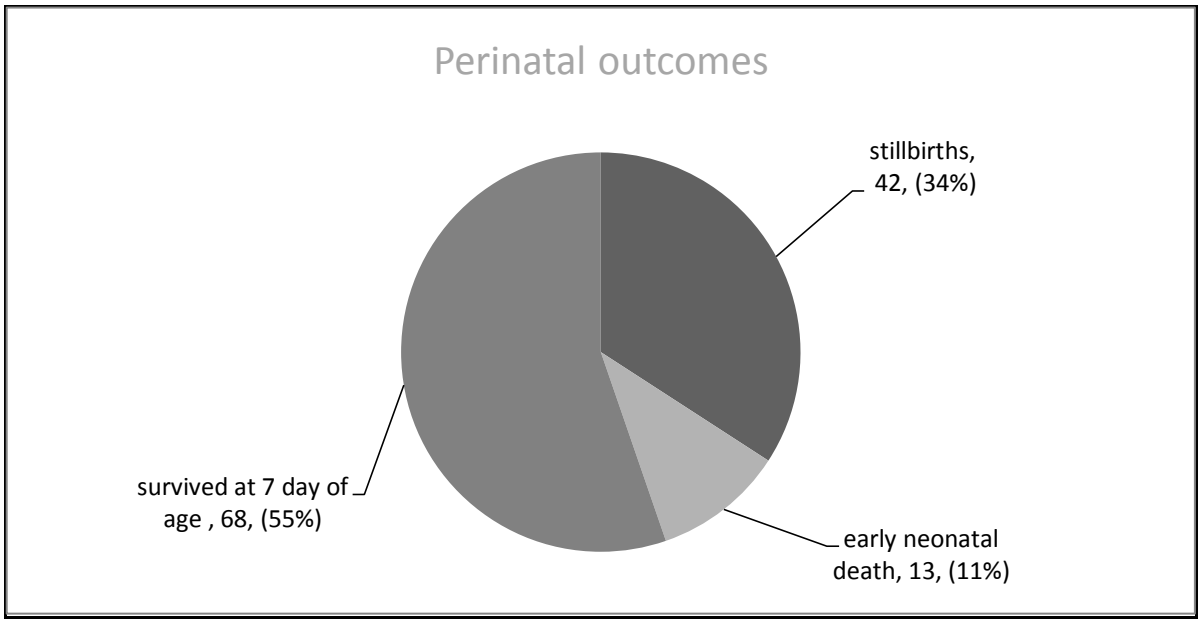
PERINATAL OUTCOMES

For the purpose of this study, the term “perinatal outcomes” was used for all infants (born alive and stillborn), while the term “early neonatal outcomes” was considered only for infants born alive and observed for the first week of live.

Perinatal outcomes

A total of 128 infants records were reviewed for analysis, of whom five were excluded: four infants born alive but did not have their outcomes recorded in their files (dead or survived) and another infant who was stillborn had no record about other variables (weight, gender, Apgar’s, etc.). Of the remaining 123 infants, 42 (34%) were stillbirths, 13 (11%) died and 68 (55%) infants survived to 7 day of life. The perinatal outcomes can be seen in figure 8.

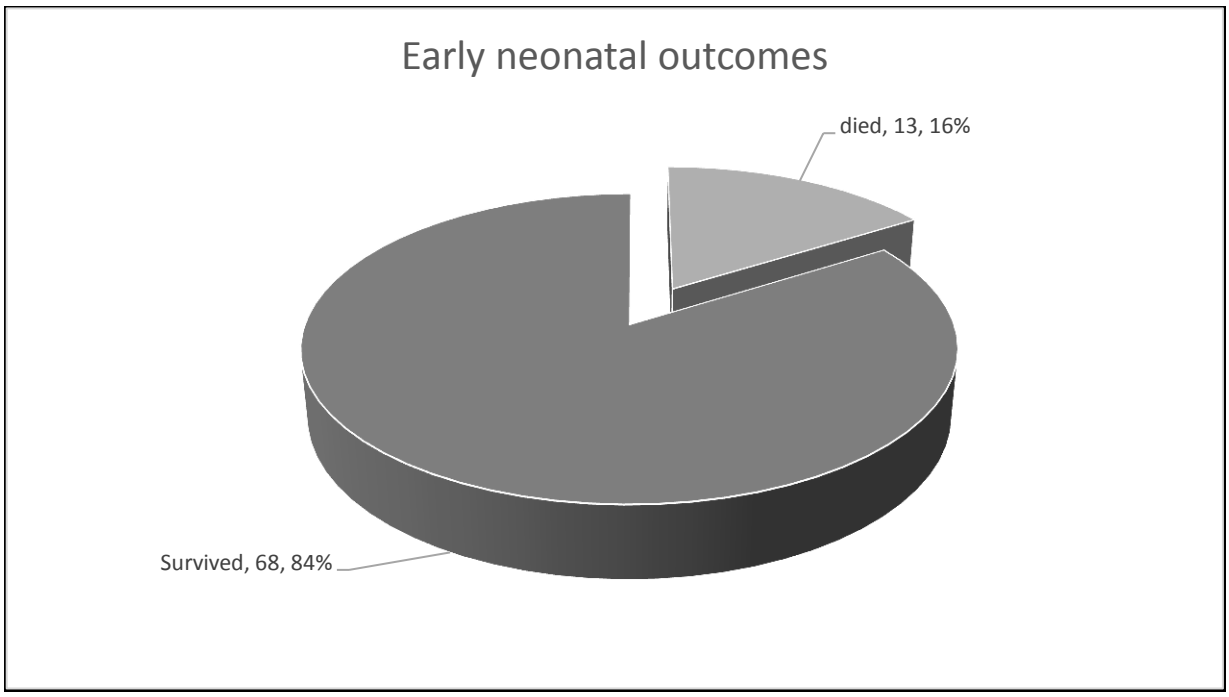
Figure 8. Perinatal outcomes



Early neonatal outcomes

Out of 85 infants born alive (Table 4), the outcomes of four infants were not available in the records. Of the remaining 81 infants, the majority (83.9%) infants survived to 7 day of life or were discharged before 7 days of age. Figure 9 represents early neonatal outcomes of infants born alive.

Figure 9.Early neonatal outcomes



Characteristics of infants born alive and then subsequently died

Details of the 13 infants who were born alive and then subsequently died are listed in table 4. All of them had poor Apgar scores at five minute (≤ 5); and it can be seen that all of the deaths were attributed to perinatal asphyxia. However, all of them, except one, were premature infants with gestational age of 35 weeks or less; thus hyaline membrane disease might have been an underling factor in some of these deaths.

Table 4.Birth weight, gestational age (GA), Gender, Apgar scores at five minute and presumed causes of death of infants born alive

Number	Weight(g)	G.A.	Gender	5 min. Apgar scores	Presumed cause of death
1	680	26	Female	2	Perinatal asphyxia
2	695	24	Male	1	Perinatal asphyxia
3	780	28	Male	Missing	Perinatal asphyxia
4	1003	33	Male	1	Perinatal asphyxia
5	1010	28	Male	.	Perinatal asphyxia
6	1100	33	Male	3	Perinatal asphyxia
7	1180	31	Male	2	Perinatal asphyxia
8	1700	31	Male	3	Perinatal asphyxia
9	1900	Missing	Female	0	Perinatal asphyxia
10	2130	34	Female	4	Perinatal asphyxia
11	2180	34	Male	5	Hypoxic Ischemic Encephalopathy
12	2910	35	Male	0	Perinatal asphyxia
13	3000	38	Male	2	Perinatal asphyxia

ASSOCIATION WITH INFANTS' OUTCOMES

With regard to factors associated with perinatal outcomes of infants born to mothers who died as complications of childbirth, all infants (still births and born alive) were initially considered together. Then, infants born alive were appraised alone to determine the factors associated with early neonatal outcomes. Analysis commenced with univariate binary outcomes logistic regression to look at individual variable association with outcomes (either survived or died) followed by multivariate logistic regression to examine more than one variables and to determine which one(s) predict (s) perinatal or early neonatal outcomes.

There were 11 variables which were the most recorded and those variables which were selected for analysis. Those variables were namely; Apgar scores, birth weight, gestation age, gender, mode of delivery, maternal age, maternal parity, maternal HIV status, ANC attendance, obstetrical and final causes of maternal deaths.

For the purpose of analysis some variables were organised in groups. Apgar scores was classified into four groups of 0; 1-3; 4-6 and 7 and above. Birth weight was categorised into four groups of less than 1000 g; 1000 - 1499 g; 1500 - 2499 g and 2500 g and more. Gestational age was divided into four groups of less than 28 weeks; 28 - 32 weeks; 33 - 36 weeks and 37 weeks and more. Maternal age was stratified into four groups of less than 18 years; 18-25 years, 26-35 years and 36 years and above. Obstetric as well as final cause of maternal deaths were analysed as they are grouped on PPIP data sheet 2nd version (PPIP v2.03) (Appendix).

Factors associated with perinatal outcomes

Univariate binary logistic regression analysis

All 11 variables were analysed individually to look for association between each and perinatal outcomes. Apgar scores at one minute were considered for all babies including stillbirths in our analysis. The P value of less than 0.05 was considered statistically significant. Apgar scores at one minute, birth weight and gestational age were infant factors which were found to be statistically significant associated with perinatal outcomes. While maternal parity was the only maternal factor which was found to be statistically associated with perinatal outcomes. For each selected variable, number of observations, odds ratio (O.R), P value and 95% CI are represented in table 5 which shows association between perinatal outcomes and those variables. The factors found to be associated with perinatal outcomes were, Apgar scores at one minute, birth weight gestational age and maternal parity.

Table 5.Association between perinatal survival and selected variables

Variables	Number of observations	O.R	P value	95% C.I
Apgar scores at 1 minute	*98*	*62.2*	*0.000*	*8.172 –73.804*
Birth Weight	*120*	*2.3*	*0.000*	*0.007 – 0.109*
Gestational Age	*120*	*1.9*	*0001*	*1.274 – 2.764*
Maternal Parity	*122*	*1.5*	*0.019*	*1.069 – 2.2116*
Mode of delivery (caesarean section)	123	1.2	0.123	0.957 – 1.440
GENDER	*112*	*1.5*	*0.332*	*0.675 – 3.198*
ANC Attendance	124	1.0	0.811	0.982 – 1.014
Maternal Age	124	1.0	0.752	0.528 – 1.587
HIV Status	76	1.0	0.483	*0.994 – 1.013*
Obstetrical Causes of Maternal Deaths	117	1.0	0.896	0.865 – 1.134
Final Causes of Maternal Deaths	122	1.0	0.467	0.807 – 1.067

Multivariate logistic regression analysis

74 infants had records of all 11 variables. Multivariate logistic regression model was used to look for predictor(s) of overall perinatal outcomes. The P value of less than 0.05 was considered statistically significant. A strong positive association was fund between maternal parity and perinatal survival rate with correlation coefficient of + 0.7 (P=0.03, 95% CI -0.007 – 0.130). Apgar scores at one minute had moderate positive association with perinatal survival rate, correlation coefficient of + 0.4 (P=0.000, 95% CI 0.309 – 0.406). Previous association found between perinatal outcomes and birth weight as well as gestational age as shown in table 5 could not be found. In addition, although weak association, mode of delivery became positively associated with perinatal outcomes, with correlation coefficient of + 0.1 (P=0.002, 95% CI 0.022 – 0.090); on the other hand caesarean section was found to be a protective factor for perinatal survival in multivariate analysis. While ANC attendance showed extremely very weak positive correlation with perinatal survival rate; the coefficient of correlation was very close to zero (+ 0.0024) as shown in table 6.

Table 6.Association between perinatal outcomes and selected variables by multivariate analysis

Overall perinatal outcomes	Coefficient	P value	95% C.I
Maternal Parity	*+ 0.7*	*0.030*	*0.007 – 0.131*
Apgar scores at 1 minute	*+ 0.4*	*0.000*	*0.307 – 0.406*
Mode of delivery (caesarean section)	*+ 0.1*	*0.002*	*0.022 – 0.090*
ANC Attendance	*+ 0.0*	*0.032*	*0.000 – 0.005*
Birth Weight	*+ 0.1*	*0.773*	*- 0.080 – 0.107*
Gestational Age	*- 0.4*	*0.326*	*- 0.128 – 0.043*
Gender	*+ 0.0*	*0.438*	*- 0.071 – 0.161*
Maternal Age	*- 0.4*	*0.533*	*- 0.132 – 0.069*
HIV Status	*- 0.0*	*0.262*	*- 0.002 – 0.001*
Obstetrical Causes of Maternal Deaths	*+0.1*	*0.410*	*- 0.013 – 0.032*
Final Causes of Maternal Deaths	*- 0.0*	*0.242*	*- 0.001 – 0.000*

Factors associated with early neonatal outcomes

Univariate binary logistic regression analysis

The same 11 variables were considered and the same variables' categories, as described before, were maintained where applicable. Each variable was individually analysed together with early neonatal outcome to establish association between them. The P value of less than 0.05 was considered statistically significant.

Apgar scores at five minutes was used, as it was the most often recorded, and there was also a strong correlation between Apgar scores at one minute, at five and at ten minute as showed by the following table:

Table 7.Correlation of Apgar's scores at different times

Apgar scores	**Power of correlation of Apgar scores**		
	Apgar score at one min	Apgar score at five min	Apgar score at ten min
Apgar score at one minute	1.00		
Apgar score at five minute	0.97	1.00	
Apgar score at ten minute	0.94	0.98	1.00

The variables found to be statistically significant associated with early neonatal survival rate in univariate analysis, were Apgar scores at five minute, birth weight and maternal parity. The following table shows association between early neonatal survival and selected variables.

Table 8.Association between early neonatal outcomes and selected variables

Variables	Number of observations	O.R	P value	95% C.I
Apgar scores at 5 minute	*75*	*18.0*	*0.000*	*4.278 –76.439*
Birth Weight	*81*	*2.5*	*0.010*	*1.243– 4.945*
Maternal Parity	*79*	*3.1*	*0.007*	*1.365– 6.814*
Gestational Age	79	1.5	0.201	0.658– 10.372
Mode of delivery (caesarean section)	81	1.2	0.295	0. 858 – 1.651
Gender	*79*	*1.5*	*0.332*	*0.675 – 3.198*
ANC Attendance	77	0.5	0.230	0. 127 – 1.642
Maternal Age	81	0.7	0.422	0. 275 – 1.716
HIV Status	62	0.9	0.850	*0. 192 – 3.895*
Obstetrical Causes of Maternal Deaths	76	0.9	0.583	0. 774 – 1.155
Final Causes of Maternal Deaths	80	0.9	0.344	0.729 – 1.116

Multivariate logistic regression analysis

All 11 variables were recorded for 67 infants whose records we analysed using multivariate logistic regression model for all variables to look for predictor(s) of perinatal outcomes. A P value of less than 0.05 was considered statistically significant. Apgar scores at five minutes had a moderately positive association with early neonatal outcome, correlation coefficient of + 0.3 (P=0.000, 95% CI 0.212 – 0.404). While maternal parity showed a weak positive

association with early neonatal survival, correlation coefficient of + 0.1 (P=0.019, 95% CI 0.015 – 0.161). Table 9 shows association between perinatal outcomes and different variables.

Table 9.Association between early neonatal survival outcomes and selected variables by multivariate analysis

Perinatal survival	Coefficient	P value	95% C.I
Apgar scores at five minute	*+ 0.3*	*0.000*	*0.212 – 0.404*
Maternal Parity	+ 0.1	0.019	0.015 – 0.161
Mode of delivery (caesarean section)	*+ 0.0*	*0.596*	*- 0.031 – 0.053*
Birth Weight	*+ 0.0*	*0.802*	*- 0.109 – 0.140*
Gestational Age	*- 0.0*	*0.564*	*- 0.131 – 0.072*
Gender	*+ 0.0*	*0.690*	*- 0.111 – 0.167*
Maternal age	*- 0.1*	*0.430*	*- 0.173 – 0.075*
HIV Status	*+ 0.0*	*0.948*	*- 0.002 – 0.002*
ANC Attendance	*+ 0.0*	*0.127*	*- 0.001 – 0.005*
Obstetrical causes of maternal deaths	*+ 0.0*	*0.677*	*- 0.000 – 0.001*
Final causes of maternal death	*- 0.0*	*0.952*	*- 0.025 – 0.023*

DISCUSSION

The goal of this study was primarily to investigate the perinatal outcomes of infants weighing more than 500 g and more whose mothers died due to complications of pregnancy and /or delivery within 42 days before being discharged from CMJAH. Secondarily, it aimed to determine the factors associated with perinatal outcomes of those infants. Lastly it sought to contribute to the body of the existing knowledge in this area of perinatology.

Over a period of ten years, from January 2003 to December 2012, a total of 128 infants with birth weight of 500 g or more born to 122 mothers who died from complication of childbirth after 22 weeks of gestational age were reviewed. Although this study was conducted at one site, our sample size is about one third of the sample studied by Saleem et al. with 345 neonates born to 336 women who died during childbearing and their sample was selected from seven countries in middle and low-income countries.[52]

The results showed that the majority of infants, i.e. 85 out of 128 infants (66.4%) who were born to mothers who died from childbirth complications, were born alive (table 4) whereas 43 out of 128 infants born to mothers who died due to childbirth complications (33.6%) were stillborn. This stillbirths rate is comparable to the one found in the Saleem study where 110 out of 145 infants, i.e. (31.8%) born to mothers who died during childbearing were stillborn.[52] However, the number of stillbirths occurring during labour and/or delivery was higher in the Saleem study (66%) than its number found in our study (46%). The lower rate of stillbirths which occurred during labour and/or delivery in our study, perhaps reflects better labour monitoring and prompt decision, such as emergency caesarean section, to save the babies at CMJAH in comparison with other hospitals in low and middle-income countries. Indeed, emergency caesarean sections were done to save the lives of infants in

70% of instances. This rate of caesarean sections is very high compared to the general estimates in sub-Saharan countries,[53, 54] as well as from the global estimates of emergency caesarean sections which is 15%.[53-56] These results should be interpreted within the context of teaching hospital like CMJAH, which is usually more equipped with more qualified staff and necessary resources than many other health facilities in low and middle-income countries. The rate of emergency caesarean sections performed on the mothers who died from childbearing in our study was found to be higher than the usual rate which is 50% at CMJAH.[57] This high rate of emergency caesarean sections should be understood as an indication to promptly save the babies in this particular group of mothers who were severely sick and dying. Being statistically significant associated with perinatal survival in multivariate analysis, caesarean section was found to reduce intrapartum-related stillbirths. This protective effect from caesarean section was found in other studies such as Darmstadt's study,[58] especially when the maternal and/or foetal lives were threatened.

A significant number of stillbirths (30%) were confirmed dead prior to admission in our study, and this is similar to results from studies conducted at teaching hospital level for all stillbirths.[59-61] This may be explained by delay consultation/referral to teaching hospitals or by maternal risk factors such as hypertension and placenta abruption, to name few, as suggested by other studies.[62, 63]

As observed by some studies,[3, 11, 52] our study found that most of neonatal deaths occurred within the first 24 hours.

In regard with the survival rate, our study revealed that early neonatal survival rate was 85% for infant born alive. These findings were almost double of the survival rate found by Saleem et al. study, which was 45%, i.e. 154 out of 345 survived. This high perinatal survival rate

could be explained by the level of both obstetric and perinatal care at CMJAH. The level of advanced care could be attributed to trained staff and adequate life support resources usually available at teaching hospitals in comparison with other health facilities in middle and low-income countries in general.

Concerning the causes of perinatal deaths, perinatal asphyxia was found to be the main cause. Indeed, all 13 infants who died had low (≤ 5) Apgar scores at five minute (Table 4). However, hyaline membrane disease was also presumed to be an underlying factor in many of those deaths as nearly 70% of those infants were less than 34 weeks of gestational age. These findings are in keeping with the study of Pattinson et al which found that asphyxia and prematurity are the most common causes of perinatal deaths in South Africa.[64, 65] These results are also in agreement with other various studies done in different settings.[28, 66-69]

As for factors associated with perinatal outcomes, birth weight and gestational age were statistically associated with perinatal survival, with P value of 0.000 and 0.003 respectively, in univariate binary logistic regression analysis. However, this association could not be found in multivariate logistic regression analysis. Using multivariate analysis, the overall predictors of perinatal outcomes of all infants born to mothers who died from childbirth complications were maternal parity, Apgar scores and mode of delivery. Thus the condition of the fetus/neonate at birth would appear to be more important than the weight or gestation as a predictor of survival. The association between mode of delivery association and perinatal survival suggests that caesarean section may have been life saving for the baby in some instances.

With regards to infants born alive only, Apgar scores at five minute, birth weight and maternal parity were the sole predictors that were statistically associated with early neonatal outcomes. Even though prematurity was presumed to be an underlying cause in some perinatal deaths as discussed above, perinatal asphyxia as for the case when both stillbirths and live births were analysed, was ascertained to be the main cause of all perinatal deaths as all infants born alive and then subsequently died had extremely low Apgar's scores. The number of infants with low Apgar scores (≤ 3) decreased from 27% at one minute to 17% at five minutes; while the number with high Apgar scores (7 and above) increased from 45% at one minute to 70% at five minute. This reflects successful neonatal resuscitation at CMJAH in the case a number of babies. In multivariate analysis, the association between early neonatal outcomes and birth weight could not be found due to the reason given above (analysis in the presence of powerful determinants). Apgar score and maternal parity were found to be the sole predictors which were statistically significant associated with early neonatal outcomes in multivariate analysis.

With respect to causes of maternal death, our results were in agreement with those found in other studies conducted in developing countries, with HIV, hypertension and antepartum haemorrhage being the top causes of obstetrical causes of maternal deaths.[70, 71] Concerning HIV/AIDS, although HIV prevalence was 71%, only 24 % of HIV positive mothers were on antiretroviral therapy and about three-quarters were at an advanced stage with CD4 < 100/µL. These results should be interpreted within the context that antiretroviral therapy for pregnant women was introduced more recently and thus many mothers had advanced HIV/AIDS in our study.

For the purpose of this study, a focus was made on perinatal outcomes (within the first days of live) of infants born to mothers who died from childbearing complications. It was beyond the scope of the current research to make a long-term follow up of these infants to investigate their outcomes at one year corrected age. Similarly, a longer period follow up would have been important to report on their social and psychological aspects.

LIMITATIONS.

This study had to face two main limitations:

1. Poor keeping of medical records:

   There was generally poor record keeping where some patients' files were unavailable either in archives or on electronic database.

2. Missing data:

   Even within the patients' files which were found, there were many missing data.

CONCLUSION

This study attempted to address the issue of perinatal outcomes of infants born to mothers who died due to childbirth complications at CMJAH between January 2003 and December 2013. Despite a lot of supporting literature which shows that mothers' complications from childbearing put the foetus at great risks including stillbirths and/or early neonatal death, little is known about perinatal outcomes of infants born to mothers who die from childbirth complications. It was a retrospective study which focused on infants weighing 500 g and above or with 22 weeks and more of gestational age born to mothers who died before being discharged from CMJAH. Our sample size was 128 infants born to 122 mothers who died as a result of childbirth complications.

The results from this study showed that the majority (66.4%) of infants born to mothers who died were born alive. There was a significant proportion of stillbirths (30%) occurring before admission to the hospital. However, the rate of stillbirths occurring around delivery at CMJAH was lower (46%) compared to its rate in middle and low-income countries (66%). The majority of infants (70%) were born by emergency caesarean. The identified main cause of perinatal mortality was perinatal asphyxia, which reflects the magnitude of foetal insult during labour or delivery of infants born to mothers who died due to childbirth complications. The perinatal survival rate was 55% while early neonatal survival rate was 84%. The main predictors which were statistically associated with perinatal outcomes were, maternal parity, Apgar scores at one minute and mode of delivery in multivariate analysis. Apgar scores at five minutes and maternal parity were found to be the sole predictors associated with early neonatal outcomes.

RECOMMENDATIONS

1. For hospitals, it is recommended that:

    - An effort to improve the quality of recording stillbirths and early neonatal deaths data should be made by all health workers and clerks in labour ward, caesarean section theatre and the neonatology unit at CMJAH.
    - A system to link perinatal deaths and maternal deaths should be initiated by the CMJAH administration, so that specific conclusions could easily be drawn to guide specific interventions to improve both maternal and perinatal survival.

2. For investigators/ researchers, it recommended that:

    - More research studies be undertaken by different researchers to provide enough data for guiding decision making in selecting most cost-effective, context sensitive and appropriate interventions to reduce both maternal and perinatal deaths.
    - Studies be conducted by researchers to determine feasibility and effectiveness of linking maternal deaths and perinatal deaths databases.

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APPENDIX

Medical Ethics Committee Clearance Certificate

R14/49 Dr Bucyibaruta J Blaise

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M130822

NAME: (Principal Investigator)	Dr Bucyibaruta J Blaise
DEPARTMENT:	Department of Paediatrics Medical School
PROJECT TITLE:	Perinatal Survival of Infants Weighing more than 500g whose mothers died in the Puerperium before Discharge: A Retrospective Descriptive Study at CMJAH
DATE CONSIDERED:	30/08/2013
DECISION:	
CONDITIONS:	
SUPERVISOR:	Prof Peter A Cooper
APPROVED BY:	Professor PE Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	18/09/2013

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.
I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report.**

Principal Investigator Signature Date 23/09/2013

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

CMJAH CEO Research Approval

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

CHARLOTTE MAXEKE JOHANNESBURG ACADEMIC HOSPITAL

Enquiries:
Ms. L. Mngomezulu
Tell: (011): 488-3793
Fax: (011): 488-3753
25th October 2013

Dr. Bucyibaruta Blaise
Paediatrics Department
CMJAH

Re: "Perinatal Survival of infants weighing more than 500g whose mother died in the Puerperium before discharged at Charlotte Maxeke Johannesburg Academic Hospital"

Permission is granted for you to conduct the above research as described in your request provided:

1. Charlotte Maxeke Johannesburg Academic hospital will not in anyway incur or inherit costs as a result of the said study.
2. Your study shall not disrupt services at the study sites.
3. Strict confidentiality shall be observed at all times.
4. Informed consent shall be solicited from patients participating in your study.

Please liaise with the Head of Department and Unit Manager or Sister in Charge to agree on the dates and time that would suit all parties.

Kindly forward this office with the results of your study on completion of the research.

Approved / ~~not approved~~

Dr. M.I. Mofokeng
Acting Chief Executive Officer

Data Collection Sheet & Coding

A. <u>INFANT DATA:</u>

1. INFANT CODE : REMOVE GT, THEN YEAR + PSI (PERINATAL SURVIVAL)+ 6 LAST DIGIT, FOR TWIN T1 AND T2 WILL BE ADDED
2. MATERNAL CODE: REMOVE GT, THEN YEAR + PSM (PERINATAL SURVIVAL)+ 6 LAST DIGIT
3. DATE OF BIRTH:
4. CONDITION AT BIRTH: (Please tick appropriate answer)
    a. Born alive= 1
    b. Stillborn, alive on admission to hospital =2
    c. Fresh stillborn, dead on admission to hospital =3
    d. Stillborn, admission status unknown =4
    e. Macerated stillborn =5
5. MODE OF DELIVERY: (Please tick appropriate answer)
    a. Normal vaginal delivery =1
    b. Vaginal breech =2
    c. Assisted vaginal delivery =3
    d. Elective CS =4
    e. Emergency CS =5
6. BIRTH WEIGHT: …. g; or a dot if unavailable; SEX: male= 1/ female=2/intersex =0 (Please tick appropriate answer)
7. APGARS: 1ST MIN: 5TH MIN 10TH MIN: (exact number or a dot if unknown)

8. RESUSCITED: (Please tick appropriate answer)
    a. No=0
    b. Oxygen=1
    c. Bagged=2
    d. Chest compression=3
    e. Adrenaline =4
    f. Intubated =5
    g. Unknown = 99

9. OUTCOME AT 7 DAYS: ALIVE =1 / DEAD = 0 or. (dot) for unknown
    a. IF DEAD THE SAME DAY AND ADMITTED TO TU AFTER RESUSCITATION INDICATE NUMBER OF HOURS
10. DATE OF OUTCOME WITHIN 7 DAYS

B. <u>MATERNAL DATA</u>

1. IDENTIFICATION CODE : REMOVE GT, THEN YEAR + PSM (PERINATAL SURVIVAL)+ 6 LAST DIGIT
2. DATE OF ADMISSION:
3. DATE OF DELIVERY:
4. DATE OF DEATH:
5. PRIMARY OBSETRIC CAUSE(S) OF DEATH: USE THE CODES IN PPIP
6. CONTRIBUTORY FINAL CAUSE (S) OF DEATH: USE THE CODES IN PPIP
7. MATERNAL AGE: (please circle) ….. yr UNKNOWN (0)
8. ANTENATAL CARE: (please circle) YES (1) NO (2) UNKNWON(99)

9. SYPHILIS SEROLOGY: (please circle) POSITIVE(1) NEGATIVE (2) UNKNOWN/ UNBOOKED(99)

10. HIV SEROLOGY: POSITIVE (1) : (please circle) NEGATIVE(2) UNKNOWN/ UNBOOKED(99)

    a. IF HIV POSITIVE :

        RECEIVED ART: (please circle) YES (1) NO (2) NOT APPLICATBLE (3) UNKNOWN FOR HIV POSITIVE (.) AND (99) IF UNBOOKED

11. CD4

    a. KNOWN : EXACT NUMBER
    b. UNKWON: (ONE DOT)
    c. NOT APLICABLE FOR HIV NEGATIVE MATHERS: (TWO DOTS)
    d. NOT AVAILABL: AUSE MOTHER UNBOOKED: (THREE DOTS)

12. TB

    a. ACTIVE TB ON TREATMENT (1)
    b. NO HISTORY OF TB (2)
    c. SUSPECTED TB NOT ON TREATMENT (3)
    d. UNKNOWN TB STATUS (.) FOR HIV POSITIVE, AND (99) IN OTHER CASES (HIVE NEGATIVE AND UNBOOKED MOTHERS)

13. GESTATION (WEEK):

    a. EXACT WEEKS OR (DOT) IF UNKWON

b. IF GESTATION LESS THAN 35 WEEKS:

RECEIVED STEROIDS: (please circle) YES (1) NO (2)

NOT APPLICABLE (3) UNKNWON (99)

Codes & Description of Obstetric Cause of Maternal Death (version: 2.03)

Code Description

0100 NO OBSTETRIC CAUSE

0110 Unspecified obstetric causes of death

0120 Assault

0130 Trauma

0140 Suicide

0150 Herbal medicine

0160 Other

0200 PRE-EXISTING MATERNAL DISEASE

0211 Undiagnosed cardiac disease

0212 Mixed mitral valve disease

0213 Other rheumatic heart disease

0214 Artificial valve complications

0215 Congenital heart disease

0216 Arrhythmias

0217 Cardiomyopathy

0218 Other cardiac disease

0221 Diabetes mellitus

0222 Thyroid disease

0223 Other endocrine disease

0231 Liver disease

0232 Intestinal disease

0233 Pancreatitis

0234 Other gastrointestinal disease

0241 Cerebrovascular accident

0242 Epilepsy

0243 Other central nervous system disease

0250 Respiratory disease

0260 Haematological disease

0271 Renal disease

0272 Genital disease

0281 Collagen disease

0282 Other immune disease

0291 Kyphoscolyosis

0292 Dwarfism

0293 Other skeletal disease

0300 NON-PREGNANCY RELATED INFECTIONS AND AIDS

0310 Pneumonia

0320 Acquired Immune Deficiency Syndrome (AIDS)

0330 Tuberculosis

0340 Bacterial endocarditis

0350 Pyelonephritis, urinary tract infection

0360 Appendicitis

0370 Malaria

0380 Meningitis

0390 Other

0400 ECTOPIC PREGNANCY

0410 Ectopic pregnancy less than 20 weeks

0420 Extra-uterine pregnancy (more than 20 weeks)

0500 ABORTION

0510 Septic abortion

0520 Uterine trauma

0530 Trophoblastic disease

0600 PREGNANCY-RELATED SEPSIS

0610 Amniotic fluid infection with ruptured membranes

0620 Amniotic fluid infection with intact membranes

0630 Puerperal sepsis following normal delivery

0640 Puerperal sepsis following caesarean section

0650 Sepsis after normal delivery with obstructed labour present

0660 Sepsis after caesarean section with obstructed labour

0670 Other pregnancy-related sepsis

0700 ANTEPARTUM HAEMORRHAGE

0710 Abruptio placentae

0720 Abruptio placentae with hypertension

0730 Placenta praevia

0740 Other antepartum haemorrhage

0800 POSTPARTUM HAEMORRHAGE

0810 Retained placenta; placenta accreta, increta, percreta

0820 Uterine atony due to uterine over distention

Code & Description of *Final Cause of Maternal Death (version: 2.03)*

Code Description

0100 HYPOVOLAEMIC SHOCK

0110 Hypovolemic shock following postpartum haemorrhage

0120 Hypovolemic shock following antepartum haemorrhage

0130 Hypovolemic shock following ectopic pregnancy

0200 SEPTIC SHOCK

0210 Septic shock following an abortion

0220 Septic shock following a viable pregnancy

0230 Septic shock following an incidental infection

0300 RESPIRATORY FAILURE

0310 Adult respiratory distress syndrome

0320 Pneumonia (including Tuberculosis)

0330 Acute respiratory failure

0400 CARDIAC FAILURE

0410 Pulmonary oedema

0420 Cardiac arrest

0500 RENAL FAILURE

0510 Acute tubular necrosis

0520 Acute medullary necrosis

0600 LIVER FAILURE

0610 Liver failure following HELLP syndrome

0620 Liver failure following drug overdose

0700 CEREBRAL COMPLICATIONS

0710 Intracerebral haemorrhage

0720 Cerebral oedema resulting in coning

0730 Meningitis / infection (including Malaria)

0740 Cerebral emboli

0800 METABOLIC

0810 Maternal ketoacidosis

0820 Thyroid crisis

0900 DISSEMINATED INTRAVASCULAR COAGULATION

0910 Disseminated intravascular coagulation

1000 MULTI-ORGAN FAILURE

1010 Multi-organ failure

1100 IMMUNE SYSTEM FAILURE

1110 HIV / AIDS

1200 UNKNOWN

1210 Home death

1300 OTHER