PERINATAL FACTORS ASSOCIATED WITH BIRTH ASPHYXIA AMONG NEONATES AT MBAGATHI COUNTY REFERRAL HOSPITAL, NAIROBI, KENYA

BEATRICE KADENYEKA AMADI

MASTER OF SCIENCE

(NURSING)

JOMO KENYATTA UNIVERSITY OF

AGRICULTURE AND TECHNOLOGY

2021

Perinatal Factors Associated with Birth Asphyxia among Neonates at Mbagathi County Referral Hospital, Nairobi, Kenya

Beatrice Kadenyeka Amadi

A Thesis Submitted in Partial Fulfilment of the Requirement for the Degree of Master of Science in Nursing of the Jomo Kenyatta University of Agriculture and Technology

2021

DECLARATION

This is my original work and has not been presented for a degree in any other university

Signature ……. Date …….

Beatrice Kadenyeka Amadi

This thesis has been submitted for examination with our approval as University Supervisors

Signature ……Date ……

Dr Sherry Oluchina, PhD

JKUAT, Kenya

Signature ……Date ……

Dr Drusilla Makworo, PhD

JKUAT, Kenya

Signature…… Date ……

Dr Bernard Mbithi, PhD

JKUAT, Kenya

DEDICATION

I dedicate this work to my family (husband Clement Amadi and children).

ACKNOWLEDGEMENT

I acknowledge my supervisors – Dr. Sherry Oluchina, Dr. Drusilla Makworo and Dr. Bernard Mbithi for their endless support and guidance throughout the period I conducted this study. I also thank my dear husband Clement Amadi, and children who have offered me encouragement and moral support.

I thank my Research Assistant Abel Khisa for his support and availability whenever I needed him. I also wish to thank JKUAT School of Nursing, KNH/UoN ERC, and Mbagathi Hospital administration for granting necessary ethical clearance and permits for the study.

I thank my fellow colleagues in the department for the encouragement and moral support they gave. Above all, I thank the Almighty God for his sufficient grace to accomplish this work.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABBREVIATIONS/ACRONYMS

AAP	American Academy of Paediatrics
APGAR	Appearance, Pulse, Grimance, Activity, Respirations
CS	Caesarean Section
HIE	Hypoxic ischaemic encephalopathy
KDHS	Kenya Demographic Health Survey
KHIS	Kenya Health Information System
LBW	Low Birth Weight
MCRH	Mbagathi County Referral Hospital
MLKH	Mama Lucy Kibaki Hospital
NBU	New Born Unit
PA	Perinatal Asphyxia
SVD	Spontaneous Vertex Delivery
UNICEF	United Nations International Children's Fund
WHO	World Health Organization

OPERATIONAL DEFINITION OF TERMS

Acidemia	Increased acidity of blood
Asphyxia	Failure to initiate and sustain breathing at birth with evidence of hypoxic ischemic encephalopathy
Antepartum	Time period before birth and refers to the mother.
Apgar score	An objective method of scoring the condition of a baby after birth. It determines heart rate, respiratory effort, muscle tone, skin color, and response to stimulation
Health workers	Nurses, Obstetricians, and paediatricians
Intrapartum	Time period from onset of labour to delivery of the placenta and refers to both mother and the foetus
Maternity unit	An umbrella that encompasses labour, and maternity wards, maternity theatre and newborn unit
Neonate	A newborn less than 28 days old
Perinatal	The period after 20 completed weeks of gestation to 7 completed days after birth.
Primigravida	A woman who is pregnant for the first time

ABSTRACT

Perinatal asphyxia is a common and serious neonatal problem in every part of the world and significantly contributes to both neonatal morbidity and mortality, given that it is a major cause of death and of acquired brain damage in newborns. Globally, deaths caused by perinatal asphyxia account for 23% of the deaths among the four million neonatal deaths. The study aimed at determining the perinatal risk factors associated with perinatal asphyxia among neonates. Specifically, the study sought to determine the antepartum risk factors associated with perinatal asphyxia among neonates at Mbagathi County Referral Hospital; to assess the intrapartum risk factors associated with perinatal asphyxia among neonates at Mbagathi County Referral Hospital; and to determine the neonatal factors associated with perinatal asphyxia among neonates at Mbagathi County Referral Hospital. This was an unmatched case control study that employed mixed methods, carried out at Mbagathi County Referral Hospital (MCRH), Nairobi. A sample size of 124 mothers (31 cases and 93 controls) was arrived at using census for cases and systematic sampling technique for controls, at an interval of 4. Quantitative data was collected using questionnaires and data abstraction forms, whereas a key informant interview guide was used to collect qualitative data. Pretesting of the study tools was carried out at Mama Lucy Kibaki County Referral Hospital. Epidata and STATA 14 software were used for data entry and analysis respectively. The analysis of quantitative data included descriptive statistics and inferential statistics used to examine relationships between the outcome and predictor variables. Hypothesis testing was done at an alpha significance level of 0.05. Qualitative data were analysed thematically in order to triangulate the quantitative data. Study findings revealed that birth interval was the only significant antepartum factor associated with perinatal asphyxia after adjusting for the role of other factors. As such, for every unit increase in birth interval, the likelihood of developing perinatal asphyxia reduces by 0.5 times (OR = 0.5; p=.03). Foetal distress (OR = 6.5 [95 % CI 2.4 - 17.4]) and membrane rupture (10 [95% CI 3.1 - 33.2]) provided statistically significant differences between those who were exposed compared to those who were not exposed, across cases and controls. Following these findings, the study concludes that less birth interval, foetal distress and membrane rupture contributed significantly to perinatal asphyxia diagnosis. The study recommends mother education on birth interval management in a bid to ensure that such preventable risk factors are eliminated.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

When new-borns are deprived of oxygen, for a period long enough to cause physical harm especially to the brain, the condition is referred to as perinatal asphyxia (PA) (Appareddy, Pryor, & Bailey, 2017). World Health Organization (WHO) defines perinatal asphyxia as the failure to sustain, or in extreme circumstances to initiate breathing at birth. Causes of perinatal asphyxia include birth trauma, congenital sepsis or maternal opiates, intrauterine pneumonia, severe meconium aspiration, cord compression, congenital pulmonary or cardiac anomalies, narcotic administration or transplacental anaesthetic, obstructed airway, or placental abruption (Pappas & Korzeniewski, 2016). Globally, deaths caused by perinatal asphyxia account for 23% of the deaths among four million neonatal deaths with an estimated one million survivors with chronic neuro-developmental morbidities like cerebral palsy, mental retardation, and learning disabilities (Kibai, 2017). Ninety nine percent of neonatal deaths take place in developing countries. Among under-fives, perinatal asphyxia is estimated to be the number five cause of death (with prevalence rate ranging from 5–10/1000 live births), after complications of preterm birth, neonatal infections, diarrhoea, and pneumonia (Ilah et al.,2015). The prevalence and mortality rate for PA are also high. In resource-poor countries like Africa, the incidence is even higher (Simiyu et al., 2017).

A study done by Onyearugha & Ugboma (2012) also indicated that perinatal asphyxia can be as a result of factors rooted in the antepartum, intrapartum and postpartum periods or a combination of all three. WHO (2017) in its review suggested that asphyxia originates primarily from the antepartum period in 50% of cases, intrapartum in 40%, and 10% in the postpartum period. Ndayisenga and Mukanyandwi (2017)

revealed that assessment of birth asphyxia in hospital-based settings involve evaluation of blood pH, appearance, pulse, activity, and respiration (APGAR) scores, foetal heart rate abnormalities, need for resuscitation, neurological changes and indication of multiple organ dysfunctions. Similar tools and metrics for asphyxia assessment were also identified by Lawn, Manandhar, Haws and Darmstadt (2014). According to Aslam et al. (2014), factors associated with perinatal asphyxia were grouped into either maternal or foetal. Ndayisenga and Mukanyandwi (2017) further categorized the risk factors into antepartum, intrapartum and foetal.

Gichogo, Murila, Matiang'i, Ndege and Bosire (2018) reported that birth asphyxia prevalence in a Kenyan hospital was 5.1%. However, these incidences are sometimes an underrepresentation of the actual prevalence of PA in the community given the exclusion of any occurrences outside health facility settings.

1.2 Statement of the problem

Perinatal asphyxia is a major cause of death and of acquired brain damage in newborns (WHO, 2014). The prognosis of asphyxia is hugely dependent on its severity. If not diagnosed early or managed properly, the newborns risk suffering cerebral palsy, developmental delay, visual and hearing impairment, and learning and behavioural problems that put a great burden for the family and society (United Nations International Children's Fund (UNICEF), 2013).

Very few infants survive after suffering severe encephalopathy resulting from PA (Antonucci, Porcella, and Pilloni, 2014). After an asphyxia event, there may be an opportunity to intervene to minimise brain damage, although this also relies on early detection (Pappas & Korzeniewski, 2016). Birth Asphyxia contributes to more than 20% of all neonatal deaths in developing countries. Kibai (2017) reported that risk factors for birth asphyxia include parity and education level, both of which are controllable factors.

Kenya continues to experience high neonatal death rates, resulting from non-communicable causes, perinatal asphyxia being among them. Kibai (2017) reported that Birth Asphyxia has a prevalence of 29.1%, and is among the leading causes of death among neonates. Perinatal asphyxia being among the top three causes of mortality among neonates yet preventable requires special attention by all stakeholders in the biomedical fields (Kenya Health Information System (KHIS), 2017). According to Kiyani, Khushdil and Ehsan (2014), greater parity and gravidity were perinatal risk factors for asphyxia. The mode of delivery, prolonged second stage of labor, prolonged rupture of membranes, mothers having maternal fever, and anaemia at delivery also contributed to asphyxia. The number of birth asphyxia cases in the Mbagathi County Referral Hospital (MCRH) in 2016 was 187 – the highest by any level 4 health facility nationwide (KHIS, 2017). When viewed in the context of total deliveries in the hospital, the prevalence was more than 5/1,000 live births (KHIS, 2017).

Nairobi County has some of the best facilities nationwide for delivering care to patients of acute neonatal complications. Data from the District Health Information System (DHIS 2) shows that close to 50% of New Born Unit (NBU) admissions are due to Birth Asphyxia. However, there is no documented data on determination of perinatal risk factors in Mbagathi County Referral Hospital (Health Information System Kenya (HISK), 2018).

1.3 Study justification

WHO (2018) reckoned that perinatal asphyxia was one of the major causes of death among children below 5 years. In Kenya, one in every 27 live births are lost as a result of neonatal and perinatal complications such as birth asphyxia. Perinatal morbidity and mortality is a good indicator of the country's general health status as well as the state of health of the mothers at the time of delivery (Kenya Demographic and Health Survey (KDHS), 2014). Additionally, KDHS (2014) reports maternal age, short birth

interval as well as high birth order as common factors leading to perinatal complication such as birth asphyxia.

By focusing on PA as a major cause of death among under-5s, the study provided a base for development of debates pertaining to the Sustainable Development Goal (SDG) 3 on ending preventable newborns and under-5 children deaths by 2030. This was particularly critical in the decade of the 2020s.

MCRH is one of the only two county referral hospitals in Nairobi County, alongside Mama Lucy Kibaki County Referral Hospital. It serves not just Nairobi County residents but also residents of Kajiado and Kiambu Counties as well as spill-overs from the Kenyatta National Hospital. Additionally, very few studies have been conducted in MCRH related to Maternal and Child Health (MCH). This study will fill this gap in dearth of knowledge. Studying the risk factors for perinatal asphyxia will facilitate appropriate policies regarding aggressive interventional treatment in MCRH and also suggest preventive measures that can be undertaken at both at MCRH and peripheral health facility settings from where these babies are referred. As such, the study findings will benefit the Ministry of Health policymakers in helping shape the policies relating to maternal and child healthcare (MCH) services. Specifically, on policy implications, and review of the maternal newborn care guidelines. Additionally, the study will inform the development of specific mechanisms to improve MCH services within MCRH, thereby benefiting the hospital directly.

1.4 Research questions

1. What are the antepartum risk factors associated with perinatal asphyxia among neonates at Mbagathi County Referral Hospital?
2. What are intrapartum risk factors associated with perinatal asphyxia among neonates at Mbagathi County Referral Hospital?
3. What are the neonatal factors associated with perinatal asphyxia among

neonates at Mbagathi County Referral Hospital?

1.5 Objectives

1.5.1 Broad objective

To determine the perinatal factors associated with birth asphyxia among neonates at Mbagathi County Referral Hospital, Nairobi, Kenya.

1.5.2 Specific objectives

a) To determine the antepartum risk factors associated with perinatal asphyxia among neonates at Mbagathi County Referral Hospital.
b) To assess the intrapartum risk factors associated with perinatal asphyxia among neonates at Mbagathi County Referral Hospital.
c) To determine the neonatal factors associated with perinatal asphyxia among neonates at Mbagathi County Referral Hospital.

1.6 Null Hypotheses

1. There is no statistically significant association between antepartum factors and perinatal asphyxia among neonates at Mbagathi County Referral Hospital.

2. There is no statistically significant association between intrapartum factors and perinatal asphyxia among neonates at Mbagathi County Referral Hospital.

3. There is no statistically significant association between neonatal factors and perinatal asphyxia among neonates at Mbagathi County Referral Hospital.

CHAPTER TWO

LITERATURE REVIEW

This chapter reviews researched theories and scientific facts on various literature pertaining to perinatal asphyxia. The section is organised in the following themes; Antepartum factors, intrapartum factors, and neonatal factors.

2.1 Overview of Birth Asphyxia

According to the American Academy of Paediatrics (AAP) as well as propositions from a cerebral palsy task, the following criterion ought to be used to define Perinatal Asphyxia: (1) Persistently low APGAR score of 0-3 at birth or for >5 minutes; (2) Mixed or Profound metabolic acidemia whereby the pH of blood sample taken from the umbilical cord is <7.00 at birth; (3) Evidence of a kind of compromise where multiple organs are involved e.g. renal, gastrointestinal, or cardiovascular compromise; or (4) Neurologic manifestations by the newborn e.g. hypotonia, coma, or seizures following an asphyxia insult (Morales, 2011). Perinatal asphyxia clinically presents with cardio-respiratory and neurological depression with APGAR, persistently less than 7 within the first 5 minutes of birth coupled with evident hypoxic compromise resulting in acidemia (Appareddy et al., 2017).

2.2 Factors affecting birth asphyxia

2.2.1 Ante-partum factors affecting birth asphyxia

Antepartum experiences have been documented to have an impact on neonatal outcomes.

Onyearugha and Ugboma (2012) in their study on foetal outcomes of antepartum and intrapartum eclampsia in Aba, southeastern Nigeria, reported that perinatal asphyxia

incidence is significantly influenced by antenatal attendance in primary healthcare facilities. The authors also indicated that lack of qualified staff in health centres result in poor follow up of the pregnant women seeking antenatal care and only complicated cases are referred. Chiabi et al. (2013), following a study in a Cameroonian urban health facility on birth asphyxia risk factors, suggested that what matters is the quality of the care accorded as opposed to the number of consultations (Chiabi et al., 2013).

Aslam et al. (2014), in their study on birth Asphyxia in Italian hospitals, suggested risk factors such as antenatal care non-attendance, decreasing or increasing maternal age, antepartum haemorrhage, and antepartum anaemia. The authors also reported that how well the presenting risk factors for patient are managed hugely impacts the severity and prognosis of birth asphyxia symptoms (Aslam et al., 2014). Tabassum, Rizvi, Ariff, Soofi and Bhutta (2014) conducted a study in a rural Pakistani hospital on birth asphyxia and reported that perinatal asphyxia was significantly associated with maternal literacy and the knowledge of mothers on health-related issues including attendance to antenatal care.

Lawn et al. (2014) also discussed how single mothers, unaffiliated to the social security system and with low level of education were also associated with perinatal asphyxia. In their study, the authors indicated that social difficulties such as lack of support network are likely to endanger the normal development of pregnancy. Presence of social support for the mothers also affected their antenatal behaviour, according to Tabassum et al. (2014). Rani, Chawla, Huria, and Jain (2012) argued that using maternal literacy levels to determine their predisposing conditions could be misleading since literacy is a cross-cutting indicator for socio-economic levels. The authors suggest that perhaps more precise factors could be the factors such as malnutrition that are often the underlying reasons behind failure to attend antenatal care, or unplanned pregnancies. Tabassum et al. (2014) reported that there is great correlation between history of stillbirths and the increased risk of perinatal asphyxia mortality, and this

finding is consistent with other reports from similar studies conducted in low-middle income countries (Lawn et al., 2014; Kiyani et al., 2014). Similarly, another study conducted by Seikkuet al. (2016) in a Finnish hospital reviewed registers of mothers who delivered at the hospital and assessed their outcomes. In their study, Seikku et al. (2016) were specifically interested in the effect of gestational age as well as mother-related characteristics that led to neurologic morbidity as well as perinatal mortality. The authors reported that the risk for low birth weight, and consequently of asphyxia is higher among those with single marital status (either unmarried or separated). They also found out that mother's unemployment, mother's age below 20 years, and low literacy levels for mothers were other risk factors for perinatal asphyxia. In addition to these factors, Rani et al. (2012) claimed that carrying out intense physical activities, an attribute that Seikku et al. (2016) neither investigated nor reported on, also had associations with perinatal asphyxia, albeit not to significant levels. Interestingly, though, there was no association between perinatal asphyxia mortality and maternal age, according to a study by Pitsawong and Panichkul (2012).

Onyearugha and Ugboma (2012) reported that lack of antenatal care is an independent risk factor for neonatal encephalopathy. Still, with regards to parity and birth intervals, according to Tabassum et al. (2014), antepartum complications like smelly or excessive vaginal discharge and anaemia or pallor were the major significant factors related to increased risk of perinatal asphyxia mortality. Apparently, Pryor, and Bailey (2017) while assessing the effect of inter-pregnancy intervals on health outcomes reported that child spacing of at least 36 months apart minimizes the risk of infant death. The median birth interval in Kenya was 36.3 months. Neonates born less than two years after a previous birth had the highest neonatal mortality rates (83 deaths per 1,000 live births) compared to children born three years after a previous birth (42 deaths per 1,000 live births) (KDHS, 2014). Conversely, Seikku et al. (2016) observed that birth interval longer than 5 years was associated with adverse perinatal outcome.

Women who delivered with birth interval 59 months and beyond delivered through caesarean section (Seikku et al., 2016).

2.2.2 Intrapartum factors associated with perinatal asphyxia

Kiyani et al. (2014) conducted a study on factors that led to perinatal complications among term babies. The authors found out that when a nuchal cord is observed in the first delivery the neonate is exposed to perinatal asphyxia and subsequent newborn death. The study reported an association between an increased risk of nuchal cord and primigravida in the United States of America (USA). In another study done by Seikku et al. (2016), second stage of labour lasting more than 30 minutes in primigravida was a factor associated with occurrence of perinatal asphyxia. Onyearugha and Ugboma (2012) conducted a study in Nigeria that investigated the outcomes of antepartum and intrapartum eclampsia. In their report, more than 60% of the deliveries were still births with 8% of them suffering perinatal asphyxia. Additionally, the authors suggested that there was a significant association between primigravida with tight nuchal cord and prolonged second stage of labour. As such, the authors reported that prolonged second stage of labour in primigravida is a risk factor of perinatal asphyxia, further suggesting the need for patient education on the importance of early booking and routine antenatal visits.

Onyearugha and Ugboma (2012) also reported that preeclampsia/eclampsia and placental malaria decreases placental blood flow leading to loss of placental integrity and damage of endothelial cells. Placental malaria, in particular, can cause an accumulation of inflammatory and infected red blood cells (Onyearugha & Ugboma, 2012). The authors further explained that these factors can lead to inadequate foeto-placental blood flow with foetal hypoxia resulting in retardation in growth and perinatal asphyxia. Aslam et al. (2014) suggested that the risk factors include prolonged rupture of membranes, meconium-stained amniotic fluid, malpresentation,

augmentation of labour with oxytocin, severe eclampsia and pre-eclampsia, and intrapartum anaemia.

Solayman, H oque, Akber, Islam, and Islam (2017) in their assessment of perinatal asphyxia prevalence within local setups reported that prolonged labor, arrest of labor, prolonged rupture of membranes, caesarean section, and non-vertex presentation are vital factors associated with perinatal asphyxia. Similarly, several studies reported abnormal amniotic fluid (foul smell, meconium stained, yellowish) to be strongly associated with asphyxia (Solayman et al., 2017; Lawn et al., 2012; Vain &Batton, 2017).Chiabi et al. (2013) studied the risk factors for birth asphyxia in rural Cameroon and observed associations between emergency caesarean section (CS) and neonatal asphyxia with an odds ratio of 2 compared to Spontaneous Vertex Delivery (SVD). The implication of this was that babies to mothers who underwent CS were twice likely to develop perinatal asphyxia compared to their SVD counterparts. In addition, the authors suggested that prolonged labour, arrest of labour, hypertensive disorders in pregnancy, and cephalo-pelvic disproportions compromised oxygen delivery to the foetus. Similarly, Solayman et al. (2017) found elective caesarean section to be a risk factor for neonatal asphyxia possibly due to factors not identified early in pregnancy which often leads to acute foetal distress and consequently lead to asphyxia. Non-cephalic presentation, prolonged rupture of membranes and the intrapartum complications of obstructed labour, cord prolapse, uterine rupture and oxytocin-induced labour were also intrapartum risk factors as noted by two studies (Chiabiet al., 2013; Solayman et al., 2017).

Tabassum et al. (2014) also observed an association between high perinatal asphyxia mortality and a number of factors, namely: prolonged labour, breech delivery, presence of fever (indicating infection) and cord around child's neck. According to Yego et al. (2013) who conducted a retrospective analysis of maternal and neonatal mortality at a teaching and referral hospital in Kenya, of all women referred to hospitals for

deliveries, most end up with life-threatening complications such as asphyxia. Similar findings on the association between neonatal complications and late referrals are also reported in various studies in Africa (Onyearugha & Ugboma, 2012). Boskabadi, Ashrafzadeh, Doosti,and Zakerihamidi (2015) reported that fever, vaginal bleeding, swelling of the hands, face, or feet; convulsions, prolonged labour and prolonged rupture of membranes were significantly associated with increased risk of perinatal asphyxia. Meconium-stained amniotic fluid was also a risk factor for birth asphyxia (Lawn et al., 2012).

2.2.3 Neonatal factors associated with perinatal asphyxia

Perinatal asphyxia is defined as the failure to initiate and sustain breathing at birth. Gupta, Sarmah, Tiwari, Shakya and Khatiwada (2014) indicated that the breath at the start of life out of mother's womb is vital as oxygen deprivation results to damage of various organs in the body. Globally, perinatal asphyxia accounts for an estimated 900,000 deaths per year and is among the primary causes of early neonatal mortality (Gupta et al., 2014).

In most of Africa, fourteen percent of neonates have a weight at birth of <2.5kg which is termed as Low Birth Weight (LBW) (Onyearugha & Ugboma, 2012). Some of the reasons advanced for LBW are poor growth in the uterus where although the neonates are term births, they are small for gestational age (Lawn et al., 2014). de Almeida et al. (2015) conducted their study in Brazil comparing the mortality rate relative to birth weights and reported that low birth weight may be caused by poor maternal nutrition, infections (such as STIs, HIV, and Malaria), obstetric causes (such as hypertension in pregnancy and multiple pregnancy), or small maternal size. According to WHO (2018), it is not common for full term babies to die simply because they are small; however, babies with an additional complication such as hypoglycaemia and hypothermia have approximately twice the risk of death compared to normal sized babies although most will survive. This report is particularly useful when put in the

context of Zhou, Changxia, Yin, and Xia (2016)'s assessment of the relationship between blood glucose disorders and neonatal asphyxia in the Maternal and Child Hospital of Hubei Province. In their report, Zhou and colleagues observed that hypoglycaemia was the most common blood glucose disorder among mild perinatal asphyxia patients. Aslam et al. (2014) suggested that the risk factors include multiple births and low birth weight infants.

Babu, Devi, and Kumar (2014) suggested that the kind of care given by clinicians could also play a role in development of birth asphyxia. The author proposed that in the absence of circulation or breathing, interventions essential for resuscitation should include the maintenance of respiration and circulation by artificial ventilation and chest compressions respectively, or cardiopulmonary resuscitation (CPR). According to Yadav and Damke (2017), the main consequence of perinatal asphyxia is hypoxic ischaemic encephalopathy (HIE). Diagnosis of HIE is based on abnormal findings on neurological examination the day after birth. According to Kibai (2017), infants can progress from mild to moderate to severe encephalopathy over 72 hours following the hypoxic-ischaemic onset. The death of an infant as a result of perinatal asphyxia is largely avoidable (Yadav & Damke, 2017).

In a study done on 196 cases of perinatal asphyxia by Kiyani et al. (2014) in a tertiary care hospital in Iran, majority of full-term babies were male (64%), at a male: female ratio of 3:2. Birth weight >2.5kg and as well as being full-term and male were the leading factors associated with perinatal asphyxia.

2.3 Summary of Literature Review

Antepartum experiences have been documented to have an impact on neonatal outcomes. Perinatal asphyxia incidence is significantly influenced by antenatal attendance in primary healthcare facilities. Lack of qualified staff in health centres result in poor follow up of the pregnant women seeking antenatal care. The reviewed

literature revealed that antenatal care non-attendance, decreasing or increasing maternal age, antepartum hemorrhage, antepartum anemia, poor maternal nutrition, infections (such as STIs, HIV, and Malaria), obstetric causes (such as hypertension in pregnancy and multiple pregnancy), or small maternal size. Some of the reviewed literature also showed that single mothers, unaffiliated to the social security system, gestational age, lack of physical activity, short birth interval, and with low level of education were also associated with perinatal asphyxia. Interestingly, though, some studies reported no association between perinatal asphyxia mortality and maternal age. For the intrapartum factors identified in the reviewed works revealed that placental Malaria, prolonged rupture of membranes, meconium stained amniotic fluid, malpresentation, augmentation of labour with oxytocin, severe eclampsia and pre-eclampsia, intrapartum anaemia, prolonged labor, arrest of labor, prolonged rupture of membranes, caesarean section, and non-vertex presentation are vital factors associated with perinatal asphyxia. Similarly, several studies reported abnormal amniotic fluid (foul smell, meconium stained, yellowish) to be strongly associated with asphyxia. Also reviewed in the literature were prolonged labour, breech delivery, presence of fever (indicating infection) and cord around child's neck all of which were associated with newborn complications. For the postpartum factors, the reviewed literature identified low birth weight, newborn size and multiple births as potentially contributing to perinatal asphyxia diagnosis.

2.4 Theoretical framework

The model that was used was based on Imogene M. King's theory of goal attainment. This theory explains the possible reasons behind various health status of individuals and groups. King integrates the personal system (the patient), the interpersonal system (relationships) and the social system, that all emphasize on joint goal setting by nurse and client.

Personal system

According to Imogene, perception, space and time are factors influencing PA. The way a mother perceives the importance of antenatal care and follow-up influences her actions during pregnancy, where she may or may not attend antenatal clinic (ANC). Failure to do these due to negative perception puts the baby at risk of developing birth asphyxia. Space refers to the environment in which the mother lives. The mother may be in an environment that lacks health facility. Time in this case refers to period at which the mother seeks health care, that is ANC attendance some mothers at risk of PA who delay in seeking health care maybe due to finances, poor decision making or ignorance will end up with babies with PA that would rather have been avoided by early identification of these risk factors during antenatal period. The nurses may also lack time to attend to the mothers due to workload.

Interpersonal system

Interpersonal system involves the interaction, communication, transaction, as stipulated by Imogene. The interaction between the Nurse and the patient occur during service delivery either at the ANC or labour ward and poor interaction influences PA occurrence. These is where the Nurse plans care with the client and the roles are well stipulated. The nurse and the patient's role towards achievement of desired goal are identified. Both verbal and nonverbal behavior is key to positive interaction to achieve education and counselling on risk factors of perinatal asphyxia (PA). During transaction, the mother the nurse monitors counsels and offers support and the client needs to adhere to care and advice. The nurse identifies the risk factors for PA and acts accordingly to avert birth asphyxia. Poor monitoring of a mother during ANC care and in intrapartum period is a risk factor of PA for the mothers at risk.

Social system

King describes the social system as the interaction with co-workers, supervisors, subordinates and the client's environment. The expectant mother's social support both by family community and healthcare workers can help prevent delay in seeking health care, which will curb on intrapartum and neonatal risk factors for PA. Good social support will prevent maternal malnutrition that can lead to anaemia which is an antepartum risk factor. Lack of decision making by the mother puts a mother at risk of her baby getting PA as she will go by decision made by either the husband or the mother in-law or the family decision maker who are ignorant of the risks the mother is exposed to.

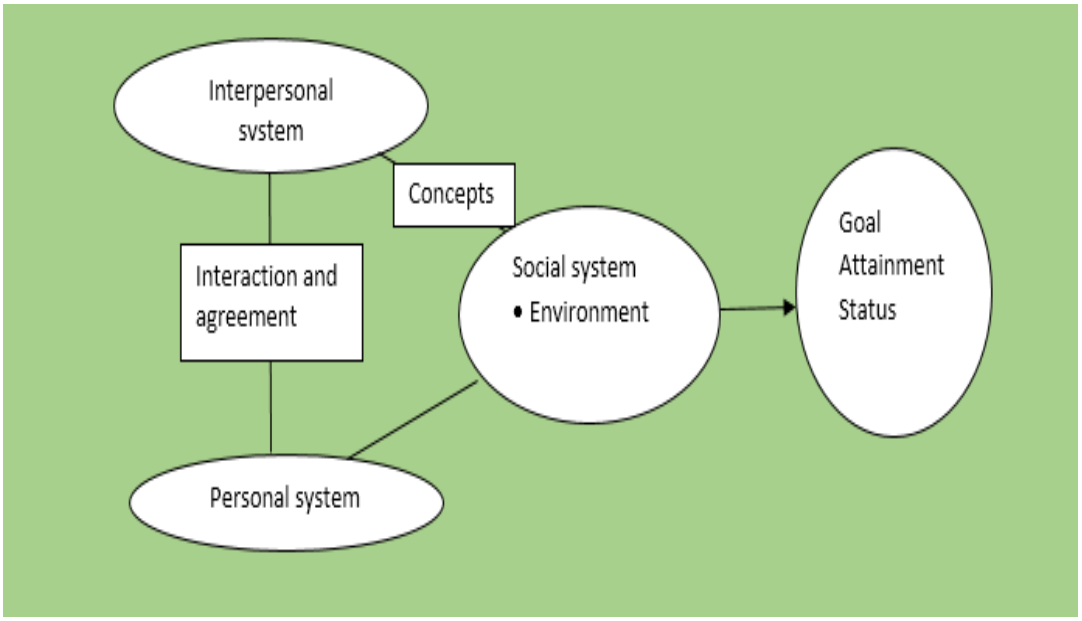


Figure 2.1: Imogene King's Theoretical framework (King, 1992)

2.5 Conceptual Framework

The risk factors for perinatal asphyxia are, antepartum, intrapartum and neonatal factors which constitute the independent variables. Antepartum risk factors include

maternal age, medical history, social history, and antenatal clinic attendance. Intrapartum risk factors include duration of labour, state of the cord, mode of delivery analgesic use, and maternal conditions like antepartum haemorrhage, intrapartum anaemia severe pre-eclampsia and eclampsia, multiple births, malpresentation, and type of labour (spontaneous, induced, augmentation of labour with oxytocin). Neonatal factors are the last independent variables such as age at birth, sex, and birth weight. Antepartum and intrapartum factors can influence the neonate's age at birth, and birth weight leading to occurrence of perinatal asphyxia. The prognosis and severity of the symptoms of birth asphyxia depend on the risk factors and management of the patient (Aslam et al.,2014). This risk factors lead to either the presence or absence of perinatal asphyxia which is the dependant variable.

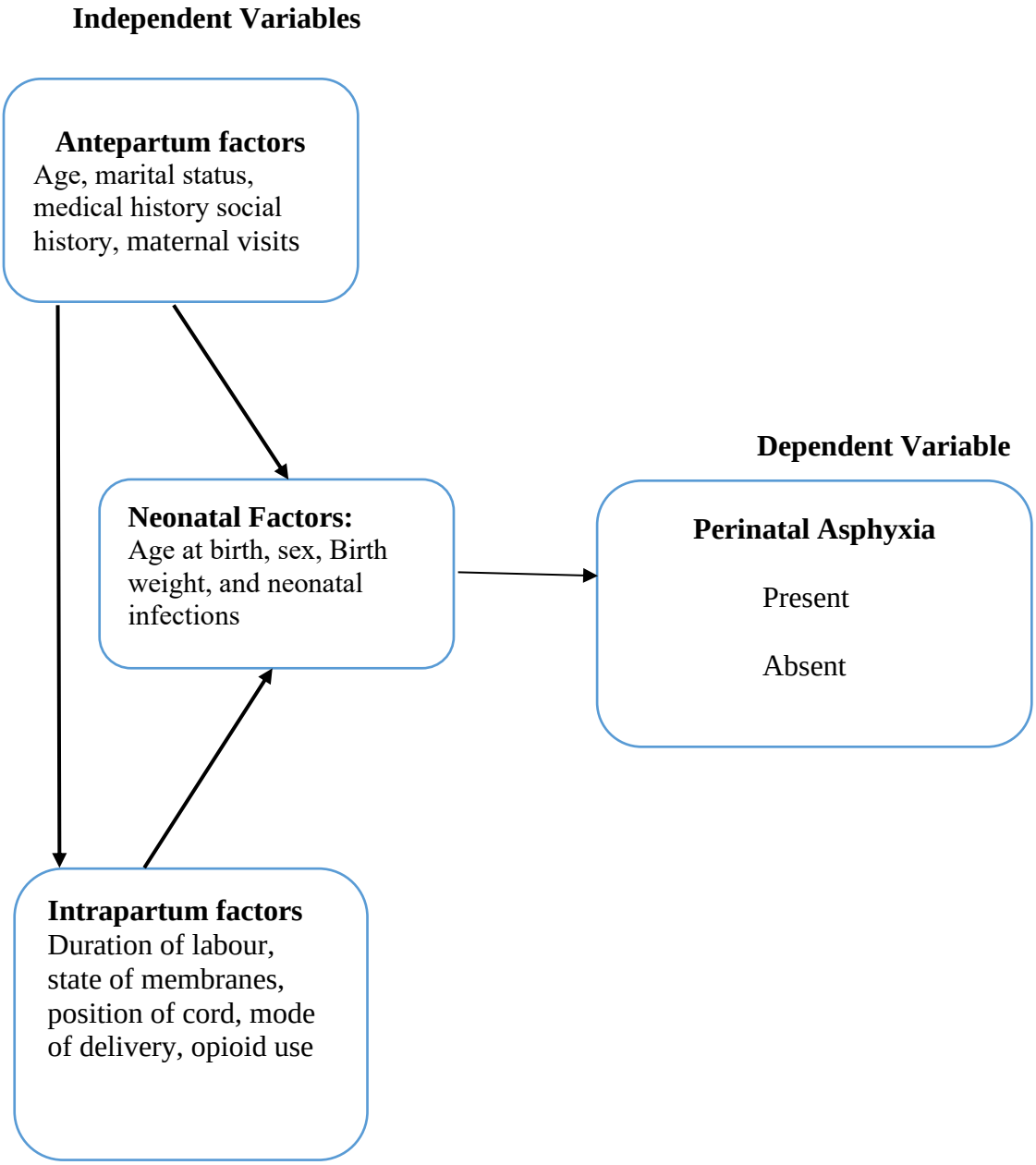


Figure 2.2: Conceptual Framework

CHAPTER THREE

METHODOLOGY

3.1 Study Design

This was an unmatched case control study, employing both quantitative and qualitative methods. The choice of unmatched over matched case control study was informed by the type of methodologies that relate to the two approaches. With the use of the unmatched approach, the study used the combination of Mantel Haenszel method and unconditional logistic regression to obtain odds ratios instead of the McNemar's test and conditional logistic regression that matched case control studies would have demanded (Yin, 2017). Pearce (2016) suggests that contrary to common belief, matching in design and analysis does not control for confounding, but may sometimes introduce confounders that may not exist if the analysis does not put into account all assumptions. Instead, Mantel Haenszel was used during analysis which purportedly yielded better statistical precision and was more pragmatic in practice, and most useful in unmatched case control studies. According to Yin (2017) case control studies are a design used to retrospectively establish the relationship between risk factors and a given outcome by comparing the frequency of the exposure among two groups: those with and those without the disease or outcome of interest. The study design was also suitable for rare disease outcomes such as perinatal asphyxia. According to Global Genes (2018) and National Organization for Rare Diseases (NORD)'s Database, Perinatal Asphyxia was listed as a rare disease.

3.2 Study Area

This study was conducted in the Maternity Unit of MCRH, Nairobi County. The hospital was one of only two county referral hospitals in Nairobi County, alongside Mama Lucy Kibaki Hospital. At the time of study, Mbagathi County Referral Hospital

was situated in Ngummo Estate, Nairobi County, along Mbagathi Road. Mbagathi County Referral Hospital received referrals from all health centres and dispensaries around the county and other surrounding counties like Kajiado, Machakos, and Kiambu.The number of neonates admitted in the newborn unit was 43 per month on average (HISK, 2018). The newborn unit was well equipped to handle neonatal emergencies.

3.3 Study and Target Population

3.3.1 Target population

The target population consisted of the entirety of all neonates born at MCRH. The target population was approximately 10,000. Additionally, the study targeted all 57 staff working in the Maternity Unit at MCRH for the Key informant interview (KII).

3.3.2 Study population

The study population comprised neonates born at MCRH during the study period. The monthly average number of deliveries at MCRH was 600. The study population consisted of new born babies below seven days old from whom cases and controls were selected Also part of the study population were the maternity unit health workers.

3.4 Inclusion and Exclusion Criteria

3.4.1 Inclusion Criteria

Cases:

All neonates delivered at MCRH, less than seven days old, with perinatal asphyxia.

Controls:

All neonates delivered at MCRH, less than seven days old, not diagnosed with perinatal asphyxia.

Health workers:

All healthcare professionals involved in taking care of patients at the MCRH Maternity Unit

3.4.2 Exclusion Criteria

Cases:

1. All neonates delivered at MCRH, less than seven days old, with perinatal asphyxia, but suffering from major congenital anomalies or syndromes
2. All neonates delivered at MCRH, less than seven days old, with perinatal asphyxia, but whom the mothers are either very sick, in coma, or physiologically challenged

Controls:

1. All neonates delivered at MCRH, less than seven days old, not diagnosed with perinatal asphyxia, but suffering from major congenital anomalies or syndromes
2. All neonates delivered at MCRH, less than seven days old, without perinatal asphyxia, but whom the mothers are either very sick, in coma, or physiologically challenged

Health workers:

All healthcare professionals involved in taking care of patients at the MCRH Maternity Unit who were unavailable during the study period.

3.5 Sample Size Determination

The Fleiss sample size formula for the method described and modified by Kelsey, Whittemore, Evans, and Thompson (1996) was used as follows:

$$N_{Kelsey} = \frac{\left(z_{\alpha/2} + z_{\beta}\right)^2 p(1-p)(r+1)}{r(p_0 - p_1)^2}$$

And

Where:

z – Standard normal deviate

α – The probability of type I error (significance level) is the probability of rejecting the true null hypothesis OR standard normal deviate given a 95% CI =.05

β – The probability of type II error (1 - power of the test (0.8)) is the probability of failing to reject the false null hypothesis= 0.2

p_0 – The proportion of cases with exposure i.e. ANC visits (estimate .291)

p_1 – The proportion of controls with exposure i.e. ANC visits (estimate .709)

r – The ratio of controls to cases = 3:1

$p= (p_0 + r \text{ X } p_1) \div (r+1)$

$n_{Kelsey} = (1.960+0.842)^2 \text{ X } 0.154 \text{ X } 0.846 \text{ X } 4 \div 3(0.291-0.5)^2$

$n_{Kelsey}= 7.851204 \text{ X}0.521136 \div 3 \text{ X } 0.043681$

n_{Kelsey}= 4.091545 ÷ 0.131043 = 9.054381

n_{Kelsey}= 31.22

Therefore, the study sample size was 124 participants (31 cases and 93 controls), at the ratio of 1:3 case to control respectively.

As for the key informant's sample, Morse (1994) suggested 30 – 50 interviewees, whereas Cresswell (1998) suggested that using 20-30 interviewees should suffice. There was a total of 57staff in the maternity unit at MCRH, all of whom took part in the key informant interview. Since the analysis of the qualitative data bore in the theory of saturation point, this point was realized after 20 key informant interviews had been conducted.

3.6 Sampling and recruitment Procedure

The study participants were classified into case or control groups, at a ratio of 1:3 respectively. Multiple studies suggest a ratio between 1:1 and 1:4 for cases to controls (Linden & Samuels, 2013; Dong, Tang, & Rosenberger, 2014). Linden and Samuels (2013), specifically also noted that a matching ratio up to 1:4 case to control ratio elicited the lowest bias. However, they also cited that financial feasibility of the chosen approach also contributed to the ratio. The assignment of participants into case or control groups was purposive and solely based on them having or not having perinatal asphyxia respectively. During this assignment into participant groups, the patients were also screened for other congenital anomalies so that those who had any such kind of anomalies were excluded from the study entirely. Upon isolation of the cases through census sampling, the study picked controls through systematic sampling at an interval of 4 given that the estimated number of non-asphyxia deliveries per month was 426 – representing 70.9% of the estimated 600 deliveries and the sample for controls was estimated to be 93.

As for the Key informant interviews, total population sampling was used where all 57 workers in the maternity unit were allowed to take part. However, the point of saturation technique was used to determine the point at which the diversity of the responses ceased leading to no new information gathered. This point was reached after 20 interviews.

3.7 Data collection

3.7.1 Data collection tools

A pre-coded structured questionnaire was designed to collect data on the risk factors of Perinatal Asphyxia. The questionnaire constituted three sections comprising antepartum factors such as mother's age, marital status, medical history, social history, and maternal visits, intrapartum factors such as prolonged labour, prolonged membrane rupture, cord presentation, cord prolapse and mode of delivery, and neonatal factors. Neonate's characteristics included questions on gender, gestational age at birth, birth weight, and questions pertaining to neonatal infections (Appendix IV). The key informant guide developed based on the study objectives was used to collect qualitative data. The persons who took part in the key informant interviews were the senior professionals including the nursing and medical officers-in-charge, and doctors at labour wards and new-born unit (Appendix VI). A data abstraction checklist was also be used to collect data from the sampled participants' files (Appendix VII).

3.7.2 Data collection procedure

Nurse/midwife research assistants were used by the researcher in collecting the data as they were placed in the maternity unit on a daily basis. Prior to the start of the data collection process, the researcher trained the research assistants on the questionnaire. The training was mainly geared towards ensuring consistency in the way the questions were asked, borrowing experiences from the lessons learnt during the pre-test. During

the training, the questionnaire translated to Swahili for easier comprehension by the participants, the researcher took the research assistants through the Swahili version of the questionnaire as well (Appendix V). Confidentiality was also assured by the researcher and her assistants to the respondents. The data was sought from the respondents using a structured interviewer-administered questionnaire that mainly provided the quantitative information. Files of participants were also used to fill in information needed on the checklist. At the end of the day, the researcher reviewed the filled in questionnaires and checklists to ascertain if they met the set completeness requirement and also if the responses were recorded in a manner that allowed for analysis. The data from the key informant interviews was collected by the researcher following face-to-face interviews to ensure that the interviews remained focused and to avoid collection of irrelevant information. The key informant responses were then recorded on the key informant interview guide for review during data analysis. During the pre-test, all 6 key informants sampled at the time indicated that they would not want to be audio-recorded. As such, the key informant interviews were not recorded.

3.7.3 Quality Assurance

Pre-testing of data collection instruments was done at the Mama Lucy Kibaki Hospital (MLKH), since it was the only other county referral facility in Nairobi City County. The hospital also provided the highest likelihood of observing similar findings as the study site. The pre-testing was done on all items for at least 10% of the sample size. For the questionnaires, the pre-test sample size used was 15 whereas we used 6 respondents for pretesting the KII guide.

Validity is the ability of the research instrument to measure what it was supposed to (Rosner, 2015). Concurrent and content validity was used in the study. When determining content validity, the researcher assessed the degree to which the constructs for each measurement item or question was represented, and whether or not they were logical. For instance, the mother's age needed to be not less than 12 years. On the other

hand, concurrent validity was used mainly during data analysis to establish the accuracy of values based on previously measured attributes for any given item. For instance, the risk factors for perinatal asphyxia ought to have reflected the expectations given the context to which the study was conducted (Bonett & Wright, 2015).

Reliability is the measure of consistency across the various sections of the tool, in comparison to the pre-study assumptions or expectations (Rosner, 2015). Specifically, the type of reliability that was assessed was internal consistency which checked on whether or not tools for given attributes, produced similar or expected findings on a number of occasions. Reliability was measured using the Cronbach's alpha to check the number of items in the questionnaire that provided reliable data. The formula for reliability checking used the number of reported responses as the numerator with the total number of questions (otherwise known as items) as the denominator. A Cronbach's Alpha of 0.7 and above for any tool was deemed acceptable (Bonett& Wright, 2015). Reliability testing was done on all items within the questionnaires and data collection forms. The questionnaire yielded an alpha value of 1 (7/7), whereas the data collection form produced a 0.875 (14/16) indicating that two of its items were not reliable and required modification. For the key informant guide, given the open-ended nature of the questions, the test for reliability was not possible to quantify in as much as all the items on the tool passed the assessment on relevance to the study content. Additionally, the validity of the consent forms was also checked. Following the pre-test, the following changes were made on the data collection tools.

Table 3.1: Results and Changes of Pre-test

Section/Tool	Finding on the tool validity/reliability	Adjustment Made	Page
Consent form for Patients	Not relevant as per the consent form	The part of name of participant and witness removed	38, 39
Section A – Antepartum factors	Participants were postnatal mothers with viable babies	Parity: Para 0 removed	49
Section B – Intrapartum factors	For clarity of data collection on malpresentations when foetus presents head first	Question BA19 Foetus face brow, and shoulder presentations added as part of malpresentations	51

3.8 Data management & analysis

The questionnaire was pre-coded for ease of data entry. All the raw data were reviewed and cross-checked to ensure completeness. The filled questionnaires were kept in a safe and confidential place that was accessible only to the researcher awaiting data entry.

After cross checking the information in the questionnaire, a data entry template was designed in Epidata to allow for the setting of controls and validation of the variables, thereby preventing data entry errors. On completion of the data entry exercise, the data was exported to STATA 14 for analysis. Data analysis involved univariate analysis for obtaining descriptive statistics (frequencies and percentages for categorical variables, and means, median and standard deviations for continuous variables). Bivariate and multivariate analysis, specifically the Mantel Haenszel method and unconditional

logistic regression were afterwards used to obtain odds ratios, regression coefficients, p-values and confidence intervals. The unconditional logistic regression was used since the study was of unmatched case control design, and given that the dependent variable was binary (with two mutually exclusive outcomes) –Presence or absence of Perinatal Asphyxia. Hypothesis testing was done at an alpha level of significance of 0.05 such that any p-values below the alpha were deemed significant. Qualitative data was analysed thematically. Key themes at the beginning of the interviews were: ANC visits recommended standards, treatments used on the mothers (pre- and post-delivery), Predisposing risk factors to PA, and "during labour" experiences. The codes were then revised routinely as new information was gathered from the qualitative data collection tool. Key themes that emerged following the analysis included Illnesses during the pregnancy, availability of drugs as a resource, as well as the role of age at birth and birth weight. The qualitative data were then used to support the outcome of the quantitative data as well as develop grounded theories for basing study conclusions (Creswell, 1998). The qualitative data from the KIIs were classified according to various themes. Data were presented using tables and charts, as well as narratives that emerged from the thematic analysis of the key informants.

3.9 Ethical Considerations

Approvals to conduct the study were obtained from Jomo Kenyatta University of Agriculture and Technology School of Nursing and the Board of Post Graduate Studies and Kenyatta National Hospital – University of Nairobi Ethical Research Committee (KNH-UoN ERC). The approval numbers were (JKU/2/137/037) and P781/11/2018 respectively. Authority to collect data was obtained from MCRH Administration with an approval number (MDH/RS/1/VOL.1) (Appendix XI). The study tools were coded and participants were not required to give their names. The data was kept under lock and key and upon entry, password-secured so as to assure for privacy and confidentiality of patient data/records. In order to minimize possible disruptions to

service delivery, the study made use of the nurses after their shifts and ward rounds during the data collection process. The researcher and research assistants collected data that was not too sensitive, and when the situations got sensitive, the patients were assured and reassured. Illiterate participants were allowed to take part through translated Swahili version of the consent and data collection forms. In case of referrals from other facilities, they were excluded from the study so as to eliminate the possibility of confounding by varying locations of study. Written and signed consents were obtained from each participant after a detailed explanation of the study being undertaken.

The study participants' signed an informed consent form, indicating their acceptance to participate in the study. The consent form also explained the purpose of the study.

CHAPTER FOUR

RESULTS AND DISCUSSION

This section presents the findings of the study. The findings are presented thematically in four sections comprising Socio-demographic factors, antepartum factors, intrapartum factors, and neonatal factors. The frequencies are presented along with the Pearson chi-square test for antepartum factors, and Cochran-Mantel Hansel chi-square test results for the inferential statistics for intrapartum and neonatal factors. The key informant responses from 20 health professionals within the hospital are also triangulated with the quantitative findings. Of the 124 study participants, 123 provided complete information that was then used for the analysis.

4.1 Socio-demographic factors affecting birth asphyxia

Table 2 below shows the distribution of the socio-demographic factors among the study participants. The variables assessed under sociodemographic characteristic included Age (categorized using a cut-off of 30 years), marital status, employment status, education level, smoking status, alcohol status, and number of ANC visits. Under employment status, those who were either self-employed or formally employed were both included in the "Employed" group. Most of the respondents were aged less than 30 years, married, and unemployed, and have at least some secondary school level education.

None of the participants smoked nor took alcohol. For the ANC visits variable, the exposure considered was '4+ visits'. Among the controls, 66% were exposed, whereas 55% of the cases were exposed. From the key informant guide, all responses were affirmative on the role played by ANC visits on perinatal asphyxia.

"When mothers come more frequently to the hospital during their pregnancy, this offers the health workers an opportunity to identify problems and prevent complications at the time of birth" (KII008),

And that:

> *"ANC visits are the mother's platform to be taught how to take care of the baby, not just pre, but during and post-delivery as well." (KII019).* And
>
> *"It is very important for mothers to be consistent, and almost loyal, so to speak, in their attendance to the ANC" (KII013).*

Table 4.1: Socio-demographic characteristics of the participant mothers

Variables	Value labels	Outcome Status					
		Controls		Cases		Total	
		N	***%***	***N***	***%***	***N***	***%***
Age (in years)	<30	64	70	24	77	88	72
	30+	28	30	7	23	35	28
Marital Status	Single	20	22	8	26	28	23
	Married	72	78	23	74	95	77
Employment Status	Unemployed	57	62	17	54	74	60
	Formal/Self employed	35	38	14	46	49	40
Education Level	Primary or below	27	29	13	42	40	33
	Secondary and above	65	71	18	58	83	54
Mother Smokes	Yes	0	0	0	0	0	0
	No	92	100	31	100	123	100
Mother takes alcohol	Yes	1	1	0	0	1	1
	No	91	99	31	100	122	99
Number of ANC visits	<4 visits	31	34	14	45	45	37
	4+ visits	61	66	17	55	78	63
	Total	92	100	31	100	123	100

The analysis of the sociodemographic characteristics of the key informants revealed that the mean age of the participants was 42.4 years. Sixty-five percent of them were female compared to 35% male participants. The majority (60%) of the KII respondents were nurses. In terms of experiences, the mean duration of overall work experience, MCH experience and MCRH work experience were 9 years, 7 years and 4 years respectively (Table 3).

Table 4.2: Sociodemographic characteristics of the Key informants

Variables	**Statistics (Mean [IQR]; or Frequency [Percentage])**
Age (in years)	42.4 [26.7 – 58]
Sex	
Male	7 (35%)
Female	13 (65%)
Overall Years of experience	9 [5 – 17]
Years of experience in MCH	7 [5 – 14]
Years of experience at MCRH	4 [3 – 14]
Cadre	
Nurse	12 (60%)
Doctor	3 (15%)
Other e.g. Clinical officer	5 (25%)

4.2 Antepartum risk factors affecting birth asphyxia

Table 4 below presents the descriptive findings of antenatal factors affecting perinatal asphyxia among the study participants. The variables assessed and presented in the table include Gestation at first visit, parity at the time of study, gravidity and birth interval.

Table 2.3: Antepartum risk factors and birth asphyxia

Variable	Value label	Controls		Cases		Total	
		N	%	N	%	n	%
Gestation at first clinic	< 16 weeks	13	14%	0	0%	13	11%
	16-27 weeks	29	32%	10	32%	39	32%
	28-32 weeks	29	32%	16	52%	45	37%
	Above 32 weeks	21	23%	4	13%	25	20%
	Not indicated	0	0%	1	3%	1	1%
Parity	Para 1	39	42%	11	35%	50	41%
	Para 2	24	26%	13	42%	37	30%
	Para 3	16	17%	4	13%	20	16%
	More than Para 3	13	14%	3	10%	16	13%
Gravida	Gravida 1	39	42%	8	26%	47	38%
	Gravida 2	24	26%	16	52%	40	33%
	Gravida 3	16	17%	3	10%	19	15%
	More than Gravida 3	13	14%	4	13%	17	14%
Birth Interval	First Delivery	39	42%	8	26%	47	38%
	1 year	3	3%	6	19%	9	7%
	2 years	9	10%	2	6%	11	9%
	More than 2 years	41	45%	15	48%	56	46%

The majority of the respondents had a gestation at first visit of "28-32 weeks". All (13) of the participants who had a gestation of less than 16 weeks at first clinic attendance had babies that did not have perinatal asphyxia. Most (41%) of the participants were

para 1, followed by those who were para 2. Among the cases, majority (42%) were para 2.

The study also conducted bivariate analysis of the antepartum risk factors and the outcome variable.

Table 5 below presents the Pearson chi-square statistics for antepartum factors including the chi-square statistic, degrees of freedom (d.f), as well as the p-values for each of the statistics. For variables whose individual frequencies were less than 5, Fisher's exact test was used.

Table 4.4: Relationship between antepartum factors and perinatal asphyxia

Variable	Value label	Controls	Cases	Total	chi-square (d.f)	p-value
Gestation at first clinic	< 16 weeks	13	0	13		
	16-27 weeks	29	10	39		
	28-32 weeks	29	16	45		
	Above 32 weeks	21	4	25	11.034 (3)	.026
Parity	Para 1	39	11	50		
	Para 2	24	13	37		
	Para 3	16	4	20		
	More than Para 3	13	3	16	2.849 (3)	.416
Gravida	Gravida 1	39	8	47		
	Gravida 2	24	16	40		
	Gravida 3	16	3	19		
	More than Gravida 3	13	4	17	7.233 (3)	.065
Birth Interval	1 year	3	6	9		
	2 years	9	2	11		
	More than 2 years	41	15	56		
	First Delivery	39	8	47	10.239 (3)	.017
Illness suffered during pregnancy	Hypertension	0	4	4 (3%)		
	Diabetes	1	1	2 (2%)		
	Anaemia	1	3	4 (3%)		
	Preeclampsia	1	0	1 (1%)		
	APH	1	0	1 (1%)	25.9576 (8)	.001*
	UTI	13	0	13 (11%)		
	HIV	7	0	7 (6%)		
	Other	7	1	8 (7%)		
	None	61	22	83 (67%)		
	Total	92	31	123 (100%)		

* Fisher's exact test p-value

Gestational age at first ANC visit and birth interval had statistically significant differences among their various categories at a 95% confidence interval (p-values .026 and .017 respectively).

The illness suffered was also statistically significant, with a p-value of .001 obtained from Fisher's exact test. These findings were further confirmed by KII informant responses such as:

> *"Patients with perinatal asphyxia also had oligohydromnious characteristics and meconium aspirate syndrome"* [KII007]. KII013 and KII017 also commented on *oligohydromnious* and *meconium aspirate syndrome* respectively as predisposing factors for perinatal asphyxia.

Other KII informants suggested that:

> *"The babies of mothers with chronic illnesses at the time of pregnancy more often than not also develop perinatal asphyxia"* [KII009]

And that:

> *"Meconium aspirate syndrome is a key indicator of whether or not a baby will develop perinatal asphyxia"* [KII006]

The study also conducted a Cochran-Mantel Hansel analysis for the antepartum factors to determine the strength of association with perinatal asphyxia. The variables assessed (gestation at first visit, gravida, birth interval, and illness status) were similar to the ones assessed under univariate and bivariate analysis. Table 6 below shows the results of Cochran-Mantel Hansel odds ratios.

Table 4.5: Mantel Hansel results for antepartum factors

Cases/Control	Odds Ratio	p-value	[95% Conf.	Interval]
Gestation at first clinic	0.106	0.069	0.009	1.196
Gravida	0.685	0.115	0.627	74.847
Birth interval	0.525	0.034	0.290	0.952
Illness status	0.811	0.662	0.316	2.079
y-intercept	44.148	0.042	1.152	1691.68

For every unit increase in gestation at first clinic, the likelihood of developing perinatal asphyxia goes down by 0.1 times, although not statistically significant (OR = 0.106, p=.069). For every unit increase in birth interval, the likelihood of having a baby with perinatal asphyxia reduces by 0.5 times (OR = 0.525; p=.03). This observation on birth interval could be due to the fact that the longer the break between deliveries, the lesser the likelihood for complications as the reproductive systems would then have fully been restored.

4.3 Intrapartum risk factors affecting birth asphyxia

Frequency distribution for the categorical intrapartum factors (foetal distress, cord prolapse, membrane rapture, mode of delivery, anaesthesia, analgesic use, and foetal presentation) were calculated as well the median and interquartile range (IQR) for the period in hours of the labour stages. The frequencies are presented for each of the case and control groups as well as the total sum of the two. The results are presented in table 7 as follows:

Table 4.6: Intrapartum factors and perinatal asphyxia status

Exposures Variables	Value label	Outcome status Cases	Controls	Total
Stage 1 Labour (hours)		Median [IQR] for Cases = 12 [9-16]; Controls = 12 [8-18]		
Stage 2 Labour (minutes)		Median [IQR] for Cases = 17.5 [10-40]; Controls = 20 [10-30]		
Fetal distress	Yes	19	18	37
	No	12	74	86
	Total	31	92	123
Cord Prolapse	Yes	1	1	2
	No	30	91	121
	Total	31	92	123
Membrane Rupture	Yes	14	7	21
	No	17	85	102
	Total	31	92	123
Mode of delivery	SVD	12	32	44
	CS	19	60	79
	Total	31	92	123
Anesthesia type	Spinal used	11	32	43
	Spinal not used	1	2	3
	Total	12	34	46
Analgesic use	Used	1	3	4
	Not Used	18	54	72
	Total	19	57	76
Fetal presentation	Breech	1	5	6
	Cephalic	30	87	117
	Total	31	92	123

The median labour period for first stage was 12 hours for both cases and controls, whereas second stage labour lasted 17.5 minutes and 20 minutes among cases and controls respectively. Labour period, from the KII, may be influenced by "passage, power, and passenger; drugs used, parity or age of the mother, and obstructed labour". Almost all (93%) patients who underwent CS, went through spinal anaesthesia and

Almost all (95%) patients who delivered normally, did not use analgesics This observation on the use of analgesic was confirmed by the findings from the KII that:

"Mbagathi Hospital does not use analgesics during delivery because of reasons such as preventing prolonged labour and crossing of placental barrier" [KII004]

The Cochran-Mantel Hansel statistics were calculated from the contingency tables involving intrapartum factors. The odds ratios for the statistics are also presented together with their confidence intervals. The results are presented in table 8 as follows:

Table 4.7: Mantel Hansel results for Intrapartum factors associated with perinatal asphyxia

Exposures		**Outcome status**			**Statistics**	
Variables	**Value label**	**Cases**	**Controls**	**Total**	**MH chi-square (d.f); p-value**	**OR [95% Conf. Interval]**
Fetal distress	Yes	19	18	37	19.19 (1); p=.000	6.509 [2.453 - 17.446]
	No	12	74	86		
	Total	31	92	123		
Cord Prolapse	Yes	1	1	2	.66 (1); p=.416	3.03 [.037 - 240.651]
	No	30	91	121		
	Total	31	92	123		
Membrane Rupture	Yes	14	7	21	23.09 (1); p=.000	10 [3.140 - 33.196]
	No	17	85	102		
	Total	31	92	123		
Mode of delivery	SVD	12	32	44	.16 (1); p=.6932	1.184 [.461 - 2.955]
	CS	19	60	79		
	Total	31	92	123		
Anesthesia type	Spinal used	11	32	43	.09 (1); p=.768	.688 [.033 - 44.202]
	Spinal not used	1	2	3		
	Total	12	34	46		
Analgesic use	Used	1	3	4	.00 (1); p=1	1 [.018 - 13.382]
	Not Used	18	54	72		
	Total	19	57	76		
Fetal presentation	Breech	1	5	6	.24 (1); p=.621	.58 [.012 - 5.501]
	Cephalic	30	87	117		
	Total	31	92	123		

The intrapartum factors assessed revealed that foetal distress and membrane rapture provided statistically significant differences between those who were exposed compared to those who were not exposed, across cases and controls. From the odds ratios for these two factors, patients who experience intrapartum foetal distress were 6.5 times more likely to also have perinatal asphyxia (OR = 6.509 [95 % CI 2.453 -

17.446]); whereas patients who had a membrane rapture were 10 times more likely to be found with perinatal asphyxia compared to those who had no exposure to membrane rapture (23.09 [95% CI 3.140 - 33.196]).

4.4 Neonatal factors

Frequency distribution for the categorical neonatal factors (age at birth, child sex, and birth weight) were calculated. Among the mothers with multiple pregnancies, none of their babies developed perinatal asphyxia. As such, the neonatal characteristics reflect the information for the babies who had perinatal asphyxia. The findings are presented in Figure 3 below.

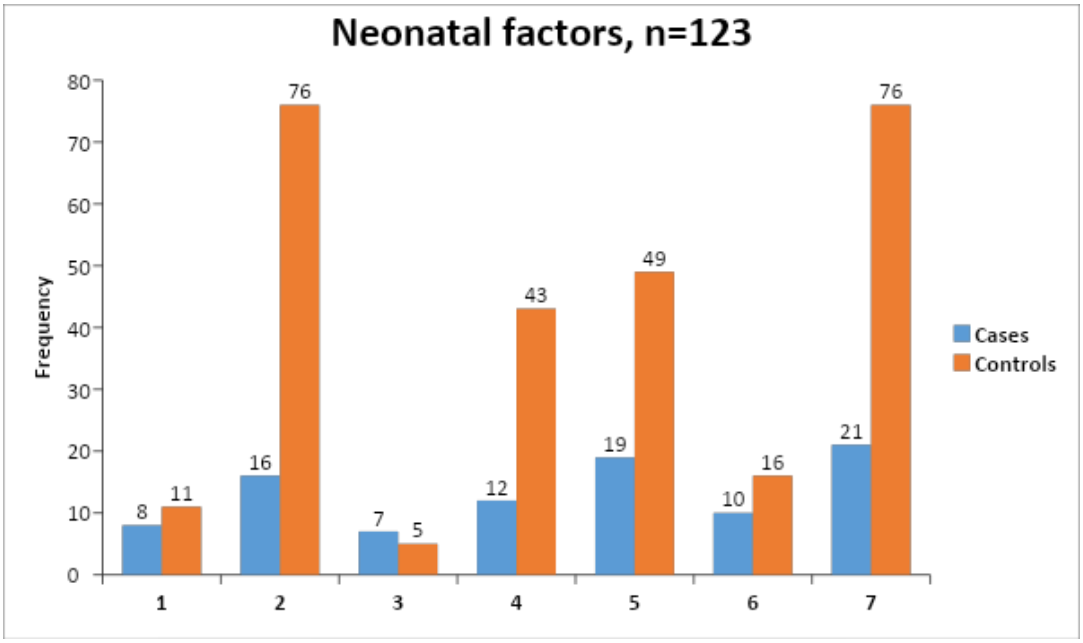


Figure 4.1: Neonatal factors and perinatal asphyxia

Most (75%) of the babies who took part in the study were delivered at term, 83% of whom were controls as expected. However, there were more cases than controls delivered post-term, indicating that there may be a causal relationship between post-

term delivery and development of perinatal asphyxia. Most (55%) were female; and most (79%) had a weight of 2.5 kg or more.

The inferential results for neonatal factors following the Cochran Mantel Hansel technique application are presented in table 9 below. The chi-square statistics, degrees of freedom, odds ratio, and their respective confidence intervals were also calculated and presented.

Table 4.8: Neonatal factors and perinatal asphyxia

Variables	Value label	Cases	Controls	Total	chi-square (d.f); p-value	OR [95% Conf. Interval]
Age at Birth	Pre-term	7	12	19	11.82 (1); p=.071	.225 [.085 - 1.602]
	At term	16	76	92		
	Post-term	8	4	12		
	Total	31	92	123		
Child Sex	Male	12	43	55	.75 (1); .386	.697 [.304 - 1.599]
	Female	19	49	68		
	Total	31	92	123		
Birth Weight	< 2.5 kg	10	16	26	3.07 (1); p=.08	2.262 [.789 - 6.216]
	2.5+ kg	21	76	97		
	Total	31	92	123		

There is not sufficient evidence to reject the null hypothesis that two of the neonatal factors assessed (child sex and birth weight) contributed significantly to whether a patient develops perinatal asphyxia or not. The key informant responses indicated that greater birth weight, pre-terms and post-terms were more at risk of developing perinatal asphyxia. The comparison between the risks among preterm vis-à-vis the post-term was far from unanimous. However, the majority of the key informants indicated that post-term babies were more at risk, compared to their pre-term counterparts. None of the respondents indicated that sex affected the chances of one developing birth asphyxia.

4.5 Discussion

4.5.1 Sociodemographic characteristics of the study participants

Most of the respondents were aged less than 30 years, married, and unemployed and have at least some secondary school level education. This observation was consistent with Seikku et al. (2016) whose study was based on a similar geographic as this study and reported to have more young mothers who were highly literate yet with poor economic status owing to their unemployment. Age, marital status, employment status, and education level did not have statistically significant differences across its categories. These findings were inconsistent with Aslam et al. (2014)'s report that decreasing or increasing maternal age affected the likelihood of developing perinatal asphyxia. These findings were also not consistent with reports from Tabassum et al. (2014) and Seikku et al. (2016). While Tabassum et al. (2014) indicated that perinatal asphyxia was significantly associated with maternal literacy and the knowledge of mothers on health-related issues including attendance to antenatal care, Seikku et al. (2016) reported that the risk for low birth weight, and consequently of asphyxia is higher among those with single marital status (either unmarried or separated). They also found out that mother's unemployment, mother's age below 20 years, and low literacy levels for mothers were other risk factors for perinatal asphyxia. In addition, these findings were not in line with Lawn et al. (2014) who suggested that low level of education was also associated with perinatal asphyxia. However, these findings could act as support for Rani et al. (2012)'s argument that using maternal literacy levels to determine their predisposing conditions could be misleading since literacy is a cross-cutting indicator for socio-economic levels.

While maternal age was not statistically significant, the gestational age at first ANC visit yielded statistically significant correlations with perinatal asphyxia. This finding supports the indication by Onyearugha and Ugboma (2012) that perinatal asphyxia was significantly influenced by antenatal attendance in primary healthcare facilities.

The finding also agrees with Seikku et al. (2016)'s report that gestational age affected other mother-related characteristics that led to neurologic morbidity including perinatal asphyxia. However, Chiabi et al. (2013), following a study in a Cameroonian urban health facility on birth asphyxia risk factors, suggested that what matters is the quality of the care accorded as opposed to the number of consultations (Chiabi et al., 2013).

4.5.2 Ante-partum factors affecting birth asphyxia

Additionally, birth interval yielded statistically significant associations with perinatal asphyxia, such that as the period between deliveries increased, the likelihood of developing perinatal asphyxia decreased. This finding is consistent with Pryor and Bailey (2017) who reported that child spacing of at least 36 months apart minimizes the risk of infant morbidity and mortality. This finding on birth interval also contradicted reports by Seikku et al. (2016) who observed that birth interval longer than 5 years was associated with adverse perinatal outcome forcing such patients to deliver through caesarean section (Seikku et al., 2016). The illness suffered such as oligohydromnious, meconium aspirate syndrome, and chronic illnesses were found to be associated with perinatal asphyxia. These findings were consistent with Seikku et al. (2016)'s report that neurologic morbidity increased the likelihood of developing further conditions such as perinatal asphyxia.

Finally, the study found no correlation between birth asphyxia and number of ANC visits. This finding was inconsistent with reports by Onyearugha and Ugboma (2012) that lack of antenatal care, is an independent risk factor for neonatal encephalopathy, a complication of perinatal asphyxia.

There is sufficient evidence therefore to reject the null hypothesis that antepartum risk factors are not significantly associated with perinatal asphyxia

4.5.3 Intrapartum factors associated with perinatal asphyxia

Foetal distress was statistically significantly associated with developing perinatal asphyxia. Specifically, patients who experience intrapartum foetal distress were more likely to also have perinatal asphyxia. This finding was consistent with Boskabadi et al. (2015) and Lawn et al. (2012) who reported that besides fever, vaginal bleeding, swelling of the hands, face, or feet; convulsions, prolonged labour and prolonged rupture of membranes foetal distress was among the major risk factors associated with perinatal asphyxia.

Membrane rapture was significantly associated with developing perinatal asphyxia with patients who had membrane rapture more likely to be found with perinatal asphyxia. This finding is consistent with the reports by Aslam et al. (2014) who suggested that the risk factors for perinatal asphyxia included prolonged rupture of membranes. Additionally, Solayman, Hoque, Akber, Islam, and Islam (2017) who in their assessment of perinatal asphyxia prevalence within local setups, indicated that membrane rupture was one of the vital factors associated with perinatal asphyxia.

Almost all patients who underwent CS, went through spinal anaesthesia whereas analgesics were not used on most mothers who delivered normally. This observation on the use of analgesic was confirmed by the findings from the KII that "*Mbagathi Hospital does not use analgesics during delivery because of reasons such as preventing prolonged labour and crossing of placental barrier".* Labour duration was higher among controls than cases – a finding that contradicts two studies that reported that prolonged second stage of labour was associated with occurrence of perinatal asphyxia (Seikku et al., 2016; Onyearugha & Ugboma, 2012).

Most participants in the study also underwent CS. As a result, there were more patients who delivered through CS than SVD for both outcome groups. In terms of the risk ratio, patients who delivered through SVD were more likely to develop asphyxia

compared to those who delivered by CS. This finding was not consistent with Chiabi et al. (2013)'s claim that CS had greater odds than SVD in terms of developing perinatal asphyxia.

Intrapartum risk factors studied are associated with perinatal asphyxia, therefore we reject the null hypothesis that intrapartum risk factors are not significantly associated with perinatal asphyxia.

4.5.4 Neonatal factors associated with perinatal asphyxia

The study investigated only three neonatal factors: Term of the baby, their birth weight and sex. The study findings revealed that there was not sufficient evidence to reject the null hypothesis that the neonatal factors assessed contributed significantly to whether a patient developed perinatal asphyxia or not. However, without regarding the significance of the statistics, the study found that term babies were less likely to have perinatal asphyxia compared to those who were delivered pre or post-term. This finding is inconsistent with Kiyani et al. (2014)'s report that full-term babies were associated with perinatal asphyxia.

As for the sex of the baby, the study observed that females were more likely to develop perinatal asphyxia compared to male babies. This finding contradicted findings by Kiyani et al. (2014) who reported that in an Iranian hospital, males were more likely to develop perinatal asphyxia compared to female babies. This finding would be taken in the viewpoint of race as a confounding factor that led to these differences in observation.

Finally, the study reported that twenty seven per cent of neonates had low birth weight; a figure that is higher than that reported by Onyearugha and Ugboma (2012) that fourteen percent of neonates had low birth weight.

The study also provided important odds for birth weight, albeit insignificant. Those who had birth weight of below 2.5kg were more likely to develop perinatal asphyxia compared to those who were born with a birth weight of 2.5kg or more. Consequently the below 2.5kgs group could be considered low birth weight. This finding is consistent with Aslam et al. (2014) who suggested that the risk factors include multiple births and low birth weight infants. This observation also agrees with Seikku et al. (2016) who reported that the risk for perinatal asphyxia was greater among patients with low birth weight.

There was no sufficient evidence to reject the null hypothesis that the neonatal factors assessed were not significantly associated with perinatal asphyxia occurrence.

4.5.5 Limitations and delimitations of the Study

The main constraint of the study was passive resistance from study participants. This was overcome by presenting to the participants an informed consent that clearly elaborated on the purpose of the study. The study was also limited by unavailability of health worker respondents due to work load. This limitation was overcome by presenting those who were available for the study with overarching and open-ended questions that allowed them to provide their individual as well as collective perspective.

4.5.6 Assumptions of the Study

The study assumed that the study participants were comfortable to provide the information required. The study also assumed that the time period set for the study sufficed, and that there would be no strikes or other major forms of interruption during the study period. Indeed, all the assumptions were affirmative.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

- The antepartum factors associated with birth asphyxia are birth interval at 95% confidence interval. At a lower confidence interval (of 90%), the gestational age at first ANC visit and illnesses suffered during pregnancy also become significant. These two factors had specific endorsement from the key informant responses.
- The intrapartum factors associated with birth asphyxia are foetal distress and membrane rapture ($p<0.05$).
- Neonatal factors assessed (birth weight, baby sex, and term of the baby) were not significantly associated with birth asphyxia.

5.2 Recommendations

5.2.1 Recommendations to medical field and administrators

1. The study recommends maternal education on birth interval management and importance of early ANC follow up in a bid to ensure that such preventable risk factors are eliminated.
2. The study recommends that specific efforts be directed at foetal distress and membrane rupture, both in terms of prevention and management in order to minimize complications and conditions that may arise as a result.

5.2.2 Recommendations for further studies

The study recommends a study to be conducted to seek in-depth understanding of the association between neonatal factors and perinatal asphyxia, not for a single

geographical location, but multiple, as well, to control for any regional or racial confounders that may exist.

REFERENCES

Antonucci, R., Porcella, A., &Pilloni, M. D. (2014). Perinatal asphyxia in the term newborn. *Journal of Pediatric and Neonatal Individualized Medicine (JPNIM), 3*(2), e030269.

Appareddy, S., Pryor, J., & Bailey, B. (2017). Inter-pregnancy interval and adverse outcomes: Evidence for an additional risk in health disparate populations. *The Journal of Maternal-Fetal& Neonatal Medicine, 30*(21), 2640-2644.

Aslam, H. M., Saleem, S., Afzal, R., Iqbal, U., Saleem, S. M., Shaikh, M. W. A., &Shahid, N. (2014). Risk factors of birth asphyxia. *Italian journal of pediatrics, 40*(1), 94.

Babu, A. B. V., Devi, S. S., &Kumar, K. B. (2014). Birth asphyxia–Incidence and immediate outcome in relation to risk factors and complications. *Int J Res HlthSci, 2*(4), 1064-71. Retrieved from: http://www.ijrhs.com/issues.php?val=Volume2&iss=Issue4

Bonett, D. G., & Wright, T. A. (2015). Cronbach's alpha reliability: Interval estimation, hypothesis testing, and sample size planning. *Journal of Organizational Behavior, 36*(1), 3-15.

Boskabadi, H., Ashrafzadeh, F., Doosti, H., &Zakerihamidi, M. (2015). Assessment of risk factors and prognosis in asphyxiated infants. *Iranian journal of pediatrics, 25*(4).

Chiabi, A., Nguefack, S., Evelyne, M. A. H., Nodem, S., Mbuagbaw, L., Mbonda, E., &Tchokoteu, P. F. (2013). Risk factors for birth asphyxia in an urban health facility in cameroon. *Iranian journal of child neurology, 7*(3), 46.

Creswell, J. W. (1998). *Qualitative inquiry and research design*: Choosing among five traditions. Thousand Oaks, CA: Sage Publications.

Darmstadt, G. L., Kinney, M. V., Chopra, M., Cousens, S., Kak, L., Paul, V. K., ... & Lancet Every Newborn Study Group. (2014). Who has been caring for the baby? *The Lancet*, *384*(9938), 174-188.

De Almeida, M. F. B., Moreira, L. M. O., Dos Santos, R. V., Kawakami, M. D., Anchieta, L. M., &Guinsburg, R. (2015). Early neonatal deaths with perinatal asphyxia in very low birth weight Brazilian infants. *Journal of Perinatology*, *35*(11), 954.

Dong, T., Tang, L. L., & Rosenberger, W. F. (2014). Optimal sampling ratios in comparative diagnostic trials. *Journal of the Royal Statistical Society: Series C (Applied Statistics)*, *63*(3), 499-514.

Gichogo, D. M., Murila, F., Matiang'i, M., Ndege, W., &Bosire, K. (2018). Prevalence of asphyxia and readiness for neonatal resuscitation in Kenya. *African Journal of Midwifery and Women's Health*, *12*(1), 21-27.

Global Genes (2018). RARE List. Retrievedfrom https://globalgenes.org/rarelist/ [online].

Gupta, S. S., Sarmah, B. K., Tiwari, D., Shakya, A. &Khatiwada, D. (2014) Clinical Profile of Neonates with Perinatal Asphyxia in a Tertiary Care Hospital of Central Nepal. Retrieved from http://www.who.int/whr/2004 /annex/en/index.html

Health Infromation System Kenya (HISK) (2018). District health information System (DHIS 2): Event Capture Records. Retrieved from hiskenya.org

Ilah, B. G., Aminu, M. S., Musa, A., Adelakun, M. B., Adeniji, A. O., &Kolawole, T. (2015). Prevalence and risk factors for perinatal asphyxia as seen at a specialist hospital in Gusau, Nigeria. *Sub-Saharan African Journal of Medicine, 2*(2), 64.

Kelsey, W. E., Kelsey, J. L., Whittemore, A. S., Evans, A. S., & Thompson, W. D. (1996). Methods in observational epidemiology (Vol. 26). Monographs in Epidemiology.

Kenya Demographic and Health Survey. (2014). Demographic Survey. Kenya Bureau of Statistics

Kibai, E. K. (2017). Perinatal factors associated with birth asphyxia among neonates in Maternity Ward Kakamega County Refferal Hospital, Kenya.

King, I. M. (1992). King's theory of goal attainment. *Nursing Science Quarterly*, *5*(1), 19-26.

Kiyani, A. N., Khushdil, A., &Ehsan, A. (2014). Perinatal factors leading to birth asphyxia among term newborns in a tertiary care hospital. *Iranian journal of pediatrics, 24*(5), 637.

Lawn, J. E., Kinney, M. V., Black, R. E., Pitt, C., Cousens, S., Kerber, K., &Oestergaard, M. Z. (2012). Newborn survival: a multi-country analysis of a decade of change. *Health policy and planning, 27*(suppl_3), iii6-iii28.

Lawn, J. E., Manandhar, A., Haws, R. A. & Darmstadt, G. L. (2014) Every Newborn: Progress, Priorities, and Potential beyond Survival Lancet, 384, 189-205.

Linden, A., &Samuels, S. J. (2013). Using balance statistics to determine the optimal number of controls in matching studies. *Journal of evaluation in clinical practice, 19*(5), 968-975.

Morales, P., Bustamante, D., Espina-Marchant, P., Neira-Peña, T., Gutiérrez-Hernández, M. A., Allende-Castro, C., & Rojas-Mancilla, E. (2011). Pathophysiology of perinatal asphyxia: can we predict and improve individual outcomes?.*EPMA Journal*, *2*(2), 211-230.

Onyearugha, C. N., &Ugboma, H. A. (2012). Fetal outcome of antepartum and intrapartum eclampsia in Aba, southeastern Nigeria. *Tropical doctor*, *42*(3), 129-132.

Pappas, A., & Korzeniewski, S. J. (2016). Long-term cognitive outcomes of birth asphyxia and the contribution of identified perinatal asphyxia to cerebral palsy. *Clinics in perinatology*, *43*(3), 559-572.

Pearce, N. (2016). Analysis of matched case-control studies. *bmj*, *352*, i969.

Pitsawong, C., &Panichkul, P. (2012), Risk factors associated with birth asphyxia in PhramongkutklaoHospital.*Thai J Obst*et*Gynaecol* 2012, 19(4):165–171. 5. ICD-10 Version. 2010.

Rani, S., Chawla, D., Huria, A., & Jain, S. (2012). Risk factors for perinatal mortality due to asphyxia among emergency obstetric referrals in a tertiary hospital. *Indian pediatrics*, *49*(3), 191-194.

Rosner, B. (2015). *Fundamentals of biostatistics*. Nelson Education. Simiyu, I. N., Mchaile, D. N., Katsongeri, K., Philemon, R. N., & Msuya, S. E. (2017). Prevalence, severity and early outcomes of hypoxic ischemic encephalopathy among newborns at a tertiary hospital, in northern Tanzania. *BMC pediatrics*, *17*(1), 131.

Seikku, L., Gissler, M., Andersson, S., Rahkonen, P., Stefanovic, V., Tikkanen, M., &Rahkonen, L. (2016). Asphyxia, neurologic morbidity, and perinatal mortality in early-term and postterm birth. *Pediatrics, e20153334*.

Simiyu, I. N., Mchaile, D. N., Katsongeri, K., Philemon, R. N., & Msuya, S. E. (2017). Prevalence, severity and early outcomes of hypoxic ischemic encephalopathy among newborns at a tertiary hospital, in northern Tanzania. BMC pediatrics, 17(1), 131.

Solayman, M., Hoque, S., Akber, T., Islam, M. I., & Islam, M. A. (2017). Prevalence of Perinatal Asphyxia with Evaluation of Associated Risk Factors in a Rural Tertiary Level Hospital. *KYAMC Journal, 8*(1), 43-48.

Tabassum, F., Rizvi, A., Ariff, S., Soofi, S., &Bhutta, Z. A. (2014). Risk factors associated with birth asphyxia in rural district Matiari, Pakistan: a case control study. *International Journal of Clinical Medicine, 5*(21), 1430-1441.

United Nations International Children's Fund (UNICEF) (2013). United Nations Children's Fund. Situação Mundial da Infância.

Vain, N. E., &Batton, D. G. (2017, August). Meconium "aspiration" (or respiratory distress associated with meconium-stained amniotic fluid?). In *Seminars in Fetal and Neonatal Medicine* (Vol. 22, No. 4, pp. 214-219). WB Saunders.

World Health Organization (2014). Injuries and violence: the facts 2014. World Health Organization.

World Health Organization (2018). World Health Report.WHO, Geneva.

Yadav, N., &Damke, S. (2017). Study of risk factors in children with birth asphyxia. *Internationa*l *Journa*l *of Contemporary Pediatrics, 4*(2), 518-526.

Yego, F., Williams, J. S., Byles, J., Nyongesa, P., Aruasa, W., &D'Este, C. (2013). A retrospective analysis of maternal and neonatal mortality at a teaching and referral hospital in Kenya. *Reproductive he*al*th, 10*(1) 13.

Yin, R. K. (2017). Case study research and applications: Design and methods. Sage publication.

Zhou, Q., Changxia, H. U., Yin, D., &Xia, S. (2016). Relationship between neonatal asphyxia and blood glucose disorder. *Chinese Journal of Perinatal Medicine, 19*(5), 336-339.

APPENDICES

Appendix I: Consent Form for Patients

My name is Beatrice Amadi, a Master's student at Jomo Kenyatta University of Agriculture and Technology, conducting a research on risk factors associated with lack of oxygen among newborn babies at Mbagathi County Referral Hospital (MCRH), Nairobi City County, Kenya. You are a potential participant because you are a mother with a child aged 7 days and below. We ask that you read this form before agreeing to be in the research. If you cannot read, you can request the researcher/research assistant to read it to you. This study will involve recruitment of study participants from the Maternity Unit of Mbagathi County Referral Hospital. Your baby has been selected to participate in this study because he/she was born in this hospital. Babies bellow seven days who lack oxygen at birth or within this period and those who had no such issues will participate in the study. In the interview, I will ask you questions regarding your status before giving birth, and I will also get your information on your health as well as the baby's. You and your baby will not be put or subjected to any form of risk by participating in this study. The review of records in this study will be secure and private, only accessible to the researchers, and used only for purposes of this particular research. Anything you tell us will remain confidential. In any sort of report of the study, we will not include any information that will make it possible to identify you. We are not asking for your name, address, or phone number. Your name and other identifying information will not be kept with this study. The study will be kept in a locked file; only the researchers for this study will have access to the records. Your decision whether or not to participate will not prejudice your future relations with Jomo Kenyatta University of Agriculture and Technology, Mbagathi County Referral Hospital staff or staff of affiliated institutions to this study. If you do not wish to take part or you do not want to answer some of the questions, you do not have to give us a reason. Even if you sign this consent form, you are free to stop at any time. You do

not need to complete it if you feel uncomfortable doing it. The results (upon consent of participants) will be shared with MCRH and Nairobi County management who will take the necessary action depending on the outcomes. The study will therefore be of benefit to the participants and the community as a whole. If your baby suffered lack of oxygen, will benefit by being protected from related other conditions. If your baby does not had no problem and cried well at birth, we will be able to advice you on ways of preventing such possible diseases. All participant mothers will then be educated and empowered on how to prevent perinatal asphyxia in the future. There will, however, be no direct financial benefits for taking part in the study.

Contact

The researcher conducting this study is Beatrice Kadenyeka Amadi. You may contact the researcher at any time.

In case of any queries or concerns, please contact the:

Principal investigator: Beatrice Kadenyeka Amadi

Address: P.O. Box 45228 00100 GPO, Nairobi

Cell phone Number: +254 722861768

Email: bamadi1967@gmail.com

OR

Research Supervisors: Dr Sherry Oluchina.

Email: soluchina@jkuat.ac.ke

Cell phone Number: +254724668425

Subject's Permission

I have been fully informed about the study and conditions of this study. I have been given the opportunity to ask questions and they have been answered to my satisfaction.

I consent to participate in the study.

_____ Sign_____ Date_____

Signature of participant

Name_____ Sign_____ Date_____

Name and signature of researcher/ research assistant

Name _____Sign_____ Date_____

Witness

Appendix II: Consent Form for Health Workers

My name is Beatrice Amadi, a Master's student at Jomo Kenyatta University of Agriculture and Technology, conducting a research on risk factors associated with perinatal asphyxia among neonates at Mbagathi County Referral Hospital (MCRH), Nairobi City County, Kenya. You are a potential participant because you are a health worker in the maternity unit of this MCRH. We ask that you read this form before agreeing to be in the research. You will be requested to respond to some questions regarding perinatal asphyxia, first, within the hospital, and also, generally on your knowledge of the condition. You are also requested to answer with as much detail as possible, relevant to each question. There will be no risks associated with participating in the study; neither will there be any direct financial benefits for taking part in the study.

Contact

The researcher conducting this study is Beatrice Kadenyeka Amadi. You may contact the researcher at any time.

In case of any queries or concerns, please contact the:

Principal investigator: Beatrice Kadenyeka Amadi

Address: P.O. Box 45228 00100 GPO, Nairobi

Cell phone Number: +254 722861768

Email: bamadi1967@gmail.com

OR

Research Supervisors: Dr Sherry Oluchina.

Email: soluchina@jkuat.ac.ke

Cell phone Number: +254724668425

Subject's Permission

I have been fully informed about the study and conditions of this study. I have been given the opportunity to ask questions and they have been answered to my satisfaction.

I consent to participate in the study.

Sign_____ Date_____

Name and signature of researcher/ research assistant

Name_____ Sign_____ Date_____

Appendix III: Fomu Ya Kibali (Swahili Version)

Jina langu ni Beatrice Amadi, mwanafunzi wa Stashahada katika shule kuu ya JKUAT. Niko katika harakati za kutafiti kuhusu vyanzo vya upungufu wa oksijeni kati ya watoto wachanga katika Hospitali ya Rifaa ya Kaunti ya Mbagathi (MCRH), Kaunti ya Jiji Kuu la Nairobi, Nchini Kenya. Lengo kuu la utafiti huu ni kuweza kuvitambua vyanzo vyote vya ugonjwa huu kwa watoto wa umri isiozidi siku saba. Unauwezo wa kuchangia katika utafiti huu kwa vile mwanao ana umri wa chini ya siku saba. Tunakusihi usome maelekezo na maagizo ya nayo fuata kwaumakinifu kabla ya kukubali kuchangia katika utafiti huu. Iwapo huwezi kusoma, umekubaliwa kumwomba mtafiti akusomee. Aidha, watakaotumika kwenye utafiti huu ni watato kwenye kitengo cha kuzaliwa cha MCRH. Mwanao amechaguliwa kuchangia katika tafiti hizi kwa vile alizaliwa katika hospitali hii. Watoto walio na upungufu wa oxijeni na wasio na upungufu huu watahusika katika utafiti huu waleo. Nitakuuliza maswali kuhusu jinsi ulivyokuwa kabla ya kuzaa, ulipokuwa ukizaa, na vile vilekuhusu afya ya mwanao alipozaliwa. Usiwe na shaka kwani wewe na mwanao hamtaathiriwa kwa njia yoyote ile inayoweza kuwa tatizo kwenu. Maneno na maarifa yote utakayotupatia kama majibu yatatunzwa kwaumakinifu, na kutumika tu kwa sababu zinazofaa. Hata wakati wa ripoti, pamoja na muda wote wakutafiti, hatutatumia maneno yatakayoweza kutumika kukujua kibinafsi. Hatutakuuliza jina lako, pahali unapotoka, au nambari yako ya simukwa vile hazitahitajika katika tafiti hizi. Ni watafiti pekee wataweza kuona majibu, vifunguo ambavyo vitakuwa na watafiti pekee. Uamuzi wako kutohusika katika utafiti huu hautaathiri uhusiano wako na Hospitali ya Rifaaya kaunti ya Mbagathi, Chuo Kikuu Cha Jomo Kenyatta, au wahusika wote wengine katika tafiti hizi. Iwapo hungependa kuhusika katika utafiti huu, haujashurutishwa kujieleza kwetu. Hata ingawa waweza kuwa umetia sahihi kibali hiki, umeidhinishwa kukatiza kuhusika kwako kwenye utafiti huu. Hujashurutishwa kumaliza utafiti huu iwapo hutajihisi vyema kuendelea. Matokeo ya utafiti huu (baadayakibaliyakuhusika) yatasambazwa kwa viongoziwa MCRH na wa afya ya Kaunti ya Nairobi ambao

watahitajika kuchukua hatua kulingana na matokeo hayo. Kwa hivyo, utafiti huu hautaifaidi tu wanaochangia, ila pia jamii yote Kenya mzima. Iwapo mwanao tayari ana upungufu wa oxijeni, atafaidika kwa kusaidiwa kuzuia magonjwa mengine yatakayo weza kutokea kwasababu ya upungufu huu. Iwapo mwanao hana upungufu wa oxijeni, tutakupa maelezo ya jinsi ya kuzuia magonjwa kama hayo. Wahusika wote wa utafiti huu watasomeshwa na kujulishwa kuhusu jinsi ya kuzuia ugonjwa huu. Hakuna mhusika yeyote atakayelipwa pesa kwa kuchangia katika utafuti huu.

Njia za Mawasiliano

Mtafiti mkuu anaitwa Beatrice Kadenyeka Amadi. Unaweza kuwasiliana namtafiti wakati wowote ule.

Iwapo unamaswali yoyote au hoja zozote, usisite kuwasiliana kwa:

:

Mtafiti Kuu: Beatrice Kadenyeka Amadi

Anwani: P.O. Box 45228 00100 GPO, Nairobi

Nambari ya Simu: +254 722861768

Barua-pepe: bamadi1967@gmail.com

AU

Msimamizi wa Utafiti: Dr Sherry Oluchina.

Barua-pepe: soluchina@jkuat.ac.ke

Nambari ya Simu:+254724668425

Idhiniya Mhusika

Nimeelezwa kwa kina matarajio na mahitaji katik autafiti huu. Nimepewa fursa ya kuuliza maswali yangu. Majibu yamenitosheleza.

Nimekubali kuchangia katika utafiti huu.

.

SAHIHI_____TAREHE_____

Jina na sahihi ya mtafiti/ msaidizi wa mtafiti

JINA_____ SAHIHI_____ TAREHE_____

Shahidi

Appendix IV : Questionnaire

Questionnaire to establish perinatal factors associated with birth asphyxia among neonates at Mbagathi County Referral Hospital, Nairobi, Kenya.

SECTION A: ANTEPARTUM FACTORS			
Instructions: This form is to be filled by the interviewer (research assistant). Use the last column as a tickbox for the correct answer. There is no one question with more than one response. The tickbox should therefore be on only one of the responses.			
Respondent Code: _____ Interview date: _____			
Code	**Question**	**Response**	
AA	**SOCIAL, ECONOMIC AND DEMOGRAPHIC FACTORS**		
AA01	Mother's Age	<30 30+	[ ] [ ]
AA02	Marital status	Never married Married Previously married	[ ] [ ] [ ]
AA03	Employment Status	Unemployed Self Employed Casual Labourer Formerly Employed	[ ] [ ] [ ] [ ]
AA04	Education Level	None Primary Secondary Post-secondary	[ ] [ ] [ ] [ ]
	BEHAVIORAL CHARACTERISTICS OF THE MOTHER		
AC10	Do you smoke?	Yes No	[ ] [ ]
AC11	Do you take alcohol?	Yes No	[ ] [ ]
AC12	Antenatal visits	Less than 4 visits 4 or more visits	[ ] [ ]

Appendix V: Questionnaire (Swahili Version)

Maagizo: Fomu hii ya paswa kujazwa na anayehoji ambaye anaweza kuwa ni mtafiti au msaidiziwake. Tumia sehemu ya mwisho pembeni kuonyesha ni jibu lipi limechaguliwa na mhojiwa. Hakuna swali lolote lililonamajibu Zaidi yamoja.		
Kodi ya Mshiriki:_____ Tarehe ya mahojiano: _____		
Kodi	**Swali**	**Jibu**
AA	**MAELEZO YA KIBINAFSI, KAZI, NA DEMOGRAFIA**	
AA01	Unamiaka mingapi?	_____
AA02	Hali ya kuolewa?	Sijawahi kuolewa [ ] Nmeolewa [ ] Nilikuwa nimeolewa [ ]
AA03	Unafanya kazi gani kuwezakujikimu?	Sinakazi [ ] Nimejiajiri [ ] Kibarua/Kijungujiko [ ] Nilikuwa nimeajiriwa, awali [ ]
AA04	Kiwango cha masomo	Sijasoma [ ] Shule ya Msingi [ ] Shule ya Upili [ ] Zaidi ya Shuleya Upili [ ]
	MAELEZO YA MAMA	
AB10	Wewe huvuta sigara?	Ndio [ ] La [ ]
AB11	Wewe hunywa pombe?	Ndio [ ] La [ ]
AB12	Kabla ya kuzaa, ulitembelea hospitali mara ngapi kupata maarifa?	Chini ya mara 4 [ ] Mara 4 au zaidi [ ]

Appendix VI: Data Collection Form/Checklist

SECTION A: ANTEPARTUM FACTORS		
	Respondent Code:	
Code	**Checklist Item**	**Observation status**
AB	**MEDICAL HISTORY**	
AB05	Gestation at first clinic attendance	Below 16weeks 16-28weeks 28-32 weeks 32-40weeks Not indicated
AB06	Parity	Para 1 [ ] Para 2 [ ] Para 3 [ ] More than Para 3 [ ]
AB07	Gravida	Gravida 1 [ ] Gravida 2 [ ] Gravida 3 [ ] More than Gravida 3 [ ]
AB08	Birth interval	1 year [ ] 2 years [ ] More than 2 years [ ]
AB09	Illness diagnosed in pregnancy	Hypertension [ ] Diabetes [ ] Anaemia [ ] Preeclampsia [ ] APH [ ] UTI [ ] HIV [ ] Others Specify _____ None [ ]
	SECTION B: INTRAPARTUM FACTORS	
BA13	Duration of 1st stage labour	_____ hours
BA14	Duration of 2nd stage labour	_____ hours
BA15	Foetal distress	Yes [ ] No [ ]

BA16	Cord prolapse	Yes [ ] No [ ]
BA17	Premature membrane rupture	Yes [ ] No [ ]
BA18	a) Mode of delivery	Vacuum [ ] Emergency CS [ ] Elective CS [ ] SVD [ ]
	b) If CS, type of anaesthesia	General Anaesthesia [ ] Spinal anaesthesia [ ]
	c) If SVD, type of analgesic	Tramadol [ ] Pethidine [ ] Morphine [ ] Analgesic not used [ ]
BA19	Presentation of foetus	Cephalic [ ] Breech [ ] Face [ ] Shoulder [ ] Brow [ ]
BA20	Type of birth	Single [ ] Multiple [ ]
	SECTION C: NEONATAL FACTORS	
CA21	Age at birth	Preterm [ ] Term [ ] Post-term [ ]
CA22	Child sex	Male [ ] Female [ ]
CA23	Birth weight	2500gms or less [ ] 2600-3500gms [ ] Above3500gms [ ]

Appendix VII: Key Informant Guide

Introduction

This is a key informant guide intended to collect information on risk factors of perinatal asphyxia. You have been selected to take part in the study following your consent to participate given that you are a health worker in the maternity unit of this MCRH. We request your detailed and in-depth response to each question.

Respondent Code: _____ Interview Date: _____

Age (in years) _____ **Sex** Male [ ] Female [ ]

How many years of experience do you have overall? _____

How many years of experience do you have in MCH? _____

How many years of experience do you have at MCRH? _____

Cadre/Designation _____

ANTEPARTUM FACTORS

1. Do you think the number of ANC visits could either enhance or prevent perinatal asphyxia? Why or why not?

_____

_____

_____

_____

2. In your opinion, who is more at risk of developing perinatal asphyxia?

INTRAPARTUM FACTORS

3. Give examples of analgesics administered to patients within this hospital during delivery? Do you think these medicines could pose any kind of risks to the mother and the foetus? Why or why not?

4. What is the ideal labour period? What factors can influence this period? How?

NEONATAL FACTORS

5. Contrast the level of risk of birth asphyxia for preterm, term and post-term babies.

6. Babies with high birth weight are more at risk of developing perinatal asphyxia. Agree/Disagree. Explain.

_____

_____

Conclusion

We highly and humbly appreciate the time you took to provide us with the information. Thank you.

Appendix VIII: JKUAT for Ethical Approval

JOMO KENYATTA UNIVERSITY
OF
AGRICULTURE AND TECHNOLOGY
SCHOOL OF NURSING
DEPARTMENT OF NURSING EDUCATION AND RESEARCH
TEL: 067- 52181-4 Extn. 4064 FAX: 067-52030 Email: nursingeducation.jkuat.ac.ke

REF: JKU/2/137/037 **DATE:** 7th November, 2018

KNH-UoN ERC
KENYATTA NATIONAL HOSPITAL
P O BOX 20723 – 00202
NAIROBI

Dear sir/Madam,

RE: REQUEST FOR ETHICAL APPROVAL FOR PROPOSAL
BEATRICE KADENYEKA AMADI – HSN311-5103/2016

The above named is a bonafide second (2rd) year student of Jomo Kenyatta University of Agriculture and Technology pursuing Master of Science in Nursing (Paediatrics). As part of their curriculum fulfillment, the students are required to undertake a research project.

The purpose of this letter is to inform you that the student is in the process of attaining ethical approval for proposal titled "**Perinatal factors associated with birth asphyxia among neonates at Mbagathi County Referral Hospital, Kenya**".

We, are, therefore requesting you to ethically approve the proposal.

Thank you.

07 NOV 2018

DR. Sherry Oluchina
COD, Nursing Education and Research

Appendix IX: KNH – UoN ERC Approval Letter

UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
Tel:(254-020) 2726300 Ext 44355

KNH-UON ERC
Email: uonknh_erc@uonbi.ac.ke
Website: http://www.erc.uonbi.ac.ke
Facebook: https://www.facebook.com/uonknh.erc
Twitter: @UONKNH_ERC https://twitter.com/UONKNH_ERC

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/93

19th March, 2019

Beatrice Kadenyeka Amadi
Reg. No. HSN 311-5103/2016
Dept. of Nursing Education and Research
School of Nursing
J.K.U.A.T

Dear Beatrice

RESEARCH PROPOSAL: PERINATAL FACTORS ASSOCIATED WITH BIRTH ASPHYXIA AMONG NEONATES AT MBAGATHI COUNTY REFERRAL HOSPITAL, NAIROBI, KENYA (P781/11/2018)

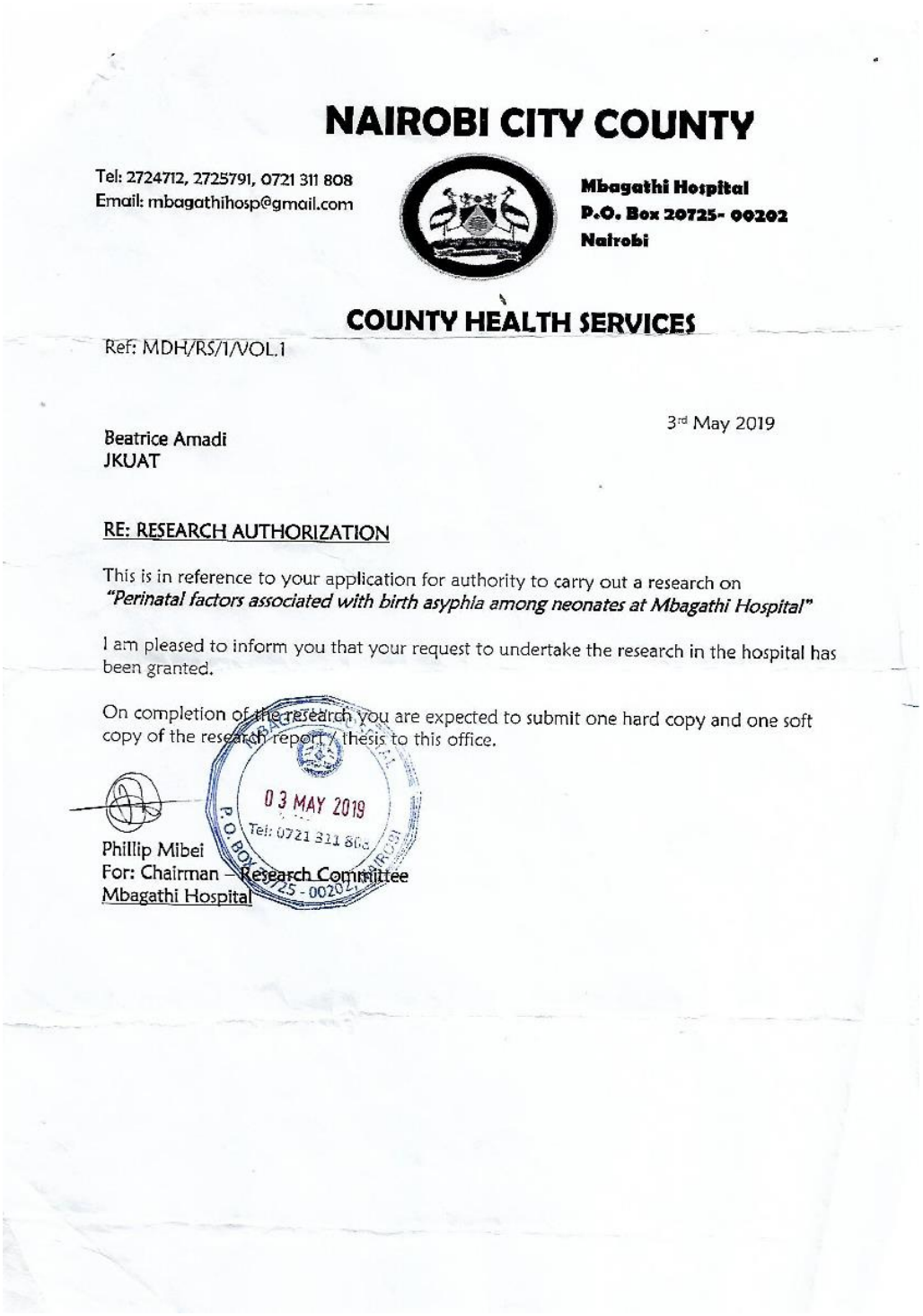
This is to inform you that the KNH- UoN Ethics & Research Committee (KNH- UoN ERC) has reviewed and **approved** your above research proposal. The approval period is 19th March 2019 – 18th March 2020.

This approval is subject to compliance with the following requirements:

a. Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b. All changes (amendments, deviations, violations etc.) are submitted for review and approval by KNH-UoN ERC before implementation.
c. Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
d. Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH- UoN ERC within 72 hours.
e. Clearance for export of biological specimens must be obtained from KNH- UoN ERC for each batch of shipment.
f. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
g. Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/ or plagiarism.

Protect to discover

Appendix X: Nairobi City County Approval Letter



NAIROBI CITY COUNTY

Tel: 2724712, 2725791, 0721 311 808
Email: mbagathihosp@gmail.com

Mbagathi Hospital
P.O. Box 20725- 00202
Nairobi

COUNTY HEALTH SERVICES

Ref: MDH/RS/1/VOL.1

3rd May 2019

Beatrice Amadi
JKUAT

RE: RESEARCH AUTHORIZATION

This is in reference to your application for authority to carry out a research on *"Perinatal factors associated with birth asyphia among neonates at Mbagathi Hospital"*

I am pleased to inform you that your request to undertake the research in the hospital has been granted.

On completion of the research you are expected to submit one hard copy and one soft copy of the research report/ thesis to this office.

03 MAY 2019

Phillip Mibei
For: Chairman – Research Committee
Mbagathi Hospital

Appendix XI: Qualitative Data Results

Initial Codes/Themes	**Final Codes/Themes**
Lack of adherence to ANC guidelines	Literacy Levels
Mothers not able to understand instructions	
Negligence on the instructions given during hospital visits	
Chronic conditions e.g. Hypertension	Mothers with Underlying Chronic Conditions
Immunocompromised mothers	
Mother age	Maternal Age
Gestational age increases the likelihood of developing PA	Gestational Age
Delayed ANC start leads to complications during and after birth	ANC duration/frequency
Frequency of ANC visits also contributes to mother/child welfare	
Oligohydromnious	Intrapartum issues/complications
Meconium aspirate	
Staff are overstretched	Resource adequacy

Appendix XII: Study Manuscript

Perinatal Factors associated with Birth Asphyxia among Neonates at a County Referral Hospital in Kenya

Beatrice Kadenyeka Amadi[1], Sherry Oluchina, BScN, MScN, PhD[2], Drusilla Makworo, BScN, MScN, PhD[2], Bernard Mbithi, BScN, MSc (PH), PhD[2]

[1]School of Nursing, Jomo Kenyatta University of Agriculture and Technology and Nursing Officer at Kenyatta National Hospital, Nairobi, Kenya

[2]School of Nursing, Jomo Kenyatta University of Agriculture and Technology, Kiambu, Kenya

Abstract Perinatal asphyxia is a common and serious neonatal problem globally and significantly contributes to both neonatal morbidity and mortality given that it is a major cause of death and of acquired brain damage in newborns. Therefore, the objective of this study was to determine the antepartum risk factors associated with perinatal asphyxia among neonates. This was an unmatched mixed case control study, conducted at a County Referral Hospital (MCRH) in Nairobi (Kenya). Participants were assigned into case or control groups purposively whilst excluding patients with congenital anomalies. The sample size comprised 124 participants, 31 cases and 93 controls, with controls being systematically picked at intervals of 4. A questionnaire, a data collection form designed with pre-coded responses, and a key informant guide were used to collect both quantitative and qualitative data respectively. Odds ratios for Mantel Haenszel method and unconditional logistic regression were obtained using STATA 14 software, with statistical inference done at an alpha level of significance of .05. The study findings revealed that age, marital status, employment status, and education level were not significantly associated with perinatal asphyxia. Birth interval was the only significant antepartum factor associated with perinatal asphyxia. For every unit increase in birth interval, the log-likelihood of having a baby with perinatal asphyxia reduces by 0.5 times (OR = 0.525; p=0.03). This observation on birth interval could be due to the fact that the longer the break between deliveries, the lesser the likelihood for complications as the reproductive systems would then have fully been restored.

Keywords Asphyxia, Neonates, Perinatal, Risk Factors

1. Introduction

1.1 Background of the study

Globally, deaths caused by perinatal asphyxia account for about 23% of the deaths among four million neonatal deaths, with an estimated one million survivors developing such complications like cerebral palsy and mental retardation. When new-borns are deprived of oxygen, for a period long enough to cause physical harm especially to the brain, the condition is referred to as perinatal asphyxia (PA) [1]. World Health Organization (WHO) defines perinatal asphyxia as the failure to sustain, or in extreme circumstances to initiate breathing at birth. Causes of perinatal asphyxia include birth trauma, congenital sepsis or maternal opiates, intrauterine pneumonia, severe meconium aspiration, cord compression, congenital pulmonary or cardiac anomalies, narcotic administration or transplacental anaesthetic, obstructed airway, or placental abruption [2]. Perinatal asphyxia clinically presents with cardio-respiratory and neurological depression with Apgar score persistently <7within the first 5 minutes of birth coupled with evident hypoxic compromise resulting in acidemia [1].

The prevalence and mortality rate for PA are also high. In resource-poor countries like Africa, the incidence is even higher, with Kenya having a prevalence rate of about 5.1% [3]. However, these incidences are sometimes an underrepresentation of the actual prevalence of PA in the community given the exclusion of any occurrences outside health facility settings. Nairobi County has some of the best facilities nationwide for delivering care to patients of acute neonatal complications. Data from District Health Information System (DHIS 2) shows that close to 50% of New Born Unit (NBU) admissions are due to birth asphyxia. However, there is no documented data on determination of perinatal risk factors in the County Referral Hospital where the study was conducted [4].

1.2 Research objective

To determine the antepartum risk factors associated with perinatal asphyxia among neonates at a County referral hospital in Kenya.

2. Methodology

2.1 Study Design

This was an unmatched mixed case control study. According to Yin, case control studies are designs used to retrospectively establish the relationship between risk factors and a given outcome by comparing the frequency of the exposure among two groups (those with and those without the disease or outcome of interest) [5]. The study design was also suitable for rare disease outcomes such as perinatal asphyxia. According to Global Genes (2018) and National Organization for Rare Diseases (NORD)'s Database, Perinatal Asphyxia was listed as a rare disease [6].

2.2 Sampling and recruitment Procedure

The study participants were classified into case or control groups, at a ratio of 1:3 respectively. Multiple studies suggest a ration of anything between 1:1 and 1:4 for cases to controls [7, 8]. It has also been noted that a matching ratio up to 1:4 case to control ratio elicits the lowest bias [7]. However, financial feasibility of the chosen approach was cited as a contributory factor to the ratio. The assignment of participants into case or control groups was purposive and solely based on them having or not having perinatal asphyxia respectively. During this assignment into participant groups, the patients were also screened for other congenital anomalies so that those who had any such kind of anomalies were excluded from the study entirely. Upon isolation of the cases, systematic sampling was used to pick controls through at an interval of 4 given that the estimated number of non-asphyxia deliveries per month was 426, representing 70.9% of the estimated 600 deliveries and the sample for controls was estimated to be 93. As for the Key informant guide, census approach was used where all the 57 workers in the maternity unit were allowed to participate. However, the point of saturation

technique was used to determine the point at which the diversity of the responses ceased leading to no new information gathered. This point was reached after 30 interviews.

2.3 Data Management

The questionnaires were pre-coded for ease of data entry. All the raw data was reviewed by the researcher and cross-checked to ensure completeness. The filled questionnaires were kept in a safe and confidential place that was accessible only to the researcher awaiting data entry.

After cross checking the information in the questionnaires, a data entry template was designed in Epidata to allow for the setting of controls and validation of the variables, thereby preventing data entry errors. On completion of the data entry exercise, the data was exported to STATA version 14 for analysis. Data analysis involved univariate analysis for descriptive statistics (frequencies and percentages for categorical variables, and means, median and standard deviations for continuous variables). Bivariate and multivariate analysis, specifically the Mantel Haenszel method and unconditional logistic regression were afterwards used to obtain odds ratios, regression coefficients, p-values and confidence intervals. The unconditional logistic regression were used since the study was of unmatched case control design, and given that the dependent variable was binary, with two mutually exclusive outcomes (presence or absence of Perinatal Asphyxia). Hypothesis testing was done at an alpha level of significance of .05 such that any p-values below the alpha were deemed significant. Qualitative data was analysed thematically. The codes were then revised routinely as new information was gathered from the qualitative data collection tools. The qualitative data were then used to support the outcome of the quantitative data as well as develop grounded theories for basing study conclusions. Data was presented using tables and narratives.

2.4 Ethical Considerations

Approvals and research permits were sought from all relevant institutions in the study. The researcher and research assistants collected data that was not too sensitive, and when the situations got sensitive, the participants were assured and reassured. Illiterate participants were allowed to take part through translated Swahili version of the consent and data collection forms. Written and signed consents were obtained from each participant after a detailed explanation of the study being undertaken. Additionally, authors do not have conflicting or competing interests towards the publication of this study.

3. Results

This section presents the findings of the study. The frequencies are presented along with the Pearson chi-square test for antepartum factors, and Cochran-Mantel Hansel chi-square test results for the inferential statistics. The key informant responses conducted on 20 professionals within the hospital, are also triangulated with the quantitative findings. Of the 124 study participants, 123 provided complete information that was then used to provide the analysis.

Table 1 shows a descriptive analysis of the socio-demographic data.

Table 3: Frequencies and Percentage Distribution for Antepartum Factors

Variables	Value labels	Outcome Status					
		Controls		Cases		Total	
		n	*%*	*n*	*%*	*n*	*%*
Age (in years)	<30	64	70	24	77	88	72
	30+	28	30	7	23	35	28
Marital Status	Never	20	22	8	26	28	23
	Married	72	78	23	74	95	77
Employment Status	Un employed	57	62	17	54	74	60
	Formal/Self employed	35	38	14	46	49	40
Education Level	Primary or below	27	29	13	42	40	33
	Secondary and above	65	71	18	58	83	54
Mother Smokes	Yes	0	0	0	0	0	0
	No	92	100	31	100	123	100
Mother takes alcohol	Yes	1	1	0	0	1	1
	No	91	99	31	100	122	99
Number of ANC visits	<4 visits	31	34	14	45	45	37
	4+ visits	61	66	17	55	78	63
	Total	92	100	31	100	123	100

** Ever Married includes those divorced/separated; n-refers to the frequencies; ANC – Antenatal Care*

Overall, most of the mothers (72%) were aged below 30 years (72%) while the ones who were married comprised 77% of the total study participants. The mothers who were unemployed were 60%, while those who had secondary school level of education or beyond, and who attended ANC for less than four times comprised about 63% of the total study participants. None (0%) of the participants smoked with about 99% of the study participants not taking alcohol. Considering these categories (age below 30 years, being married, being unemployed, secondary education and above, and attending ANC for less than 4 visits) as exposures, 70% of the controls were exposed before 30 years of age compared to 77% of cases. The proportion exposed for marital status was almost close to the control (78%) and case (74%) groups. For the employment status, the proportion of the unemployed mothers among controls (62%) was higher than among the cases (54%). There were also more controls (71%) exposed to secondary school education or higher compared to cases (58%). Pertaining to ANC visits, 34% of the controls were exposed compared to 45% of the cases, implying a likely correlation between birth asphyxia and number of ANC visits. From the key informant guide, all the responses were affirmative on the role played by ANC visits on perinatal asphyxia.

Table 2 presents the findings, both descriptive, as well as the Pearson chi-square statistics for antepartum factors.

Table 4: Relationship between Antepartum Factors and Perinatal Asphyxia

Variable	Value label	Controls	Cases	Total	$\chi 2$ (d.f)	p
Gestation at first clinic	< 16 weeks	13	0	13	11.034 (4)	.026
	16-27 weeks	29	10	39		
	28-32 weeks	29	16	45		
	Above 32 weeks	21	4	25		
	Not indicated	0	1	1		
Parity	Para 1	39	11	50	2.849 (3)	.416

	Para 2	24	13	37		
	Para 3	16	4	20		
	More than Para 3	13	3	16		
Gravida	Gravida 1	39	8	47	7.233 (3)	.065
	Gravida 2	24	16	40		
	Gravida 3	16	3	19		
	More than Gravida 3	13	4	17		
Birth Interval	1 year	3	6	9	10.239 (3)	.017
	2 years	9	2	11		
	More than 2 years	41	15	56		
	First Delivery	39	8	47		
Illness suffered during pregnancy	Hypertension	0	4	4	25.958 (8)	.001*
	Diabetes	1	1	2		
	Anaemia	1	3	4		
	Preeclampsia	1	0	1		
	APH	1	0	1		
	UTI	13	0	13		
	HIV	7	0	7		
	Other	7	1	8		
	None	61	22	83		
	Total	92	31	123		

** Fisher's exact test p-value; UTI – Urinary Tract Infection; HIV – Human Immunodeficiency Virus*

Gestational age at first ANC visit and birth interval had statistically significant differences among their various categories at a 95% confidence interval, although Gravida type was close to significant (p-values .026, .017, and .065 respectively). The illness suffered was also statistically significant, with a p-value of .001 obtained from Fisher's exact test. Also with regards to the illnesses, the KII respondents indicated that oligohydromnious and meconium aspirate syndrome, as well as chronic illnesses may have contributed to the development of perinatal asphyxia.

Table 3 shows the Cochran-Mantel Hansel statistics for the antepartum factors. Only the factors that had statistically significant chi-square statistics were evaluated to obtain the Mantel Hansel odds ratio.

Table 5: Mantel Hansel Results for Antepartum Factors

Cases/Control	Odds Ratio	p-value	[95% Conf.	Interval]
Parity	0.106	0.069	0.009	1.196
Gravida	0.685	0.115	0.627	74.847
Birth interval	0.525	0.034	0.290	0.952
Illness status	0.811	0.662	0.316	2.079
cons	44.148	0.042	1.152	1691.680

For every unit increase in parity, the log-likelihood of developing perinatal asphyxia dropped by 0.1 times, although not statistically significant (OR = 0.106p=.069). For every unit increase in birth interval, the log-likelihood of having a baby with perinatal asphyxia reduced by 0.5 times (OR = 0.525; p=.03). This observation on birth interval could be due to the fact that the longer the break between deliveries, the lesser the likelihood for complications as the reproductive systems would then have fully been restored.

4. Discussions

Age, marital status, employment status, and education level did not have statistically significant differences across its categories. These findings were inconsistent with what Aslam et al.'s report that decreasing or increasing maternal age affected the likelihood of developing perinatal asphyxia [9]. These findings were also not consistent with reports from Tabassum et al. and Seikku et al. [10, 11]. While Tabassum et al indicated that perinatal asphyxia was significantly associated with maternal literacy and the knowledge of mothers on health-related issues including attendance to antenatal care, Seikku et al. reported that the risk for low birth weight, and consequently of asphyxia is higher among those with single marital status (either unmarried or separated) [10, 11]. They also found out that mother's unemployment, mother's age below 20 years, and low literacy levels for mothers were other risk factors for perinatal asphyxia. In addition, these findings were not in line with Lawn et al. who suggested that low level of education was also associated with perinatal asphyxia [12]. However, these findings could act as support for Rani et al.'s argument that using maternal literacy levels to determine their predisposing conditions could be misleading since literacy is a cross-cutting indicator for socio-economic levels [13].

While maternal age was not statistically significant, the gestational age at first ANC visit yielded statistically significant correlations with perinatal asphyxia. These findings support the indication by Onyearugha & Ugboma that perinatal asphyxia was significantly influenced by antenatal attendance in primary healthcare facilities [14]. The findings also agree with Seikku et al. report which showed that gestational age affected other mother-related characteristics that led to neurologic morbidity including perinatal asphyxia. However, Chiabi et al., following a study in a Cameroonian urban health facility on birth asphyxia risk factors, suggested that what matters is the quality of the care accorded as opposed to the number of consultations [15].

Additionally, birth interval yielded statistically significant associations with perinatal asphyxia, such that as parity increased, the likelihood of developing perinatal asphyxia decreased. These findings were consistent with those of another study which reported that child spacing of at least 36 months apart minimized the risk of infant morbidity and mortality [16]. These findings were also contradicted the findings of another study by Seikku et al. which established that birth intervals longer than 5 years were associated with adverse perinatal outcomes forcing such patients to deliver through caesarean section [11]. The conditions suffered such as oligohydromnious, meconium aspirate syndrome, and chronic illnesses were found to be associated with perinatal asphyxia. These findings were consistent with Seikku et al.'s report that neurologic morbidity increased the likelihood of developing further conditions such as perinatal asphyxia [11].

Finally, the study found no correlation between birth asphyxia and number of ANC visits. This finding was inconsistent with reports by Onyearugha & Ugboma that lack of antenatal care, is an independent risk factor for neonatal encephalopathy, a complication of perinatal asphyxia [14].

5. Conclusions

The study results demonstrated that greater birth interval reduced the likelihood of developing perinatal asphyxia by 0.5 times (OR = 0.525; p=.03). Reducing the confidence interval to 90% would ensure more factors are significant such as gestational age and illnesses suffered during pregnancy.

Acknowledgement

The study would like to acknowledge Beatrice Kadenyeka Amadi, Sherry Oluchina, BScN, MScN, PhD, Drusilla Makworo, BScN, MScN, PhD, and Bernard Mbithi, BScN, MSc (PH), PhD. Beatrice was the principal investigator for the study, and was also involved in developing the manuscript write-up for publication. Sherry, Drusilla and Bernard were involved in supervising the study activities from its inception to completion.

REFERENCES

[1] Appareddy S, Pryor J, Bailey B. Inter-pregnancy interval and adverse outcomes: Evidence for an additional risk in health disparate populations. The Journal of Maternal-Fetal & Neonatal Medicine. 2017 Nov 2;30(21):2640-4.

[2] Pappas A, Korzeniewski SJ. Long-term cognitive outcomes of birth asphyxia and the contribution of identified perinatal asphyxia to cerebral palsy. Clinics in perinatology. 2016 Sep 1;43(3):559-72.

[3] Gichogo DM, Murila F, Matiang'i M, Ndege W, Bosire K. Prevalence of asphyxia and readiness for neonatal resuscitation in Kenya. African Journal of Midwifery and Women's Health. 2018 Jan 2;12(1):21-7.

[4] Health Information System Kenya. District health information System (DHIS 2): Event Capture Records. 2018. Retrieved on 28/07/18 from: hiskenya.org

[5] Yin RK. Case study research and applications: Design and methods. Sage publications; 2017 Sep 27.

[6] Global Genes. RARE List. 2018. Accessed on 20/08/18 from: https://globalgenes.org/rarelist/ [online].

[7] Linden A, Samuels SJ. Using balance statistics to determine the optimal number of controls in matching studies. Journal of evaluation in clinical practice. 2013 Oct;19(5):968-75.

[8] Dong T, Tang LL, Rosenberger WF. Optimal sampling ratios in comparative diagnostic trials. Journal of the Royal Statistical Society: Series C (Applied Statistics). 2014 Apr;63(3):499-514.

[9] Aslam HM, Saleem S, Afzal R, Iqbal U, Saleem SM, Shaikh MW, Shahid N. Risk factors of birth asphyxia. Italian journal of pediatrics. 2014 Dec;40(1):94.

[10] Tabassum F, Rizvi A, Ariff S, Soofi S, Bhutta ZA. Risk factors associated with birth asphyxia in rural district Matiari, Pakistan: a case control study. International Journal of Clinical Medicine. 2014 Dec 4;5(21):1430.

[11] Seikku L, Gissler M, Andersson S, et al. Asphyxia, Neurologic Morbidity, and Perinatal Mortality in Early-Term and Postterm Birth. Pediatrics. 2016;137(6). doi:10.1542/peds.2015-3334.

[12] Lawn JE, Blencowe H, Oza S, et al. Every Newborn: progress, priorities, and potential beyond survival. The Lancet. 2014; 384(9938):189-205. doi:10.1016/s0140-6736(14)60496-7.

[13] Rani S, Chawla D, Huria A, Jain S. Risk factors for perinatal mortality due to asphyxia among emergency obstetric referrals in a tertiary hospital. Indian Pediatrics. 2011;49(3):191-194. doi:10.1007/s13312-012-0058-9.

[14] Onyearugha CN, Ugboma HAA. Fetal outcome of antepartum and intrapartum eclampsia in Aba, southeastern Nigeria. Tropical Doctor. 2012;42(3):129-132. doi:10.1258/td.2012.110206.

[15] Chiabi A, Nguefack S, Evelyne MA, Nodem S, Mbuagbaw L, Mbonda E, Tchokoteu PF. Risk factors for birth asphyxia in an urban health facility in Cameroon. Iranian journal of child neurology. 2013; 7(3):46.

[16] Boskabadi H, Ashrafzadeh F, Doosti H, Zakerihamidi M. Assessment of Risk Factors and Prognosis in Asphyxiated Infants. Iranian Journal of Pediatrics. 2015;25(4). doi:10.5812/ijp.2006.