INFANT AND MATERNAL FACTORS AFFECTING NUTRIENT ADEQUACY FOR OPTIMAL GROWTH OF PRETERM INFANTS AT EMBU REFERRAL HOSPITAL, EMBU COUNTY, KENYA

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DECLARATION

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

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DEDICATION

To the almighty God, for giving me good health and a sound mind to pursue my dream

To my mother Wilkister: For believing in me and praying for me

To my wife Bernice Wanjiru Oyoo: For your love, prayers and moral support;

To my sons Eric and Edwin: May this inspire you to achieve greater heights in academics

To my brother Dr. Obonyo: For your love and encouragement which has propelled me to achieve my goal

Finally to the preterm infants and their mothers who participated in this study.

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ABBREVIATIONS AND ACRONYMS

AP : American Pediatrics

ANC : Antenatal Clinic

BPD : Bronchopulmonary Dysplasia

CS : Caesarean Section

EF : Enteral Feeding

EFA : Essential Fatty Acid

ELFRH : Embu Level Five Referral Hospital

EP : Extreme Preterm

FI : Feed Intolerance

ESPGHAN : European Society for Pediatric Gastroenterology, Hepatology And Nutrition

GERD : Gastroesophageal Reflux Disorder

GI : Gastrointestinal

GR : Gastric Residuals

HPS : Hydrolysed Proteins

KCRH : Kirinyaga County Referral Hospital

KDHS : Kenya Demographic Health Survey

KU : Kenyatta University

KUERC : Kenyatta University Ethics Review Commissioner

KNH : Kenyatta National Hospital

LBW : Low Birth Weight

LOHS : Length of Hospital stay

MCH : Maternal Child Health

MIYCN : Mother-Infant Young Child Nutrition

MDG	:	Millennium Development Goals
MIYCN	:	Mother-Infant Young Child Nutrition
MOH	:	Ministry of Health
MP	:	Moderate Preterm
NACOSTI	:	National Commission of Science and Technology Innovation
NBU	:	New Born Unit
NCAPD	:	National Coordinating Agency for Population and Development
NEC	:	Necrotizing Enterocolitis
NGT	:	Nasogastric Tube
PDA	:	Partent Ductus Arteriosus
PMA	:	Postmenstrual Age
RDS	:	Respiratory Distress Syndrome
SGA	:	Small for Gestational Age
SPSS	:	Statistical Package for Social Sciences
TPN	:	Total Parenteral Nutrition
UK	:	United Kingdom
UNICEF	:	United Nations Children's Fund
UNPD	:	United Nations Population Division
USA	:	United States of America
VP	:	Very Preterm
WHO	:	World Health Organization

OPERATIONAL DEFINITION OF TERMS

Fluid	Liquid administered intravenous, oral or tube (Breast milk, formula milk and parenteral feeds).
Feeding challenges	Problems experienced by the caretakers while feeding preterm infants.
Gestational age	Age of a pregnancy based on the actual beginning of the last monthly period.
Kangaroo care	Care of preterm infants including exclusive and frequent breastfeeding in addition to skin-to-skin contact.
Low Birth Weight baby	The birth weight of less than or equal to 2500grams regardless of gestational age at the time of birth.
Mother	A female who has given birth within the age bracket of 13 to 49 years.
Neonates	A newborn baby less than 28 days of life.
Premature infants	Infants born before completion of 37 weeks of gestation or fewer than 259 days of gestation since the first day that a woman experiences her menses.
Small for gestational age	A baby smaller in size than normal for gestational age or below the 10^{Th} percentile for gestational age.
Nutrient adequacy	The daily amount of nutrients required to aid optimal growth in preterm infants in terms of quantity and composition.

Nutrient intake	Total volume of feeds consumed by the preterm infant per day.
Optimal growth	Increase in terms of body weight by 15g/kg/day, length and head circumference by 1 cm per week by the preterm infant.
Preterm infant factors	These are factors that influence preterm nutrient requirements such as health condition, gestational age, and birth weight.

ABSTRACT

Feeding premature infants is a challenge to mothers whose babies are admitted to the newborn units. The emphasis in the management of preterm infants majorly concentrates on medication and fluid requirements but not on meeting the key nutrients for growth such as protein. The international guidelines on preterm infant feeding are not easily met by poor families in sub-Saharan Africa. Records from various hospitals in Kenya reveal preterm postnatal growth restrictions and poor outcomes in preterm infants both in hospitals and their subsequent life. In response to this revelation, several studies have been conducted to determine the possible causes of high growth retardation and death among preterm infants. However, the studies conducted in Kenya have not adequately addressed preterm feeding during their early life. The current study sought to fill this gap. The purpose of this study was to determine the nutrient adequate for optimal growth of preterm infants in the newborn unit at Embu Level Five Referral (ELFRH), Kenya. Moderating variables relating to maternal characteristics and preterm infant factors were also established for optimal growth of preterm infants during their stay in the hospital newborn unit at Embu Level Five Referral (ELFRH), Kenya. A longitudinal cohort study involving a sample size of 106 preterm infants admitted to the newborn unit (NBU) was used to execute the research at Embu Level Five Referral Hospital (ELFRH), Kenya. Moderating variables relating to maternal characteristics and preterm infant factors were also established for optimal growth of preterm infants during their stay in the hospital newborn unit. The infants' baseline anthropometric measures were taken on admission and thereafter on alternate days and weekly assessments of length and head circumference were conducted till discharge to monitor their progress. Purposive sampling was used to determine the study area and a comprehensive sampling technique was used to determine the sample size. A validated questionnaire was used to collect the demographic and social-economic status data and the feeding progress of the preterm infants. Anthropometric measurements were taken daily for the weight while head circumference and the length every week. The data was analysed using means, percentages for descriptive analysis, Pearson correlation analysis for bivariate and linear regression analysis aided by the Statistical Programme for Social Sciences version 23.0 to predict the relationship between the independent and dependent variables. Data was presented in frequency and percentages. A p-value of <0.05 was used as the criterion for statistical significance. The study found a statistically significant moderate degree of positive correlation of ($R= .649$; $P<.05$) between nutrient adequacy and infant optimal growth with 42.1% variance in infant optimal growth explained by nutrient adequacy. Maternal factors as a moderator had a statistical insignificant contribution ($R=.085$; $P>.05$) while preterm infant factors as a moderator had a statistical significant contribution ($R=.160$; $P< .05$) additionally both contributed 0.7% and 2.5% respectively in preterm infant growth. The study concluded that nutrient adequacy had a significant effect on infant optimal growth. Maternal factors had no moderating effect on infant optimal growth. Further, the study concluded that preterm infant factors had a moderating effect on infant optimal growth. The study recommended that there was a need for the provision of adequate nutrients to facilitate the infant optimal growth; there was minimal need for the management of the maternal factors since it has no moderating effect on the infant optimal growth while there was a need for the management of the preterm infant factors in particularly mode of feeding since it revealed a significant moderating effect on nutrient adequacy for infant optimal growth.

CHAPTER ONE: INTRODUCTION

1.1 Background information

Preterm birth is defined by WHO as all births before 37 completed weeks of gestation or fewer than 259 days since the first day of a woman's last menstrual period (C. P. Howson, Kinney, Mcdougall, & Lawn, 2013). Preterm birth can be further sub-divided into three categories based on gestational age: extremely preterm (EP) (<28 weeks), very preterm (VP) (28 - <32 weeks) and moderate preterm (MP) (32 - <37 completed weeks of gestation). MP birth can further be grouped into early and late moderate preterm (32-<34 completed weeks) and (34 - <37 completed weeks) respectively (Howson, Kinney & Lawn, 2013).

Globally, an estimated 15 million babies are born prematurely every year translating to more than one baby in every 10 babies delivered and accounts for more than 1.1 million deaths annually with much more occurring unaudited (Howson, Kinney & Lawn, 2013; Chawanpaiboon et al., 2019). Preterm births have been noted to be increasing in most of the countries over the last 20 years. In high-income countries, the survival rate of extremely preterm infants is above 90% because these countries have identified prematurity as a priority area. However, in Kenya like other middle and low-income countries, these babies have less than a 10% survival rate (Blencowe et al., 2013). According to the WHO global action report on preterm births, it has been reported that 78.9% of preterm births occur in Africa and Asia continent and unfortunately these continents contribute to more than 80% of the preterm mortality worldwide (Chawanpaiboon et al., 2019). Among the top 11 countries with a preterm birth rate of more than 15%, nine of them are actually in sub-Saharan Africa (Lawn et al., 2013). Currently, prematurity is the second leading cause of death in children under 5 years and is also identified as the most common

direct cause of death in neonates. For the babies who survive, many face a lifetime of significant disability (Howson, Kinney & Lawn, 2013). Being born preterm also increases a baby's risk of dying due to other causes, especially from neonatal infections with preterm birth estimated to be a risk factor in at least 50% of all neonatal deaths (Blencowe et al., 2013).

It is estimated that in Kenya, 193,000 babies are born preterm each year and 13,300 children under the age of five die due to direct preterm birth related complications (Blecowe et al., 2013). Preterm infants' nutrient requirements are high and nutrient in-adequacy has been identified as one of the major challenges in preterm infants' care which eventually leads to growth restriction and poor outcomes in preterm infants in their early and future life. With the rise in the number of preterm births, there has been a commensurate increase in their admission in the newborn units where they are taken care of before they achieve the discharge weight which will enable them to survive like any other baby born normally. However, inconsistencies have been noted in their nutrition and the duration taken before achieving discharge weights from various newborn units causing an alarm among members of the Ministry of Health concerning preterm neonatal nutrition and medical management.

1.2 Statement of the Problem

Preterm infants are highly susceptible to extra-uterine growth restrictions. This requires a delicate balance between medication, fluid and nutritional management. Yet, emphasis in the management of preterm infants in most NBUs majorly concentrate on medication and fluid requirements but not on meeting key nutrients of protein, fat and carbohydrates for growth (Price & Groh-Wargo, 2013).In developed economies, preterm infants management has evolved from concentrating

on medication and meeting fluid requirements only to laying focus on the nutrients requirements unlike in the middle and low-income countries. Studies indicate that the international guidelines on preterm infant feeding remain a challenge to most public hospitals and for most poor families in sub-Saharan Africa. (Abiramalatha, Thomas, Gudpa, Viswanathan & McGuire, 2017). It is estimated that in Kenya, 193,000 babies are born preterm each year and 13,300 children under five years die due to direct preterm complications (Blecowe et al., 2013). Records from various hospitals in Kenya reveal growth restrictions and poor outcomes in preterm infants both at care units and in their subsequent life. However, studies conducted in Kenya unlike in developed countries to determine the possible causes of high growth retardation and death among preterm infants, have not adequately addressed preterm feeding during their early care particularly those born below 37 weeks of gestation. Consequently, from an empirical standpoint preterm infant feeding in terms of macronutrients, remains unclear. This study was motivated by the need to fill this gap by establishing nutritional considerations in the feeding of preterm infants. The current study, therefore, sought to determine infant and maternal factors affecting nutrient adequacy for optimal growth of preterm infants in the newborn unit at Embu Level Five Referral Hospital (ELFRH) Embu County, Kenya.

1.3 Purpose of the study

The main purpose of this study was to establish infant and maternal factors affecting nutrient adequacy for optimal growth of preterm infant in Newborn Unit at Embu Level Five Referral Hospital (ELFRH) Embu County, Kenya.

1.4 Objectives of the study

1. To determine nutrient adequacy in the feeding of preterm infants for optimal growth at ELFRH, Kenya.

2. To determine the optimal growth of preterm infants at ELFRH, Kenya
3. To determine the relationship between nutrient adequacy and optimal growth of preterm infants at ELFRH, Kenya
4. To establish the moderating effect of maternal factors (maternal age, mode of delivery, income) on the relationship between nutrient adequacy and optimal growth of preterm infants at ELFRH, Kenya.
5. To establish the moderating effect of preterm infant factors (gestational age, mode of feeding, medical condition) on the relationship between nutrient adequacy and optimal growth of preterm infants at ELFRH, Kenya.

1.5 Hypotheses of the study

H_{01}-There is no significant relationship between nutrient adequacy in the feeding of preterm infants and optimal growth at ELFRH, Kenya.

H_{02}- There is no significant relationship between maternal factors, nutrient adequacy and optimal growth of preterm infants at ELFRH, Kenya.

H_{03} – There is no significant relationship between Preterm infant factors, nutrient adequacy and optimal growth of preterm infants at ELFRH, Kenya.

1.6 Significance of the study

Preterm infants are at high nutritional risk because of poor nutrient stores at birth, digestive and neurodevelopmental immaturity, and increased risk of medical and surgical complications. The study findings are expected to bridge the gap in preterm infant nutrition for optimal growth. The study findings will also help policymakers in their decision to standardize preterm care practices in Kenya.

1.7 Delimitation of the study

The research was limited to preterm infants who are born without any congenital malformation admitted at Embu Level Five newborn unit on day one of life. The scope of the study was limited to nutrient adequacy with main consideration on macronutrients-protein, fat and carbohydrates in the feeding of preterm infants.

1.8 Limitation of the study

The achievement of study objectives faced the challenge of some sampled preterm infants dying during the study as well as some caretakers not consenting for their infants to be recruited in the study. Parenteral and human milk fortifiers were not available affecting total nutrient intake

1.9 Assumption of the study

The success of this study could only be realized on the assumption that severe neonatal infections which directly affect the feeding of the preterm infant were not to be encountered during the entire period of the preterm infant in the NBU. The variables were therefore controlled for this study.

1.10 Conceptual framework

Optimal preterm growth depends on several nutritional considerations including nutrient quantity and quality. This relationship was conceived as being moderated by both maternal and preterm infant factors.

Nutrient adequacy is the total nutrient intake that meets all the nutrient requirements for preterm infants to aid growth. The recommended nutrient intake in terms of energy, protein, fats and fluids are 110kcal/kg/d-130kcal/kg/d, 3-4.5g/kg/d, 4.8-6.6g/kg/d and 135-200 ml/kg/d (Agostoni et al., 2010). Maternal factors associated with challenges such as breast problems, lack of sufficient milk, fatigue, the mode

of delivery, maternal age and maternal income; may influence on mothers' early breastfeeding practices. On the other hand, preterm infant factors such as gestational age, mode of feeding and medical condition could have some effects on the nutrient adequacy

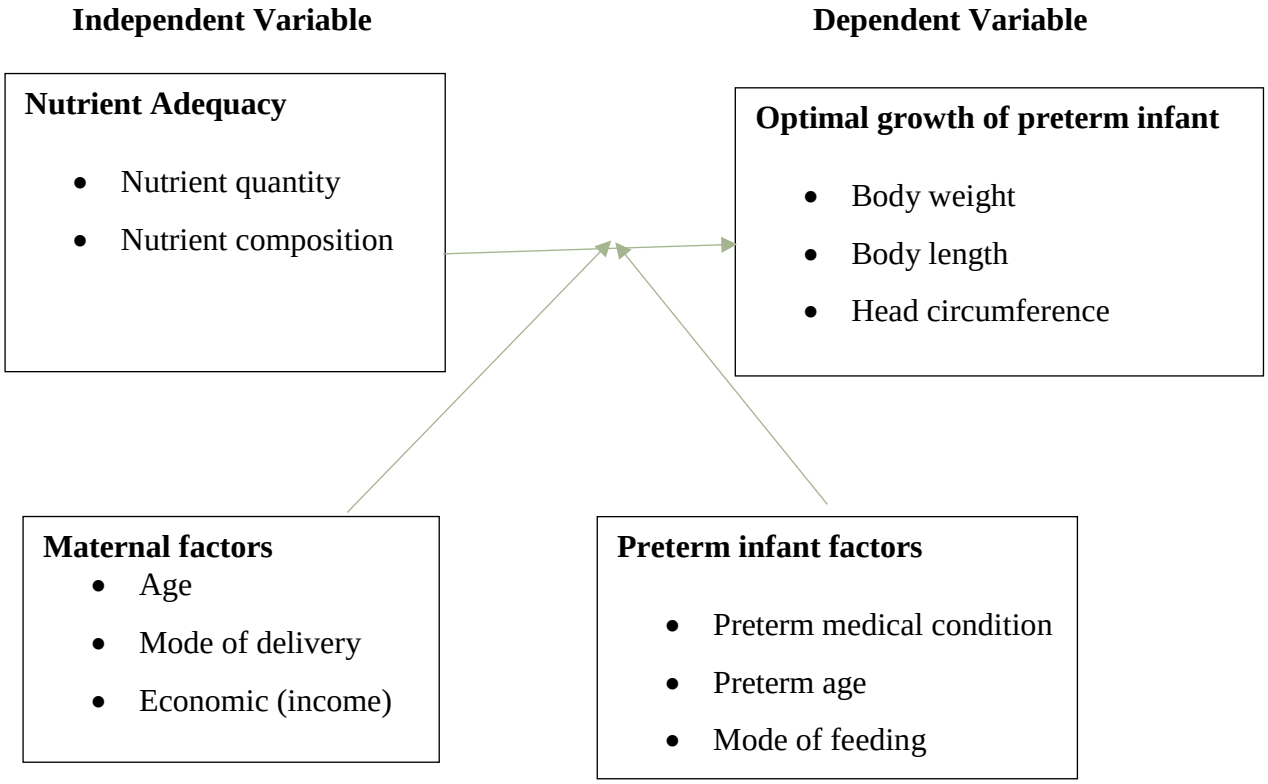

Figure 1. 1: Relationship between nutrient adequacies in the feeding of preterm Infants and optimal growth

Source: Agostoni et al., 2010; Abiramatha et al., 2017; Ho et al., 2016; Kumar et al., 2017; Tonkin et al., 2018).

CHAPTER TWO: LITERATURE REVIEW

2.1 The causes of preterm births

According to WHO preterm births are all births that occur before 37 completed weeks of gestation or fewer than 259 days since the first day of a woman's last menstrual period (Howson, Kinney & Lawn, 2013). These births can further be grouped based on gestational age: EP (less than 28 completed weeks), VP (28 to 32 completed weeks) and MP (32 but less than 37 completed weeks of gestation). MP births can further be grouped into early and late preterm birth (32-<34 completed weeks) and (34 - <37 completed weeks) (Howson, Kinney & Lawn, 2013). Preterm infants can also be sub-divided based on birth weight as follows: low birth weight (LBW) all preterm infants born with less than 2500g, very low birth weight (VLBW) those born with less than 1500g and extremely low birth weight, less than 1000g (Raiten, Steiber, & Hand, 2016).

Globally, out of the 15 million preterm births, it is estimated that 1.1 million preterm infants' deaths occur annually with more unrecorded (Chawanpaiboon et al., 2019). In Kenya, 193,000 preterm infants representing 12.3% of the total birth are born annually (Howson, Kinney & Lawn, 2013). Unfortunately, the recent available data in East Africa shows that preterm infants or small for gestational age births together with complications associated with preterm births contribute to about 52% of neonatal deaths annually (Kariuki et al., 2012).

2.1.1 Maternal factors

Maternal factors such as medical conditions can either lead to spontaneous delivery or medical delivery (caesarean section) (Cs) of preterm infants. These medical conditions include; preeclampsia, placenta abruption, oligohydramnios, Rhesus haemolytic disease, diabetes, chronic blood pressure, asthma, cardiac disease and

renal disease. advanced maternal age, multiple gestations, obesity, smoking and previous preterm delivery are also associated with preterm delivery (Howson et al., 2012;(Blencowe et al., 2013). Fetal complications such as intrauterine growth retardation, congenital malformation and premature rupture of the membrane can also lead to preterm birth (Leal et al., 2016)

2.1.2 Good pregnancy care practice

All pregnant women should receive good care, including at least eight antenatal visits with a healthcare worker (C. P. Howson et al., 2013). During these visits, pregnant mothers with a higher risk of preterm birth (e.g. those with a previous history of preterm birth delivery) should be informed that it may recur again so that they can plan accordingly (Leal et al., 2016). Women who experience preterm labour should give birth in a health facility where both the mother and her baby can get the proper care. At this time they may be referred to a hospital with the more advanced care and the best and safest time to do this is when the baby is still in the womb.

2.2 Nutrient Adequacy for optimal growth of preterm infants

2.2.1 Nutrient Quantity

Growth assessment is the most appropriate measure of optimal nutritional adequacy in preterm infants. The fetus fat and lean body tissue are gradually accrued as gestational age progresses, however postnatal development and observed accretion of fat and lean body tissue differ depending on the quantities and the volume of feeds consumed (Bhatia et al., 2013). Nutrient adequacy in terms of quantity is directly related to the rate of growth in preterm infants and this has led to more effort being put on preterm infant nutrition to avoid extra-uterine growth restriction (De Curtis et al., 2012). The fundamental principle underlying nutritional care for the preterm infant is that quantity should be adequate to ensure that poor nutrition is no hindrance

to the clinical outcome. Sufficient nutritional supply of EP infants is difficult to achieve because of concurrent morbidity, metabolic problems such as hyperglycaemia, feeding intolerance and extremely high nutrient requirements. These infants therefore often accumulate nutritional deficits during their stay in the neonatal intensive care unit. Insufficient nutrient intakes result in poor postnatal growth, which has been linked with poor neurodevelopmental outcomes.

To meet optimal nutrition requirements of preterm infants as well as the benefits of breastfeeding, breast milk should be consumed in large quantities to aid adequate growth and bone mineralization which is not possible with preterm infants.

2.2.2 Nutrient Requirement

The different nutrients needed by preterm infants are; fluid, protein, energy (mainly in the form of carbohydrates & fat) and micronutrients such as vitamins and minerals. Human milk has (66-68kcal/100ml energy), (1.38-1g/100ml) protein and (3.0-3.2g/100ml) fat and these values are well known to change with the advancing duration of lactation (Grote et al., 2016).

2.2.3 Fluid requirements

The standard fluid requirement for a preterm infant is 135ml-200ml/kg/day (Agostoni et al., 2010). According to the ministry of health guidelines released in 2016, the Kenyan Pediatric protocol recommends fluid intake on day one of life to be 80ml/kg/day increasing by 20ml daily for the first week of life to a maximum of 180ml/kg/day. Fluid is restricted in the early stages of life to reduce complications associated with fluid overloads such as partent ductus arteriosus (PDA) and respiratory complications (Patole, Kumaran, Travadi, Brooks, & Doherty, 2007).

2.2.4 Calorie requirement

Adequate caloric needs for preterm infants are currently estimated to be 110–135 kcal/kg/day (Agostoni et al., 2010) as compared to 96–120 kcal/kg/day for term babies. To meet this energy requirement, the preterm infant will have to consume large volumes of breastmilk ranging from 165ml -201ml/kg/day (Abiramalatha et al., 2017). However, the fluid recommendations by the Kenya (MOH) of 2018 protocol will only provide about 54kcal/kg/day on day one of life from breastmilk. According to (Rana, Kumar & Praveen 2018) study conducted in India revealed that the amount of expressed breast milk fed to a preterm infant is less in energy as compared to enteral feed needed per day by preterm infants.

2.2.5 Protein requirement

Adequate protein intake by very-low-birth-weight preterm infants (≤1,500 g at birth) is essential to optimize growth and development. The estimated needs for this population are the highest of all humans, however, the recommended intake has varied greatly over the past several years at the clinicians' discretion. (Ee, Sj, Fetal, & Med, 2011)

The protein requirement of a preterm infant is mainly needed for tissue growth and nitrogen accretion (Agostoni, 2010). For protein to play its role in tissue growth, enough caloric intake is required to spare the protein from being used as a source of energy. European society of Peadetrician Gastroenterology Hepatology and nutrition recommends protein requirements of 3.0g-4.5g/kg/day depending on the gestation age and weight. However, breastmilk given at the recommended volumes of 135-200ml/kg/day by the European Society for Pediatric Gastroenterology Haematology and Nutrition (ESPGHAN) and the 80ml-180ml/kg/day by the MOH will not meet these protein requirements. Intake above 200ml/kg/day may meet protein

requirements but increases also the cases of intolerance, gastroesophageal reflux, aspiration pneumonia, necrotizing enterocolitis, or complications associated with fluid overload (Abiramalatha et al., 2017).

2.2.6 Fat requirement

Fats are important for preterm infants to meet their nutritional components for both essential fatty acid (EFA) and increased energy needs (Ho & Yen, 2016). Breast milk provides approximately 50% of non-protein energy from fat which is adequate for optimal growth and to spare protein for tissue synthesis. Preterm infants at birth are deficient fat stores because they missed the final trimester of pregnancy thus they require increased fat intake compared to their counterpart full-term infants to achieve optimal growth and development (Ho & Yen, 2016). Fat provides nearly half of the total calories in human milk and contributes to both growth and brain development in both preterm infants and term infants. However, this is not sufficient for preterm infants despite the many health benefits for the preterm infants that breast milk offers. Insufficient fat intake in preterm infants fed on human milk alone may adversely affect growth and development (Ea, Brown, & Je, 2018).

2.3 Optimal growth of preterm infants

Growth is one of the most important outcomes in determining the well-being of a preterm infant, and provision of optimal nutrition is a modifiable independent factor that could facilitate optimal growth of preterm infants as per the WHO guidelines (Fenton et al., 2013). According to the American Academy of Paediatrics' statement, the goal of preterm infants' nutrition is to provide nutrition that will match the intrauterine growth rate and body composition of the fetus at the same gestational age. For growth to be considered optimal, it must meet the minimum guidelines of 15g/kg/day set by WHO and other international studies. Factors such as clinical

conditions and resource limitations in hospitals may influence the adoption of effective feeding practices. Internationally, nutritional recommendations have been created and growth studies evaluated among preterm infants in the UK, USA and other high-income settings. However, there is a paucity of studies in this area among low-income, middle-income and upper-middle-income countries including Kenya, despite the growing availability of neonatal intensive care and NBU in most hospital setting (Mathew, Gupta, Santhanam, & Rebekah, 2018)

2.4 Preterm infant factors and nutrient adequacy

2.4.1 Infant gestational age

Preterm infant gestational age is the direct measure of the degree of maturity. Higher gestational age at birth is associated with infants receiving their first enteral feed earlier and finally reaching full enteral feeds earlier resulting in a shorter period of hospital stay. This is mainly because the coordinated suck swallow breath cycle matures with advancing gestational age (Kwok, Dorling, & Ojha, 2017). Some preterm infants by 28 weeks of gestational age, may have established a suck swallow breathe cycle reflex but have insufficient physiological endurance to maintain the cycle while feeding (Kumari & Jain, 2019); (Barlow, 2010). The smooth coordination of sucking, swallowing and breathing during breastfeeding helps the infant to feed well and effectively which is only achieved from 32 to 34 weeks gestation (Foster, Psalia & Patterson 2016).

(Jadcherla, Wang, Vijayapal, & Leuthner, 2010) analysed the feeding progression of the three categories of preterm infants and revealed that EP infants take a long time to achieve the full enteral and oral feeds as compared to the other two

categories. This was confirmed by a study by (Park, Knafl, Thoyre, & Brandon, 2015) where only EP and VP infants were studied.

2.4.2 Medical conditions

2.4.2.1 Neurological

Preterm infants especially EP infants are prone to suffer an early neurologic injury caused by intraventricular bleeding which can lead to the death of brain tissue. For the safety of oral feeding proper neurodevelopmental maturation is essential to coordinate sucking, swallowing and breathing cycle (Barlow, 2010; Abiramalatha, Thomas, Gupta, Viswanathan, & Mcguire, 2017).

2.4.2.2 Bronchopulmonary dysplasia (BPD)

Inflammations, and delayed development of the infant lung which is associated with preterm infants greatly affect the volume of feeds given to the infants. Most infants do recover from BPD but some may experience long-term breathing difficulties. Because of the destruction of alveoli, the infant will have to breathe much faster and harder thus affecting the volume of feeds. The amount of energy needed to support breathing increases with the breathing rate resulting in low energy left for growth (Guimarães, Rocha, Guedes, Silva, & Pissarra, 2014).

2.4.2.3 Patent ductus arterial

Patent ductus arteriosus (PDA) is one of the most common medical conditions experienced by preterm infants especially EP infants. PDA is identified as one of the greatest risks to several morbidities such as bronchopulmonary dysplasia (BPD), decreased perfusion of vital organs and even mortality in preterm infants. A fluid restriction has been used as conservative management to PDA however; this has

negatively affected the nutrient intake of preterm infants who may not meet their nutrient requirements due to the reduced fluid intake (Patole et al., 2007).

(Abdel-hady, Nasef, Shabaan, & Nour, 2013) reported that patent ductus arteriosus (PDA) especially PDA in the presence of sepsis, is a well document risk factor to preterm feed intolerance which negatively affects the feeding progression to full oral feeds.

2.4.2.4 Gastroesophageal Reflux Disorder

The passage of gastric content into the oesophagus is common to babies born preterm and is normally associated with increased enteral fluid intake, immature oesophageal motility, supine position and permanent tube feeding. This condition can lead to BPD, apnea and failure to thrive, however, frequent small feeds as first revealed in a study by (Corvaglia et al., 2013) showed a positive relationship between frequency of feeds and Gastroesophageal Reflux Disorder (GERD). This problem can be reduced by reducing the fluid intake but the nutrient intake will be affected due to the reduced fluid volume.

2.4.2.5 Necrotizing enterocolitis

Necrotizing enterocolitis is gastrointestinal inflammation common among preterm infants characterized by gastrointestinal dysfunction. Preterm formula milk is associated with increased incidences of NEC compared to breast milk. However, breast milk given at the standard volume will not offer enough nutrients needed for preterm optimal growth. Severe infections are more common among preterm infants because their immune systems are not yet fully developed contributing to a higher risk of infection and death (C. P. Howson et al., 2013). Feeding of the sick preterm infants will have to be cautious or put on hold at times until the preterm infant

stabilizes before resuming full feeds thus affecting the nutrient adequacy as well as optimal growth (Abbott et al., 2017).

2.4.3 Mode of feeding

Preterm infants need extra nutrients for optimal growth based on the preterm infants' weight and gestational age compared to term infants (Abiramalatha et al., 2017). The nutrient requirements by the preterm infant are higher than term infants because they have missed part or all of the third trimester of pregnancy when rapid nutrient accretion and growth occur.

Preterm infants' nutrient requirements differ according to the route of nutrient delivery used, especially proteins whose availability is reduced when delivered through parenteral nutrition thus affecting growth negatively (Mosca et al., 2017). However, enteral nutrition is the most preferred mode of feeding compared to total parenteral nutrition (TPN) because of the many complications associated with (TPN). Early and timely parenteral nutrition in preterm infants remains an important component of feeding and should be used when necessary to support enteral nutrition as indicated in table 2.1.

Table 2. 1: Typical preterm feeding progression

Preterm infant Gestational age (weeks)			
≤ 28 weeks	28-31 weeks	32-34 weeks	34-37 weeks
Pacifier sucking (Non-nutritive suck)			
• TPN for 1-2 weeks as enteral feeds advance via tube	• TPN for 1-2 weeks as enteral feeds advance via tube	• Gag reflex • Early rooting reflex • Minimal nutritive suck • Gradually start breast/cup feeding as per infant cues	• Gag reflex • Infant nipple all feeds • Coordinated suck, swallow and breathing • Intermediate /Mature rooting reflex

Source: (Mosca et al., 2017)

2.4.3.1 Enteral feeding

Enteral nutrition is the most preferred mode of feeding in babies born preterm who are yet to fully establish full oral feeding. Delayed initiation of enteral feeding (EF) is associated with gut atrophy and bacteria translocation which increases the rate of sepsis (Willemjn, Marijn, Chris and Johannes, 2011).

A study in the United Kingdom on MP infants 30-33 weeks of gestation by (Kwok et al., 2017) revealed a conservative approach in the feeding of EP infants despite other studies showing positive progress and tolerance of feeds among this category of infants. (Abiramalatha et al., 2017) confirmed that MP infants can tolerate high volumes of enteral feeds than the standard 200ml/kg/day limit. This study also showed a positive relationship between high volumes of EF and weight gain compared to the standard volume of EF. Breast milk is the first choice for earlier initiation of feeds since it is better tolerated and has a lower risk of necrotizing enterocolitis (NEC) as well as easily digested. However, this may not be possible

for medical reasons or the absence of breast milk leading to the introduction of preterm formula milk despite the association with increased cases of NEC.

2.4.3.2 Parenteral feeding

The European Society for Pediatric Gastroenterology Hepatology and Nutrition (ESPGHAN) committee of nutrition considers the goal for caring for preterm infants as obtaining a functional outcome similar to that of a term infant. To reduce the interruption of nutrients that occurs at birth, an aggressive nutritional intake has been proposed to correct this interruption. Parenteral nutrition (PN), which allows the delivery of an infant's nutrition requirements for growth and development to be met, is indicated in these infants. This mode of feeding is also indicated where feeding via the enteral route is impossible, inadequate EN or when EN is considered dangerous (Curtis, Dito, Lucchini, & Terrin, 2014). The use of parenteral nutrition (PN) has been on the rise for the last 20 years within the first day of life. Preterm infant given the right amount of protein through PN normally achieves the recommended anthropometry indices sooner in comparison to those who are not given (Ho & Yen, 2016). However long-term usage of (PN) is linked to risks such as sepsis, thrombosis, fluid overload, hypoglycaemia or hyperglycaemia, and cholestasis.

2.5 Maternal factors and nutrient adequacy

Parents of preterm infants are normally required to make complex decisions about the management of their infants. These decisions which are mainly informed by the advice from healthcare professionals should be an informative and shared process that includes the wishes of the parents with proper documentation of all the management decisions (Cummings & Fetus, 2015). These mothers also have difficulties in producing adequate quantities of breast milk for their infants during

the length of their hospital stay especially in the first few days post-delivery and the macronutrient content of breast milk change over time with carbohydrates and lipids concentration being high in the first few days and protein varying inversely with postnatal age (Mosca et al., 2017)

2.5.1 Mother's age

A study by (Kitano et al., 2016) revealed that both maternal age and parity were significantly associated with EBF initiation and the prim parous mothers aged 35 years or older were most strongly linked with not being able to initiate EBF at hospital discharge. These results may suggest that first-time mothers in late child-bearing age are at greater risk of not being able to initiate EBF (Kitano et al., 2016). However, young mothers are not against the health benefits of breastfeeding but they lack the experience and skills of breastfeeding and expressing breast milk. This affects the amount of milk available for the infant as well as milk let down. Family support is a source of influence to feeding practices by teenage mothers because the teenage mothers tend to take up similar feeding practices they have seen being practiced by their mothers or other close relatives.

2.5.2 Mode of delivery

Mothers who have delivered spontaneously tend to establish breast milk supply earlier than those who have delivered through caesarean section (CS) deliveries. CS is strongly linked to delayed breast milk production, poorer infant suck, and delayed initiation of breastfeeding which occur mostly after six hours post-surgery. Caesarean surgery comes with a lot of emotional and physical stress (Lau & Smith, 2011). A study in Pakistan by (Saeed & Fakhar, 2011) on the effects of mode of delivery on infant feeding practices reported that CS affects maternal initiation of

breastfeeding, postpartum prolactin and challenges in positioning the baby to aid breastfeeding.

2.5.3 Socio-economic status

Low socioeconomic status is one of the major barriers to sufficient milk production. Mothers of preterm infants need proper help and encouragement from the people around them to reduce the stress associated with preterm delivery. (Maastrup, Hansen, Kronborg, & Bojesen, 2014), a study conducted in Sweden, University of Lund revealed that mothers of preterm infants need the presence and support of their spouse and the people around them to reduce anxiety and stress associated with preterm delivery. In cases where breast milk or expressed breast milk is not enough, mothers of preterm infants will have to buy preterm formula milk which is a challenge to low socio-economic status mothers.

The inadequacies of nutrient content in breast milk make it difficult to provide adequate nutrients to the infants and in cases where there is little or no milk established, then preterm formula milk will have to be given. These milk fortifiers and preterm formulas are expensive and mothers from low socio-economic status may not afford to buy them for their infants. (Cavallo et al., 2015) in his study conducted in Italy revealed that the care for preterm infants who are VLBW requires a lot of resources, including huge hospital costs at birth and during early childhood, transport cost and even the time that is lost during admissions.

2.6 Summary of the literature review

Prematurity is a growing concern in both developed as well as developing countries mainly because of the rise in the number of preterm birth. However, developing countries are at a disadvantage because they lack proper data on preterm infant care

and also most of the studies on preterm infant care are conducted in the developed countries where preterm infants have been identified as a priority area. The literature reviewed lacked guidelines on adequate nutrition for optimal preterm growth and some studies combined both preterm infants and VLBW infants in the same study. Low birth weight infants are not necessarily preterm and can as well be term babies. Finally, the reviewed literature was not all in agreement on the time of feed initiation, mode of feeding for different gestational ages, amount of feeds to give and progression of feeds especially to EP and VP infants.

Despite the availability of international nutrition guidelines, infants born preterm remain vulnerable to inadequate nutrition. Challenges to optimal growth of preterm infants were found to be the nutritional recommendations, preterm infant related factors and maternal characteristics. This study addressed the literature gap by establishing the optimal preterm infant growth as well as the related nutritional considerations to aid optimal growth.

CHAPTER THREE: METHODOLOGY

3.1 Research design

A hospital-based longitudinal cohort study design was used to execute the study. The study design ensured that the results and findings presented were based on data collected from individual preterm infants admitted to NBU over an extended period of time (Caruana, Roman, Hernández-sánchez, & Solli, 2015). The study was generally observational, with quantitative data being collected on particular individuals preterm infants daily till discharge without any external influence being applied (Caruana et al., 2015). The recruitment of preterm infants started in October 2019 following the acquisition of all approvals with the subsequent follow-ups ending in January 2020.

3.2 Research Variables

Independent Variable: nutrient adequacy with the key emphasis on nutrient quantity and composition of the feeds.

Dependent Variable: optimal growth of preterm infant with the indicators being; body weight, body length and head circumference.

Moderating Variables: preterm infant factors (gestational age, mode of feeding, preterm medical condition) and maternal factors (maternal age, Mode of delivery, income).

3.3 Study area

The study was carried out at Embu Level Five Referral hospital newborn units, Kenya. The hospital was purposively sampled because the majority of the people in Embu and its environs seek healthcare services from the hospital. The county has four constituencies Runyenjes, Manyatta, Mbere north and Mbere south with

Manyatta where ELFRH is located being the most densely populated. This is as a result of the high influx of workers both skilled and unskilled in the former headquarter of Eastern province possibly making it a low to the middle socioeconomic area.

3.4 Target population

The study population comprised of all the preterm infants born at ELFRH or referred to the facilities from other hospitals on day one of life. According to the maternity services health facility register MOH 333, 20-30 preterm infants are delivered every month at ELFRH.

3.4.1 Exclusion criteria

All preterm live births born with hypoxic-ischemic encephalopathy, multiorgan failure, major congenital anomalies and those whose caretakers decline to give consent were excluded from the study.

3.4.2 Inclusion criteria

All preterm infants admitted to the NBU at ELFRH with the consent of their mothers or caretakers were recruited in the study.

3.5 Sampling technique

The purposive sampling technique was used in selecting the hospital since it is the largest referral hospital in the county with an advanced newborn unit. Participants were selected using a comprehensive sampling technique where all preterm infants who meet the inclusion criteria with the consent of their caretakers were included in the study.

3.6 Sample size

The desired sample size was determined by a comprehensive sampling method as shown in table 3.1 due to the small number of preterm infants' deliveries. Data from the health records at the ELFRH indicate an average of approximately 30 preterm infants per month. The expected population in the four months study period was 120 preterm infants. At a precision of 5%, the expected sample size using a comprehensive sampling in table 3.1 was approximately 96 preterm participants (Bartlett et al., 2001 & Israel, 2013).

A ten percent of the calculated sample size was added to cater for attrition i.e.

10% of 96 = 9.6

Thus, the total sample size was 106 preterm infants.

Table 3. 1: Sample size determination

Size of population	Sample size (n) for precision (e) of:		
	±5%	**±7%**	**±10%**
100	81	67	51
125	96*	78	56
150	110	86	61
175	122	94	64
200	134	101	67
225	144	112	70

*Represent adequate sample size for the population at 5% precision

Sources: (Business & Sdn, 2017), (Bartlett et al., 2001) & (Israel, 2012)

3.7 Research instruments

A standard modified Mother-Infant Young Child Nutrition (MIYCN) questionnaire was used in collecting quantitative data from all the participants (appendix G). The questionnaire was subdivided into different parts. Part A: Collected data on socio-demographic characteristics of mothers (marital status, maternal age, and education level) and mode of delivery. Part B and C: Sections elicited information on preterm infants' characteristics and medical conditions respectively.

3.8 Pre-testing of data collection tools

To ensure the accuracy of the research instruments, pre-testing and adjustments were made where necessary. The pre-testing was done at Kirinyaga County Referral Hospital newborn unit (KCRH), Kenya by taking 10% (11 preterm infants) of the determined sample size of the population and administering the questionnaire to them for two weeks. KCRH is the largest referral hospital in Kirinyaga County which is neighbouring Embu County and exhibits similar characteristics as the target population.

3.9 Validity and Reliability

3.9.1 Validity

A standard modified validated Mother-Infant Young Child Nutrition (MIYCN) questionnaire was used for the study (Division of nutrition 2013). The questionnaire was also evaluated by my supervisors at the Kenyatta University Department of Food, Nutrition and Dietetics to ensure that it is in line with the objectives of the study.

3.9.2 Reliability

Test-retest reliability of the research instruments was established during pretesting. Two pre-test sessions were conducted among 11 preterm infants at the KCRH newborn unit within a span of one month. Test-retest reliability was established by examining the consistency of responses and correlation coefficient. The questionnaires yielded a correlation coefficient of 0.80 (0.7-0.97; 95% CI), which was considered adequate since it was above 0.70 recommended by (Downing, 2004).

3.10 Recruitment and Training of Research Assistants

Before data collection, two research assistants were recruited and trained for five days on the study objectives, data collection tools and anthropometry measurement equipment. The research assistants recruited were degree holders in food nutrition and dietetics and were fluent in both English, Kiswahili and Kiembu languages. The recruited research assistants were doing their internship in various hospitals in Embu County. They underwent training involving discussions, demonstrations and practical exercises. They were also guided on how to administer the questionnaires and take the required measurements.

3.11 Data collection procedure

A formal self-introduction was done by the researcher, followed by the signing of the informed consent. Data was then collected using a pretested questionnaire, administered to the caretaker or the infant's mother in NBU to get the demographic and socio-economic data. Preterm infant dietary intakes were collected by asking the mother, the nurses and confirming from the Pediatric feeding chart by the research assistant daily for all admitted preterm infants in the NBU until the date of discharge. Nutrient intake in terms of IV fluids, breast milk and formula milk was measured by taking the total volume of nutrients taken within twenty-four hours

daily till discharge. Actual intake was subtracted from recommended, fluid, energy, fat and protein intakes to determine the daily nutrient deficits or excesses of the preterm infant. The individual average nutrient intake for the length of stay in the NBU was calculated by dividing the total nutrient intake by the number of days in the NBU. The final average for the population sample was calculated by calculating the total for all the individual averages for all the preterm infants then dividing by the population sample. The population sample average nutrient was compared to the recommended nutrient intake to determine the adequacy. The preterm infants' body weight, body length and head circumference were taken on admission by use of Seca type of weighing scale and length board while non-elastic measuring tape was used for the head circumference. Before taking the weight, the weighing scale was calibrated using a known standard weight to determine the accuracy. The weight was taken in the morning before the 9.00 am feeding with minimal medical equipment attached to the baby if possible and without pants. The length of the baby was taken with the baby lying supine with the heels, back of legs, behinds (buttocks), shoulders and the head touching the board while the head circumference was taken by taking round the non-elastic tape measure round the head from the occipital point to the frontal bone. The measurements were taken three times and the average was calculated to get the exact measurement that was entered in the questionnaire. This was repeated on alternate days for the weight and weekly for both the height and the head circumference for all the preterm infants until the date of discharge from the NBU. The preterm medical condition was collected from the preterm infant file.

3.12 Data analysis

Data was entered into Statistical Package for Social Sciences (SPSS) version 23.0 which was released in the year 2015 for analysis. The analysis of the means,

frequencies and standard deviation were used for descriptive analysis of demographic, socio-economic characteristics of the study participants, nutrient adequacy and preterm infant optimal growth as indicated in table 3.2. Pearson correlation and linear regression analysis models were used to analyse the relationship between the nutrient adequacy, preterm infant factors, maternal factors and optimal growth of preterm infants as indicated in table 3.2. A p-value of <0.05 was used as a criterion for statistical significance. Target energy of 110-135 kcal/kg/day, protein of 3-4.5 g/kg/day, fat of 4.8-6.6 g/kg/day and fluid of 135-200ml/kg/day were considered adequate (Agostoni et al,. 2010). A growth rate of 15g/kg/day-30g/kg/day was considered optimal growth of preterm infants according to WHO (Agostoni et al,. 2010).

Table 3. 2: Summary of objective, data collection and analysis

Objectives	Data collection tools/Data collected and by whom	Participants	Data analysis
1. To determine nutrient adequacy in the feeding of preterm infants for optimal growth at ELFRH, Kenya.	-Researcher administered Questionnaire -Volume of feeds consumed -Growth	Preterm infants	Frequencies Mean Percentages
2. To determine the optimal growth of preterm infants at ELFRH, Kenya	-Researcher administered Questionnaire -Weight -Height -Head circumference	Preterm infants	Frequencies Mean Percentages
3. To determine the relationship between nutrient adequacy and optimal growth of preterm infants at ELFRH, Kenya	-Researcher administered Questionnaire -Volume of feeds consumed -Growth	Preterm infants	Pearson Correlation Linear Regression
4. To establish the moderating effect of maternal factors (maternal age, mode of delivery, income) on the relationship between nutrient adequacy and optimal growth of preterm infants at ELFRH, Kenya.	-Researcher administered Questionnaire -Maternal factors that affect preterm feed adequacy -Volume of feeds consumed -Growth	Infants mother	Frequencies Percentages Pearson Correlation Linear Regression
5. To evaluate the moderating effect of preterm infant factors(gestational age, mode of feeding, medical condition) on the relationship between nutrient adequacy and optimal growth of preterm infants at ELFRH, Kenya	-Researcher administered Questionnaire -Maternal factors that affect preterm feed adequacy -Volume of feeds consumed -Growth	-Preterm infants	Frequencies Percentages Pearson Correlation Linear Regression

3.13 Ethical considerations

Clearance was sought from Kenyatta University School of Graduate (Appendix A) followed by ethical clearance by Kenyatta University Ethical Review Committee (KUERC) (Appendix B and C). In addition, permission was obtained from Embu County Health Management Team (Appendix D). A research permit was granted by the National Commission of Science and Technology Innovation (NACOSTI) (Appendix E) License No: NACOSTI/P/19/1463. The questionnaire was administered to the preterm infants upon obtaining consent from their parents or caretakers by signature or thumbprint. Participation was voluntary and any refusal to participate had no consequences in the management of their babies. There were neither direct benefits nor risks to the participants. The researcher ensured that all information obtained was kept strictly confidential and only used for the purpose of the study.

CHAPTER FOUR: FINDINGS OF THE STUDY

4.1 Introduction

This chapter presents the analysed data and the findings of the study. In particular, presented are questionnaire completion rate, demographics of the respondents, and infant and maternal factors affecting nutrient adequacy for optimal growth of preterm infants.

Infant factors, maternal factors, nutrient adequacy, and optimal growth of preterm infants were first analysed descriptively to bring out the characteristics of the variables under study. Thereafter, Pearson correlation and linear regression analyses were conducted to bring out how infant factors, maternal factors moderate the relationship between nutrient adequacy and optimal growth of preterm infants.

4.2 Questionnaire completion rate

In this section, the completion rate of the questionnaire was checked. The findings are shown in table 4.1.

Table 4.1 shows that 106 questionnaires were distributed. The fully filled questionnaires were 94.3% (100) and the partially filled were 5.7 % (7). The number completed was above the threshold measurement of 50% (Mugenda & Mugenda, 2008) and was therefore large enough to be managed through regression analysis.

Table 4. 1: Questionnaire completion rate

	Number of questionnaires (%)
Fully completed	100 (94.3)
Partially completed	6 (5.7)
Total	**106**

4.3 Demographics of the respondents

In this section, results on the demographics of the respondents were sought, analysed and presented. In particular, results on the respondents' age, marital status of the respondents, educational level of the respondents and income were analysed and presented.

4.3.1 Demographic and Socio-economic status of the respondents

The study sought to establish the socio-economic status of the respondents. The distribution is summarized in table 4.2.

Table 4. 2: Demographic and Socio-economic status.

Variable	Category	Frequency (%)
Mother's age (yrs.)		
	15-21	25 (25)
	22-28	30(30)
	29-35	28(28)
	36-42	11(11)
	43-49	6(6)
Marital status		
	Divorce	2(2)
	Married	82(82)
	Single	16(16)
Education level		
	None	2(2)
	Primary	45(45)
	Secondary	34(34)
	College	12(12)
	University	7(7)
Family income (Ksh.)		
	<5000	37(37)
	5000-9000	45(45)
	10000-14000	5(5)
	15000-19000	11(11)
	>19000	2(2)

The table revealed that 25.0% (25) of the respondents had an average age of 18 years, 30.0% (30) had an average age of 25 years, 28.0%(28) had an average age of 32 years, 11.0%(11) had an average age of 39 years, and 6.0% (6) had an average age

of 46 years. In general, about 83.0% of the respondents had their ages below 36 years. This implied that most of the respondents were in their reproductive age. The majority of the mothers 82 %(82) were married with only 16.0% (16) and 2.0% (2) being single and divorced respectively. 2% (2) of the mothers had no basic education, 45.0% (45) of respondents had primary education, 34.0% (34) of the respondents had secondary education, and 12.0% (12) had college education while 7.0% (7) of the respondents had a university education. The findings revealed that the majority of the respondents were literate and were able to handle the research questions with minimal assistance from the researcher. 37.0% (37) of the respondents had an income less than Ksh.5000, 45.0 % (45) had an average income of Ksh. 7000, 5.0%(5) had an average income of Ksh.12000, 11.0%(11) had an average of Ksh 17000, and 2.0%(2) had an average income above Ksh. 19000. Approximately 82% (82) of the families had a monthly income of less than Ksh. 10,000, which perhaps had some effect on the development and growth of infants.

4.4 Maternal factors affecting nutrient adequacy

In this section, maternal factors were analysed and presented. In particular, analysed and presented are the mother's age, mode of delivery of the mother and economic (income) status of the family.

Table 4.3 revealed a mean maternal age of (28 ±9) with 25.0% (25) of the respondents having an average age of 18 years, 30.0% (30) had an average age of 25 years, 28.0%(28) had an average age of 32 years, 11.0%(11) had an average age of 39 years, and 6.0% (6) had an average age of 46 years. In general, about 83.0% of the respondents were below 36 years of age. This implied that the majority of the respondents were in their reproductive age. 79.0% (79) of the mothers had a spontaneous vaginal delivery (SVD), while 21.0% (21) of them had an emergency

caesarean section. The table also revealed a mean family income of Ksh (7800±5120) with 37.0% (37) of the respondents having income less than Ksh.5000, 45.0 % (45) had an average income of Ksh 7000, 5.0%(5) had an average income of Ksh12000, 11.0%(11) had an average of Ksh 17000, and 2.0%(2) had an average income above Ksh. 19000. Approximately 82% (82) of the families had a monthly income of less than Ksh. 10,000.

Table 4. 3: Maternal factors affecting nutrient adequacy

Variable	Category	Frequency (%)	M	SD
Mother's age (yrs.)				
	15-21	25(25)		
	22-28	30(30)		
	29-35	28(28)	28	9
	36-42	11(11)		
	43-49	6(6)		
Mode of delivery				
	Spontaneous vaginal delivery(SVD)	79(79)		
	Emergency Caesarean section	21 (21)		
Family income (Ksh.)	<5000	37(37)		
	5000-9000	45(45)		
	10000-14000	5(5)	7800	5120
	15000-19000	11(11)		
	>190000	2(2)		

4.5 Preterm infant factors affecting nutrient adequacy

In this section, preterm infant factors were analysed and presented. In particular, infant medical conditions, preterm age, and mode of feeding were analysed and presented in table 4.4 below.

Table 4. 4: Preterm infant factors

Variables	Category	Number of infants (%)	M	SD
Medical diagnosis				
	Neonatal jaundice	7 (7)		
	Birth asphyxia	13 (13)		
	Respiratory distress syndrome	80 (80)		
Preterm gestational age (weeks)				
	<28	2 (2)	33	0.95
	28-32	33 (33)		
	33-37	65 (65)		
Mode of feeding				
	IV & Nasogastric tube	47 (47)		
	IV & Cup & breastfeeding	49 (49)		
	IV & Exclusive Breastfeeding	4 (4)		

Table 4.4 shows that 80.0 % (80) of the infants had respiratory distress syndrome, 13.0% (13) of them had birth asphyxia and 7.0% (7) of the infant had neonatal jaundice. The mean gestational age of the infants was (33±0.95) years. Only 2.0 %(2) of the infants had a gestational age of less than 28 weeks, 33.0 % (33) of the infants had a gestational age of less than 32 weeks, while the majority of the infants had a gestational age of 65.0 %(65) of the infant had a gestational age of less than 37weeks. Almost half the infants 47.0% (47) were fed through intravenous fluids before being fed through a nasogastric tube, 49% (49) were fed through IV fluids

before transiting to cup & breastfeeding. All the preterm infants were stabilized with IV fluids before transiting to the appropriate feeding mode.

4.6 Nutrient adequacy affecting optimal growth

In this study, nutrient intake was measured by nutrient quantity consumed by the infants as indicated in table 4.5.

Table 4.5: Composition of feeds given to the preterm infant

Feed composition of feeds	**Number of infants (%)**
Breast milk	100(100)
Preterm formula	14(14)
Dextrose 10%	100(100)
Fortified dextrose 10%	100(100)
Totals	**100**

Table 4.5 shows that 100% of the infants were fed on breastmilk, 14% were fed on both breast milk and preterm formula, all the infants 100% used dextrose 10% on day one of life and all infants used fortified dextrose 10% on the second day of life.

Table 4. 6: Nutrient quantities given to preterm infants

Particulars	**Group 1**		**Group 2**	
	Day 1 nutrient intake	Cumulative nutrient intake (average intake)	Day 1 nutrient intake	Cumulative nutrient intake (average intake)
No. of infants	86		14	
Av. Bwt (g)	1867		1740	
Energy (kcal)	273.9(19.5)	9233.4(63)	397.9(16.3)	1890(77.58)
Protein (g)	0(0)	139(0.94)	0(0)	46.1(1.89)
Fats (g)	0(0)	501.6(2.82)	0(0)	87.2(3.57)
Fluid (mls)	7152(49)	15886 (108.1)	996(41)	2734(112.2)
Av. wt.	-8.6		2.6	
Av. length	0.38		0.45	
Av. H/c	0.3		0.4	

Abbreviations: Av. wt., average weight; **Av. Bwt**.' Average birth weight; **Mls**. Millilitre; **Wt**., weight. Cumulative nutrient intake and average intake in brackets, Group 1: Dextrose 10%, fortified dextrose, and breastmilk; Group 2: dextrose 10%, fortified dextrose, breastmilk, and preterm formula.

Recommended nutrient intake: fluid (135-200ml/kg/d), energy (110-135kcal/kg/d), and protein (3-4.5g/kg/d and fats (4.8-6.6g/kg/d) (Agostoni et al., 2010)

The findings in table 4.6 revealed average nutrient intake for group 1 on day one of life as follows fluid 49ml/kg/d; energy 19.5kcal/kg/d; protein and fats was 0g/kg/d respectively. The table further reveals the average nutrient intake at the end of the study for group 1 as follows fluid 108.1ml/kg/d; energy 63kcal/kg/d, protein and fats 0.94g/kg/d and 2.82g/kg/d respectively. Day 1 of life for group 2 table 4.6 revealed an average fluid intake of 41ml/kg/d, energy 16.3kca/kg/d and 0g/kg/d for both proteins and fats. At the end of the study period, table 4.6 reveals an average fluid intake of 112.2mls/kg/d, energy 77.58kcal/kg/d, protein 1.89g/kg/d and fat intake of 3.57g/kg/d. Table 4.6 also revealed an average birthweight in both groups 1 and 2 as 1867g and 1740g while average weight gain in both groups were -8.6g/d and

2.6g/d respectively. The table finally reveals that both the groups did not meet the recommended nutrient requirements.

4.7 Optimal growth of preterm infants

In this section, data were sought on the optimal growth of preterm infants. In particular, the indicators considered were body weight, body length and head circumference of the infants.

Table 4. 7: Average body weight gain based on gestational age

Gestational age (weeks)	Number of infants (%)	Av. Birth weight	Av. Discharge weight	Weight gain (g/kg/d)
< 28	2(2)	1160	1815	15.5
28-32	33 (33)	1581	1896	6.7
33-37	65 (65)	2107	2137	-19.7
Total	**100**			

Table 4.7 shows that 65% (65) of the moderate preterm infants had an average weight loss of -19.7g/kg/day, 33% (33) of the very preterm infants had an average weight gain of 6.7g/kg/day and only 2% (2) of the extremely preterm infants had an average weight gain of 15.5g/kg/day. The table further revealed 98% of inadequate weight gain and only 2% had adequate weight gain as per the WHO guidelines. The average birth weight for the extremely preterm infant was 1160g, 1581g for very preterm and 2107g for moderately preterm infants respectively. The average discharge weight was 1815g for extremely preterm infants, 1897g for very preterm infants and 2137g for moderately preterm infants respectively.

Table 4. 8: Growth characteristic of preterm infants

	Weight gain ranges (g) number of infants (%)			
Group 1				
No. of infants	**86**			
Birth weight (g)	**>(-14)**	**(-14-0)**	**< 15**	**>15**
<1000			1(1)	1(1)
1000- <1500	3(3.5)	2(2.3)	12(14)	7(8.1)
1500-<2000	5(5.8)	10(11.6)	17(19.8)	1(1.2)
2000-<2500	11(12.8)	1(1.2)	2(2.3)	0
>=2500	9(10.5)	3(3.5)	1(1.2)	0
Gestational age (wks.)				
<28			1(1.2)	1(1.2)
28-32	0	2(2.3)	17(19.9)	8(9.3)
33-37	15(17.4)	14(16.3)	22(25.6)	6(7)
Group 2				
No. of infants		**14**		
Birth weight (g)	**>(-14)**	**(-14-0)**	**< 15**	**>15**
<1000			0	0
1000- <1500	0	0	2(14.3)	1(7.1)
1500-<2000	1(7.1)	1(7.1)	4(28.6)	3(21.4)
2000-<2500	1(7.1)	0	0	0
>=2500	0	1(7.1)	0	0
Gestational age (wks.)				
<28	0	0	0	0
28-32	1(7.1)	0	1(7.1)	1(7.1)
33-37	2(14.3)	2(14.3)	4(28.6)	3(21.4)

≥(-14): Severe weight loss,; (-14-0): Moderate weight loss; <15: Moderate weight gain; >15: Normal weight gain

In group 1, table 4.8 revealed that the majority of preterm infants who gained more than 15g/d were very preterm infants 8(9.3%) which was also revealed in the very

low birth weight category 7(8.1%) while the majority of those with more than (-14g/d) weight loss were moderate preterm infants 15(17.4%) and low birth weight 11(12.8%). On the other hand, table 4.8 revealed the majority of preterm infants who gained more than 15g/d and those who lost more than (-14g/d) were moderate preterm infants 3(21.4%) and 2(14.3%) respectively in group 2.

Table 4.9: Preterm infants Length of Hospital stay (LOHS)

Length of stay (days)	Number of infants (%)	M	SD
< 10	40		
11-20	25		
21-30	17	15.9	3.4
31-40	13		
>40	5		
Total	**100**		

Table 4.9 revealed a mean length of hospital stay (15.9±3.4) days. 40 %(40) of infants stayed in the new-born unit for less than ten days and only 18 %(18) stayed for one month and above in the new-born unit.

4.8 Relationship between variables

In this section, an analysis of how infant and maternal factors affect the relationship between nutrient adequacy and optimal growth of preterm infants is conducted, presented and interpreted. In particular, analysed were: nutrient adequacy and optimal growth of preterm infants; moderating effect of maternal factors on the relationship between nutrient adequacy and optimal growth of infants, and the moderating effect of preterm infant factors on the relationship between nutrient adequacy and optimal growth.

4.8.1 Effect of Nutrient Adequacy on Optimal Growth of Preterm Infants

The effect of nutrient adequacy on optimal growth of preterm infants was analysed, presented and interpreted. Pearson Correlation was done to test the nature of the relationship between nutrient adequacy and preterm infant optimal growth. The results are shown in Table 4.10.

Table 4.10: Correlation between nutrient adequacy and infant optimal growth

		Nutrient adequacy	Optimal growth
nutrient adequacy	Pearson Correlation	1	.649**
	Sig. (2-tailed)		.0001
	N	100	100
optimal growth	Pearson Correlation	.649**	1
	Sig. (2-tailed)	.0001	
	N	100	100

**. Correlation is significant at the 0.0001 level (2-tailed).

Table 4.10 shows that there was a positive moderate relationship between nutrient adequacy and infant optimal growth($R=.649$; $p<0.05$).

Linear regression analysis was consequently sought to reveal the extent effect of nutrient adequacy on optimal growth. At a 5% significant level, the hypothesis that there is no statistically significant effect of nutrient adequacy on optimal growth of preterm infants was tested. The results are shown in Table 4.11.

Table 4.11: Regression analysis of nutrient adequacy and optimal growth

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**T**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	1.481	.198		7.492	.000
	Nutrient adequacy	.611	.072	.649	8.445	.000
	$R=.649$					
	$R^2=.421$					
	Adjusted $R^2=.415$					

a. Dependent Variable: infant optimal growth
b. Predictors: (Constant), Nutrient adequacy

Table 4.11 shows a statistically significant moderate degree of positive correlation (R= .649; P<.05) between nutrient adequacy and optimal growth. R-square of .421 measures part of optimal growth which was explained by the nutrient adequacy. It shows that approximately 42.1% of the variation in optimal growth was attributed to variation in nutrient adequacy. The adjusted R square provides an idea of how the model may be generalized. It should be as close to R square as much as possible if not the same. In this case, the difference for the final model is small; i.e.0.006 or 0.6%. This means if the model was derived from the population rather than a sample, then it would have accounted for approximately 0.6% less variance.

Table 4.11 shows that nutrient adequacy had a statistically significant effect on infant optimal growth (β=.649; P<.05). Additionally, it reveals that .611unit variance in infant optimal growth was attributed to a unit change in nutrient adequacy.

In conclusion, the regression model 4.1 has a statistically significant moderate degree of positive correlation (R= .649; P<.05) between nutrient adequacy and infant optimal growth. The model has about 42.1% variance in infant optimal growth explained by nutrient adequacy. Additionally, it reveals that .611 unit variance in infant optimal growth was attributed to a unit change in nutrient adequacy.

4.8.2 Effect of Maternal and preterm infant Factors on the Relationship between Nutrient Adequacy and Optimal Growth

In this section, the regression analysis was used to investigate the extent and effect of maternal and preterm infant factors on the relationship between nutrient adequacy and optimal growth was analysed and interpreted.

It was, therefore, worthwhile to investigate the extent maternal and preterm infant factors perhaps affect the relationship between nutrient adequacy and infant optimal

growth. At a 5% significant level, the hypothesis that maternal and preterm infant factors have no statistically significant effects on the relationship between nutrient adequacy and optimal growth of preterm infants were tested and the results are shown in table 4.12 and 4.13 below.

Table 4.11 showed that there was a statistically significant moderate positive correlation (R= .649, P<0.05) between nutrient adequacy and optimal growth. R-square of .421 measures part of optimal growth which was explained by the nutrient adequacy. It shows that approximately 42.1% of the variation in optimal growth was attributed to variation in nutrient adequacy.

On the other hand, Table 4.12 below shows that after the entry of maternal age, there was a statistically moderate positive correlation (R= .653, P<.05) and the total variance in infant optimal growth explained by the model as a whole 42.7%. The variable maternal age explained an additional 0.6% variance in optimal growth of infants. Nevertheless, on the addition of mode of delivery, there was a statistically moderate positive correlation (R= .649, P<.05) and the total variance in infant optimal growth explained by the model as a whole 42.1%. While on the addition of maternal income, there was a statistically moderate positive correlation (R= .658; P<0.05) and the total variance in infant optimal growth explained by the model as a whole 43.3%. The variable maternal income explained an additional 1.2% variance in the optimal growth of infants. In summary table 4.12 shows that, after the entry of maternal factors, there was a statistically moderate positive correlation (R= .654; P<.05), and the total variance in infant optimal growth explained by the model as a whole 42.8%. The variable maternal factors explained an additional 0.7% variance in optimal growth of infants.

The study finding in Table 4.11 shows that there was a statistically significant moderate positive correlation (R= .649; P<.05) between nutrient adequacy and optimal growth. R-square of .421 measures part of optimal growth which was explained by the nutrient adequacy. It shows that approximately 42.1% of the variation in optimal growth was attributed to variation in nutrient adequacy. Upon the entry of preterm infant age, in table 4.12, there was a statistically moderate positive correlation (R= .653; P<.05) and the total variance in infant optimal growth explained by the model as a whole 42.6%. The variable preterm infant age explained an additional 0.0 % variance in optimal growth of infants. Preterm infant age also revealed an insignificant negative correlation (R= -.072; P<.05) with nutrient adequacy. While the mode of feeding showed that there was a statistically moderate positive correlation (R= .691; P<.05) and the total variance in infant optimal growth explained by the model as a whole 46.7%. The variable mode of feeding explained an additional 4.6% variance in optimal growth of infants. With the entry of infant medical diagnosis, the table revealed a statistically moderate positive correlation (R= .650; P<.05) and the total variance in infant optimal growth explained by the model as a whole 42.3%. The variable infant medical diagnosis explained an additional 0.2% variance in optimal growth of infants. Finally, entry of preterm infant factors, table 4.12 still revealed a statistically significant moderate positive correlation (R= .668; P<.05). Nevertheless, there was an improvement and the total variance in infant optimal growth explained by the model as a whole was 44.6%. The variable preterm infant factors explained an additional 2.5% variance in optimal growth of infants

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Table 4.12: Relationship between nutrient adequacy, maternal, preterm infant factors and optimal growth

Variables	R	P-value	R^2
Nutrient adequacy and Maternal factors	.654*	.000	**.428**
Maternal factors	.085	.237	.007
Nutrient adequacy and maternal age	.653*	.000	.427
Maternal age	.077	.323	.006
Nutrient adequacy and mode of delivery	.649*	.000	.421
Mode of delivery	.002	.982	.000
Nutrient adequacy and maternal income	.658*	.000	.433
Maternal income	.110	.155	.012
Nutrient adequacy and preterm infant factors	.668*	.000	**.446**
Preterm infant factors	.160*	.039	.025
Nutrient adequacy and medical diagnosis	.644*	.000	.477
Medical diagnosis	.041	.603	.056
Nutrient adequacy and mode of feeding	.611*	.000	.426
Mode of feeding	.240*	.002	.005
Nutrient adequacy and gestational age	.653*	.000	.423
Gestational age	-.072	.354	.002

R: correlation coefficient; P-value: significance level; R^2: proportion of variance on dependent variable which is explained by the independent variable

*Correlation is significant at the 0.05 level (2-tailed)

Table 4.13 below shows that nutrient adequacy had a statistically significant contribution to infant optimal growth (β=.611; P <.05). On addition of maternal age as a moderating variable in table 4.13, nutrient adequacy was a statistically significant contributor to infant optimal growth (β=.603; P<.05) however, maternal age made a statistically insignificant contribution (β=.056; P >.05). With the addition of mode of delivery as a moderating variable on the other hand shows that nutrient adequacy was a statistically significant contributor to infant optimal growth (β=.611;

P<.05) with the mode of delivery making a statistically insignificant contribution (β=.001; P >.05). Finally, maternal income as a moderating variable in table 4.13 revealed that nutrient adequacy was a statistically significant contributor to infant optimal growth (β=.606; P<.05) while maternal income made a statistically insignificant contribution (β=.090; P >.05).

Table 4.13 further shows that nutrient adequacy had a statistically significant contribution to infant optimal growth (β=.611; P <.05). On addition of the preterm gestational age as a moderating variable in table 4.13, nutrient adequacy was a statistically significant contributor to infant optimal growth (β=.610; P<.05) while preterm gestational age made a statistically insignificant contribution (β=-.095; P >.05).

However, on the addition of infant medical diagnosis as a moderating variable, nutrient adequacy was a statistically significant contributor to infant optimal growth (β=.606; P<.05) with infant medical diagnosis making a statistically insignificant contribution (β=.058; P >.05). While the mode of feeding as a moderating variable made a statistical significant contribution to nutrient adequacy for optimal growth of preterm infants (β=.196; P<.05).

Table 4.13 finally showed that on addition of preterm infant factors as a moderating variable, nutrient adequacy was a statistically significant contributor to infant optimal growth (β=.622; P<.05) with preterm infant factors making a statistically significant contribution (β=.160; P <.05). Additionally, .289 units change in optimal growth of preterm infants was attributed to a unit change in preterm infant factors, while .586 unit change in optimal growth of preterm infants was attributed to a unit change in nutrient adequacy.

Table 4.13: Predictors of optimal preterm infant growth (Linear Multiple regression)

Predictor variable	Optimal preterm infant growth	
	β	P-value
Nutrient adequacy and Maternal factors	**.613**	**.000***
Maternal factors	.089	.273
Nutrient adequacy and maternal age	.603	.000*
Maternal age	.056	.323
Nutrient adequacy and mode of delivery	.611	.000*
Mode of delivery	.001	.982
Nutrient adequacy and maternal income	.615	.000*
Maternal income	.095	.155
Nutrient adequacy and Preterm infant factors	**.586**	**.000***
Preterm infant factors	.289	.039*
Nutrient adequacy and mode of feeding	.575	.000*
Mode of feeding	.196	.002*
Nutrient adequacy and gestational age	.610	.000*
Gestational age	.095	.352
Nutrient and medical diagnosis	.606	.000*
Medical diagnosis	.058	.603

β: Beta coefficient; P-value: significance level

*All the models R^2 were significant at ($P< 0.05$)

CHAPTER FIVE: DISCUSSION OF THE FINDINGS

5.1 Introduction

This chapter presents the discussion of the results from the study done at ELFRH Kenya comparing the findings of the study with the previously published data, by explaining and making reference to the limitations of the study. The findings of the study were discussed following the study objectives: nutrient adequacy in the feeding of preterm infants for optimal growth of preterm infants at ELFRH Kenya, optimal growth of preterm infants at ELFRH, Kenya and the relationship between nutrient adequacy and optimal growth of preterm infants at ELFRH, Kenya. Establishing the effect of maternal factors on the relationship between nutrient adequacy and optimal growth of preterm infants at ELFRH Kenya and evaluating the effect of preterm infant factors on the relationship between nutrient adequacy and optimal growth of preterm at ELFRH Kenya.

5.2 Nutrient adequacy for optimal growth of preterm infant

For optimal growth and body composition to be realized in infants born preterm, their nutritional management should be personalised to meet their individual needs according to the preterm infant's gestational age and birth weight. Currently, the adequacy of nutrient intakes among preterm infants is monitored by changes in weight, length of the body, and head circumference.

For adequate growth of 15g/kg/day recommended by WHO and other studies to be achieved, an infant needs adequate nutrients in terms of energy, protein as well as fluids. This present study found an average fluid volume intake of 108.1ml/kg/day in group 1 and 112.2mls/kg/d in group 2. This was not consistent with fluid recommendations of 135 -200 ml/kg/day (Agostoni et al., 2010). The findings, however, were within the Kenyan MOH 2018 recommendations of 80-

240ml/kg/day. This study, however, was in contrast with a study comparing the rate of growth between high-volume enteral feeds >200ml/kg/day and standard 200ml/kg/day (Thomas, Cherian, Santhanam, & Jana, 2012; Mathew et al., 2018). The failure by infants to meet the standard volume of 200mls/kg/day in this current study could have been due to infants related factors such as not tolerating the prescribed amount of feeds, maternal factors such as having insufficient breastmilk and hospital-related factors such as new-born unit staffs failing to get an intravenous line in case of IV fluids or not informing mothers properly on the amount of breastmilk to express.

The current study found an average energy intake of 63kcal/kg/day and 77.58kcal/kg/d respectively in both groups 1 and 2. This was neither consistent with both studies in Brazil which revealed an average energy intake of 114kcal/kg/day nor the recommendation of 110-135kcal/kg/day by ESPGHAN respectively (Holzbach, Moreira & Pereira, 2018; Agostoni et al., 2010).

Preterm infants require higher protein intakes than term infants to attain adequate growth rates and have relatively higher rates of protein turnover. Guidelines from the European Society of Paediatric Gastroenterology, Hepatology and Nutrition Committee (ESPGHAN) recommend enteral protein intakes of 4.0-4.5g/kg/d for infants of less than 1000g and 3.0-4.0g/kg/d for those weighing 1000 -1800g. Energy, fat and fluid recommendations are 110-135kcal/kg/day, 4.8-6.6g/kg/day and 135-200ml/kg/day respectively (Agostoni et al., 2010).

Protein intake as per the present study was 0.94g/kg/day in group 1 and 1.89g/kg/d in group 2 which were below the recommendations of 3.0-4.5g/kg/day. The fats intake were 2.82g/kg/day in group 1 and 3.57g/kg/d for group 2 which were not within the recommendations of 4.8-6.6g/kg/day by (ESPGHAN) guidelines. The

nutrient requirements were not met in this study as per the (ESPGHAN) guideline of 2010. The inadequate nutrient intake in this study could be due to the insufficient amount of nutrients in breastmilk, an insufficient supply of breastmilk and the absence of breastmilk fortifier. The current findings were in agreement with a study in Australia which revealed that in the first three weeks of preterm infants life born <1000g failed to meet protein requirements (Tonkin et al., 2018). The current study was further in agreement with a study by (Stoltz Sjostrom et al., 2013) which showed energy and protein intakes were positively and independently correlated with all growth outcomes, even when taking a multitude of other risk factors into account.

5.3 Optimal growth of preterm infants

In this study, the average weight gain was (-8.6g/kg/d) and 2.6g/kg/d in both groups 1 and 2 respectively. The body lengths were 0.38cm/w and 0.45cm/w in group 1 and 2 while the head circumference were 0.3cm/w in group 1 and 0.4cm/w in group 2. A study by (Were & Bwibo, 2006) in Kenya revealed a mean weight gain of 13.54g/kg/d which was in contrast with the current study however, body length of 0.34cm/week and 0.32cm/week for the head circumference were consistent with the present study. Another similar study conducted in London, UK revealed weight loss of -258g per day in some infants and weight gain of 29g per day which was not consistent with the findings of the current study (Cole et al., 2014). The current study did not agree with both studies on preterm infants on standard and high volume feeds which revealed 15.7g/kg/day for standard feed volume and 16.2g/kg/day for high feed volume respectively (Abiramalatha et al., 2017) and Romanian study on preterm infants between 25-33 weeks of gestational age which revealed a weight gain of 17.3 g per day among infants fed mothers' breastmilk (Manea, Boia, Iacob,

Dima, & Iacob, 2016). The severe weight loss in this study could be attributed to the large numbers of late moderate preterm infants who were discharged based on their birth weight before starting to gain weight (Table 4.7), contraction of the extracellular fluid resulting in postnatal weight loss reported to be between 7% and 20 % of birth weight in the first 1-2 weeks of life and provision of inadequate nutrition, in particular, the low levels of protein in breastmilk, lack of parenteral feeds and breastmilk fortifier. Inadequate growth in this study could also be as a result of metabolic intolerance, inappropriate parenteral nutrition protocols, fluid restriction and feeding intolerance representing the main barriers to the provision of appropriate nutrient intakes in infants born preterm.

The current study results are supported by other studies which found out that infants born between 33-36 weeks of gestational age are at risk of growth retardation compared to the ones born between 28-32 weeks of gestational age (Behrman & Butler 2007; Sammy, Chege & Oyieke, 2016). In Kenya, currently, the discharge criterion is based on the preterm infants attaining a body weight of 1800g among other factors.

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5.4 Relationship between nutrient adequacy and optimal growth of preterm infants

The current study findings showed a statistically significant moderate degree of positive correlation (R= .649; P<.05) between nutrient adequacy and optimal growth with the R-square of .421 (42.1%) measures part of optimal growth which was explained by the nutrient adequacy. This was in agreement with a study by (Miller et al., 2012) which revealed a relationship between high protein intake and growth in human milk-fed preterm infants. An Italian study also revealed that for preterm

infants' optimal growth and body composition to be realized, their nutritional management should be personalised to meet their individual needs according to preterm infants' gestational age, birth weight and their need for catch-up growth (Gianni et al., 2015). However, a study by (Mathew et al., 2018) revealed that a growth velocity of 10–15 g/kg/day can be achieved using unfortified expressed breast milk, though at higher feeding volumes of 200 ml/kg/day. Providing optimal nutritional care to preterm infants increases survival and enhances the quality of life. The implementation of a nutrient-enriched diet during hospital stay promotes growth and optimizes neurodevelopmental outcomes (Mosca et al., 2017).

5.5 Effect of Maternal Factors on the Relationship between Nutrient Adequacy and Optimal Growth

This study found out statistically moderate positive correlation (R= .654; P<.05) between maternal factors, nutrient adequacy and optimal preterm infant growth with the total variance in infant optimal growth explained by nutrient adequacy and all the maternal factors being 42.8%. The variable maternal factors explained an additional 0.07% variance in optimal growth of infants. This being the first study to look at the moderating effects of maternal factors on nutrient adequacy and optimal growth, there was no previous study to compare the findings with. However, the previous studies did not look at how the sub-variables in maternal factors modulate the preterm infants' nutrient intake.

5.5.1 Maternal age

This study revealed a mean maternal age of (28±9) years with the age bracket of 22-28 years being the most prevalent at 30% (30). In general, about 83.0% (83) of the respondents had their ages below 36 years. This implies that most of the respondents were in their reproductive age. This is consistent with studies conducted in Kenya

which found that (82%) of mothers were below 35 years of age with a mean maternal age of 24.5 years and (63.4%) were between the ages of 20-29 years (Sammy, Chege & Oyieke, 2016). Rwandan study revealed a mean maternal age of (28.03±6.089) which is similar to the current study (Bayingana, Muvunyi, & Africa, 2010). This age group has been reported to have better survival among preterm infants according to KDHS 2008/09. However, the current study revealed that maternal age as a moderating variable made a statistically insignificant contribution (β=.056; P >.05) to nutrient adequacy for optimal growth of preterm infants. (Griffiths, Tate, Dezateux, Study, & Health, 2005) confirmed in his study that mothers who are young at first motherhood despite the infant gestational age at birth were less likely to initiate any breastfeeding to their babies.

This study finding did not report any relationship between the age of the mothers and the care of their babies which was inconsistent with the study which revealed that young mothers have poor knowledge of new-born care compared to their older counterparts (Lucia, 2011). The present study never reported any findings on macronutrient and micronutrient content of breastmilk or association of maternal age and macronutrients content of breastmilk unlike the study by (Hascoet et al., 2019).

5.5.2 Mode of delivery

This study found that most mothers had a spontaneous vaginal delivery (SVD) of 79.0% while 21.0% of them had an emergency caesarean section. In contrast, Vaginal and caesarean section deliveries took place in 54% and 46% of the case and 50% for both SVD and C/S respectively in previous studies (Saeed & Fakhar, 2011) & (Maastrup et al., 2014). This contrast could be due to the socio-economic status differences of the two study areas. The present study revealed that C/S delivery mothers tend to take more than 24 hours before visiting their babies in the new-born

unit, they also take longer to establish breastmilk and also experience difficulties in attaching their babies to the breast due to the pain from the incision site. This could be because the C/S postnatal ward and new-born unit were far apart and most mothers only managed to walk one-day post-C/S surgery. In comparison, a study in Denmark revealed an association between mode of delivery, time breast expression is initiated and breastfeeding at discharge with those who initiate earlier having good outcomes (Maastrup et al., 2014).

Post-delivery mothers and new-borns have an emotional and physiological attachment to be together. Keeping mothers and new-borns together is a safe and healthy birth practice recommended by WHO. There is a bunch of evidence supporting immediate, uninterrupted skin-to-skin contact with the infant after vaginal birth and after caesarean surgery for all medically stable mothers and their new-borns irrespective of preferred feeding mode and routine separation during the early days of life after birth should be discouraged. Separation of mothers and their babies is known to affect the establishment of breastmilk as well as the initiation of breastfeeding (Crenshaw, 2019). However, that was not the case with the current study where the mothers of the preterm infants were only allowed skin-to-skin contact once the infants were stable and above 1500g by weight. Two separate studies found an association between C/S delivery and delayed breastfeeding initiation and significant differences between the breastfeeding rates of women delivering vaginally as compared to those delivered through caesarean section (Bentley et al., 2016; Saeed & Fakhar, 2011). One of the studies showed 58% of mothers with feeding problems had a caesarean delivery and 42% had a vaginal delivery. Finally, this current study found that mode of delivery as a moderator had

a statistically insignificant contribution (β=.001; P >.05) with nutrient adequacy for optimal growth of preterm infants.

5.5.3 Socio-economic status.

The findings of the current study found out that the majority of the mothers 45.0 % (45) had an average income of Ksh 7800 ($65) with a mean income of (7800±5120). This was similar to the unpublished study conducted in Rwanda which revealed that a large proportion of the mothers were casual workers 53 (42.4%) with the majority of them (47.2%) having a family income of under fifty thousand Rwandan francs (approximately 62.5$) per month (Alice, 2018). Taking care of a preterm infant in the new-born unit is very expensive and most mothers cannot afford it without support from the government. In Kenya no study has been conducted to find out the cost nor did this present study seek to find out the cost of preterm infant care in the new-born unit. A study in China by (Zhu, Wang, Chen, & Zhou, 2020) revealed that the economic burden of the initial hospitalization for extremely preterm infants was substantial, especially for extremely preterm infants and those who suffered from specific major complications. This was also confirmed by a study in the United States which reported that the average baby born 28 to 31 weeks gestational age costs $95,000 in medical care in the first year of life alone (Lawn et al., 2013). However, a study in Italy revealed a lower hospitalization cost of $ 23,000 (Cavallo et al., 2015). Low socioeconomic status families cannot afford the cost of hospitalization thus affecting the quality of care given to their preterm infants. The findings were also in agreement with the WHO 2012 report, where more than 90% of preterm infants born before 28 weeks of gestational age in poor countries died in their early neonatal period.

This study found that some mothers had insufficient breastmilk and could also not afford preterm formula resulting in inadequate nutrient intake. This was consistent with findings from studies in Nigeria, Pakistan and Ethiopia which demonstrated a close association between low socioeconomic status and increased incidence of asphyxia (Namusoke, Nannyonga, Ssebunya, & Nakibuuka, 2018; Wayessa, Belachew, & Joseph, 2017). On the contribution to the nutrient adequacy for optimal growth of preterm infants, maternal income as a moderating variable made a statistically insignificant contribution (β=.090; P >.05).

5.6 Effect of Preterm Infant Factors on the Relationship between Nutrient Adequacy and Optimal Growth

This study found a statistically significant moderate positive correlation (R= .668; P<.05) moderating effects of preterm infant factors, nutrient adequacy and preterm optimal growth. Nevertheless, there was an improvement and the total variance in infant optimal growth by 44.6% as a whole. The variable preterm infant factors explained an additional 2.5% variance in optimal growth of infants. This being the first study in Kenya to look at the moderating effects of preterm infant factors on nutrient adequacy for optimal growth of the preterm infant, there was no other study to compare the current findings with. However, the studies available compared only how sub-variable in preterm infant factors generally relate to preterm infant care.

5.6.1 Preterm gestational age

This study revealed that most of the preterm infants 65% (65) were moderate preterm with a mean gestational age of (33±0.95). This was consistent with two separate studies which revealed that a large proportion was moderate preterm at 64.9% and 80% respectively (Kirk et al., 2017; Lawn et al., 2013). WHO report has also documented that most premature births (84%) occur at 32 weeks of gestational and

above which was conforming to this study. However, this study revealed 4% for infants less than 28 weeks which was also consistent with a study that revealed 5% for premature infants less than 28 weeks of gestational age (Lawn et al., 2013). In this current study gestational age was found to be closely related to the mode of feeding, nutrient requirements and morbidities among preterm infants. This was consistent with studies done in India, Italy and in Texas USA which found a correlation between oral feeding skills and lower gestational age and the increased need for nutritional care during their stay in hospital respectively (Kumari & Jain, 2019; Smith, 2011 & Giannì et al., 2016). However, a study in Denmark showed an inverse relationship between preterm infants' gestational age and breastfeeding in preterm infants at discharge (Maastrup et al., 2014). The current study finding was also in agreement with the study in Italy which revealed that the coordinated suckling skill that allows for the provision of adequate intake for growth by suckling feeds alone begins to mature at 34 weeks (Gianni et al., 2015). The present study finding was in agreement with the study done in Texas USA that found out the relationship between gestational age and morbidities such as RDS, birth asphyxia, jaundice and decreases as gestational age increases which have direct effects on the volume of feeds (Mclntire and Leveno, 2008).

The relationship between gestational age and breastfeeding in the current study could be due to the documented evidence that suckles, swallow coordination gets better with advancing of gestational age and only mature after 34 weeks of gestational age. The current study finally, revealed that preterm gestational age as a moderating variable made a statistically insignificant contribution (β=.095; P >.05) to nutrient adequacy for optimal growth of preterm infants. This was confirmed by (Chiang, Sharma, Nelson, Olson, & Perrine, 2019) which revealed the rates of

reception of breast milk by extremely preterm infants, very preterm infants, moderate preterm infants and term infants at 71.3%, 76%, 77.3% and 84.6% respectively

5.6.2 Mode of feeding

This study only looked at the intravenous fluid and enteral feeds which were either given through intravenous route, NGT or cup since there were no parenteral feeds at the facility. The IV fluids consisted of dextrose 10% which was given on day one of life then dextrose 10% fortified with sodium chloride and potassium chloride from day two of life. Breast milk was introduced from day two of life and in extremely few cases preterm formula was also used via NGT and cup when breastmilk was not available. The study further revealed that all the infants100% (100) were given IV fluids before transiting to the appropriate feeding mode based on their weight and tolerable levels with 49% (49) and 47% (47) transiting to cup & breastfeeding and NGT feeding respectively. In comparison a study in Nigeria revealed 94.1% getting IV fluids in their fast day of life (Ta & Ob, 2015). Contrary to other studies, the appropriate feeding mode for preterm infants in this present study was chosen based on the birth weight of the infants and medical status. Infants with < 1500g were fed through a nasogastric tube after 24 hours stabilization with IV fluids before advancing to cup and finally breastfeeding regardless of the gestational age. Unstable infants were also fed through NGT regardless of birth weight and gestational age. Only 4% (4) infants were breastfed directly once they were stable. This study revealed that the majority of the infants started enteral feeding within 24 hours post-delivery, infants either lost weight or failed to gain weight when switched from one mode of feeding method to the other, the majority of infants were not able to finish the prescribed feeds once cup feeding was introduce resulting to loss of

weight. The present study was consistent with a study conducted in Australia that reported that mothers of preterm infants did not like, or had challenges with cup feeding. Mothers' in this current study reported that cup feeding was taking long and infants tend to vomit compared to tube feeding (Collins et al., 2004).

The findings in this study also revealed that infants were discharged before fully exclusively feeding on the breast. The few who were exclusively breastfeeding either lost weight or failed to gain weight. This was in agreement with the study in Australia that found a moderate, negative association between the mean number of direct breastfeeds and change in the rate of weight gain after 34 weeks of PMA (Tonkin et al., 2018). Thus, the higher the number of direct breastfeeds per day, the slower the growth rate after 34 weeks post-delivery. The current study finally, revealed that mode of feeding as a moderating variable made a statistically significant contribution (β=.196; P <.05) to nutrient adequacy for optimal growth of preterm infants.

5.6.3 Preterm medical condition.

This study revealed the most common morbidity among preterm infants was respiratory distress syndrome 80.0 % (80) of the infants had respiratory distress syndrome. The findings were similar to a study by (Mccallie et al., 2011) which revealed 80% of preterm infants with RDS compared to a study conducted in Romania which showed respiratory distress syndrome among infants born less than 33 weeks of 64.7% (Manea et al., 2016). An Australian study revealed that a large percentage of infants born <1000 g had chronic lung disease (66%) (Tonkin et al., 2018).

The high numbers of infants with RDS in the current study could have been due to the inclusion of all RDS cases regardless of the severity. This study also revealed

that fluid is normally restricted when preterm infants experience RDS, constipation and abdominal distension thus affecting the nutrient intake in terms of volume of feeds. On the contrary, fluid was neither restricted nor increased when the preterm infant had jaundice. Adverse side effects of high fluid intake in preterm infants with bronchopulmonary dysplasia, patentductus artarusus, and necrotitis enterocolitis among other medical conditions have been documented (Bell and Accarregui, 2014). However, fluid restriction on the other hand had adverse effects on nutrient adequacy to the preterm infants since the volume of fluid consumed correlates with the nutrient intake. This study was consistent with two separate studies which showed that preterm infants with comorbidities especially respiratory morbidities and the degree of illness in the first week of life have feeding problems thus need early nutrition support (Dodrill, Donovan, Cleghorn, Mcmahon, & Davies, 2008 & Ehrenkanz et al., 2020). The Romanian Study further revealed slow weight gain among infants with major comorbidities (Manea et al., 2016). The current study finally, revealed that preterm infant medical condition as a moderating variable made a statistically insignificant contribution (β=.058; P >.05) to nutrient adequacy for optimal growth of preterm infants

CHAPTER SIX: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary of findings

This research was aimed at establishing the relationship between nutrient adequacy and optimal growth of preterm infants at ELFRH, optimal growth of preterm infants and the moderating effects of both maternal and preterm infants' factors on the relationship between nutrient adequacy and optimal growth of preterm infants at ELRH new-born unit. This chapter summarises the objectives, methodology, major findings, conclusion and recommendations for further research.

6.1.1 Nutrient adequacy in the feeding of preterm infants for optimal growth

The first objective of the study was to determine nutrient adequacy for optimal growth. The study found a mean energy intake of 63kcal/kg/day for group 1 and 77.5kcal/kg/d for group 2 respectively, mean protein intake of 0.94g/kg/day in group 1 and 1.89g/kg/d in group 2 and a mean fat intake of 2.82g/kg/day in group 1 and 3.57g/kg/day in group 2 while fluid intake had a mean of 108.1ml/kg/day in group 1 and 112.2mls/kg/day for group 2. Nutrient adequacy was not met in both groups.

6.1.2 Optimal growth of preterm infants

The second objective of the study was to determine the optimal growth of preterm infants. The study revealed an average weight gain of (-8.6g/kg/day) for group 1 and 2.6g/kg/d for group 2 respectively. On the other hand, a mean of 0.38cm/week for group 1 and 0.45cm/week for group 2 for body length while the head circumference was 0.3cm/week and 0.4cm/week in the two groups respectively.

6.1.3 Relationship between nutrient adequacy and optimal growth of preterm infants

The third objective of the study was to establish the relationship between nutrient adequacy and optimal growth of preterm infants at ELFRH Kenya. The null hypothesis was that ‘’there is no statistically significant effect of nutrient adequacy on preterm infants optimal growth” After preliminary investigations, it was revealed that nutrient adequacy had a statistically significant moderate degree of positive correlation ($R= .649$; $P<.05$) with preterm infant optimal growth. Additionally, the model revealed that .611 unit variance in infant optimal growth was attributed to a unit change in nutrient adequacy.

6.1.4 The effects of Maternal and preterm infant factors on the relationship between nutrient adequacy and optimal growth of preterm infants

The fourth objective of the study was to establish the effect of maternal factors on the relationship between nutrient adequacy and optimal growth of preterm infants at ELFRH Kenya. The null hypothesis that “maternal factors have no statistically significant effect on the relationship between nutrient adequacy and optimal growth of preterm infants” was tested and after preliminary investigations. The study revealed that there was a statistically insignificant contribution to infant optimal growth ($\beta=.085$; $P>.05$) with a 42.8% variance in infants' optimal growth attributed to nutrient adequacy and maternal factors. Maternal factors, therefore, explained an additional 0.07% variance in infant optimal growth.

The last objective was to evaluate the effect of preterm infant factors on the relationship between nutrient adequacy and optimal growth of preterm at ELFRH Kenya. The null hypothesis, “preterm infant factors have no statistically significant effect on the relationship between nutrient adequacy and optimal growth of preterm

infants" was tested in preliminary investigations. The study revealed that there was a statistically significant contribution to infant optimal growth ((β=.160; P <.05) with 44.6% variance in infants' optimal growth attributed to nutrient adequacy and preterm infant factors. Preterm infant factors, therefore, explained an additional 2.5% variance in infant optimal growth.

6.2 Conclusions

Nutrient adequacy had a statistically significant moderate positive correlation with infant optimal growth as indicated by weight, length and head circumference. Nutrient adequacy had a statistically significant effect on infant optimal growth.

Maternal factors and nutrient adequacy had a statistically significant moderate positive association with infant optimal growth. Maternal factors; mode of delivery, economic status and maternal age all had a statistically insignificant moderating influence on the relationship between nutrient adequacy and infant optimal growth.

Preterm infant factors and nutrient adequacy had a statistically significant moderate positive correlation with infant optimal growth. Preterm infant factors; gestational age, the medical condition had a statistically insignificant moderating influence on the relationship between nutrient adequacy and optimal growth. However, the mode of feeding had a statistically significant moderating influence on the relationship between nutrient adequacy and infant optimal growth.

6.3 Recommendations

6.3.1 Recommendations for policy

This study gives recommendations for policy, practice and further research to the Government of Kenya, nongovernmental organizations, health care facilities, maternal health and nutrition scholars. Given the conclusion, the study recommended the following:

This present study points out the need for the provision of adequate nutrients to facilitate the infant's optimal growth. The failure to meet nutrient requirements calls for public health concern through interventions to reduce the undernutrition among preterm infants in Kenya. Awareness programs about the consequences of undernutrition in preterm infants, including prevention of undernutrition could be made available in all health care facilities. This can be a combined initiative among all the stakeholders working to improve maternal and child health (MCH). The government through the Ministry of health should come up with a policy guide to ensure adequate nutrition for preterm infants. The government should also organize regular training for healthcare providers working in the new-born units to improve care to this vulnerable group. This will help the infants to meet their nutrient requirements particularly in the first weeks of life when most mothers may not express enough breastmilk to provide adequate nutrition for optimal growth.

The study also pointed out the need for the management of maternal factors, namely; age, mode of delivery and income as it moderates the relationship between nutrient adequacy and infant optimal growth. The healthcare providers should sensitize the mothers during their ANC visits on the pregnancy outcome and the economic consequences. The MOH should also set up a special package for preterm deliveries to cushion the families from the tough economic challenges that come with preterm delivery.

Finally, the study shows the need to improve the management of Preterm infant factors, namely; age, mode of feeding and medical conditions as it moderates the relationship between nutrient adequacy and infant optimal growth. The MOH should install in all public levels four, five and all the teaching and referral hospitals with adequate equipment and make available medicine required to manage preterm-

related medical conditions that have a great bearing on the nutrient delivery. The government through the ministry of health to provide specialized training for all health care providers working in this special ward so that they can offer prompt and optimal care. Finally, the government through the ministry of health could streamline the inconsistencies in the feeding of breastmilk by gestational age that exist among preterm infants in different hospitals. Hospitals to implement policies and practices to ensure that all mothers and their infants receive support for breastmilk feeding and that infants born preterm receive breastmilk as soon as it is medically viable to help reduce these differences in the feeding of preterm infants.

6.3.2 Recommendation for practices

This study points out the need to apply an age-appropriate mode of feeding to meet adequate nutrition for optimal growth of preterm infants. The Government through the ministry of health could focus more on areas such as ensuring that preterm infant nutrition requirements are met and proper preterm infant nutrition feeding practices are adhered to by health care providers working in the new-born unit. Finally, to address the challenges that mothers and caregivers of preterm infants could come across when feeding infants hospitalized for long periods, hospitals might also consider providing support such as helping mothers prepare for long-term breastmilk expressing and providing follow-up lactation education and advice throughout an infant's hospitalization.

6.3.3 Recommendation for Further research

The current study was limited by its small cohort size (n=100). Due to this limited number of infants, the results cannot be generalized and used for the design of clinical policy guidelines. Further studies should be done involving a larger number of infants so that the findings can be useful in the design and establishment of clinical

guidelines for the care of preterm infants. The present study did not look at the cost associated with preterm infants' hospital stay thus further studies should be done on the cost of hospital care for preterm infants. Finally, more studies on the maternal factors and preterm infant factors and how they affect preterm infants’ nutrition for more comparison with the current study.

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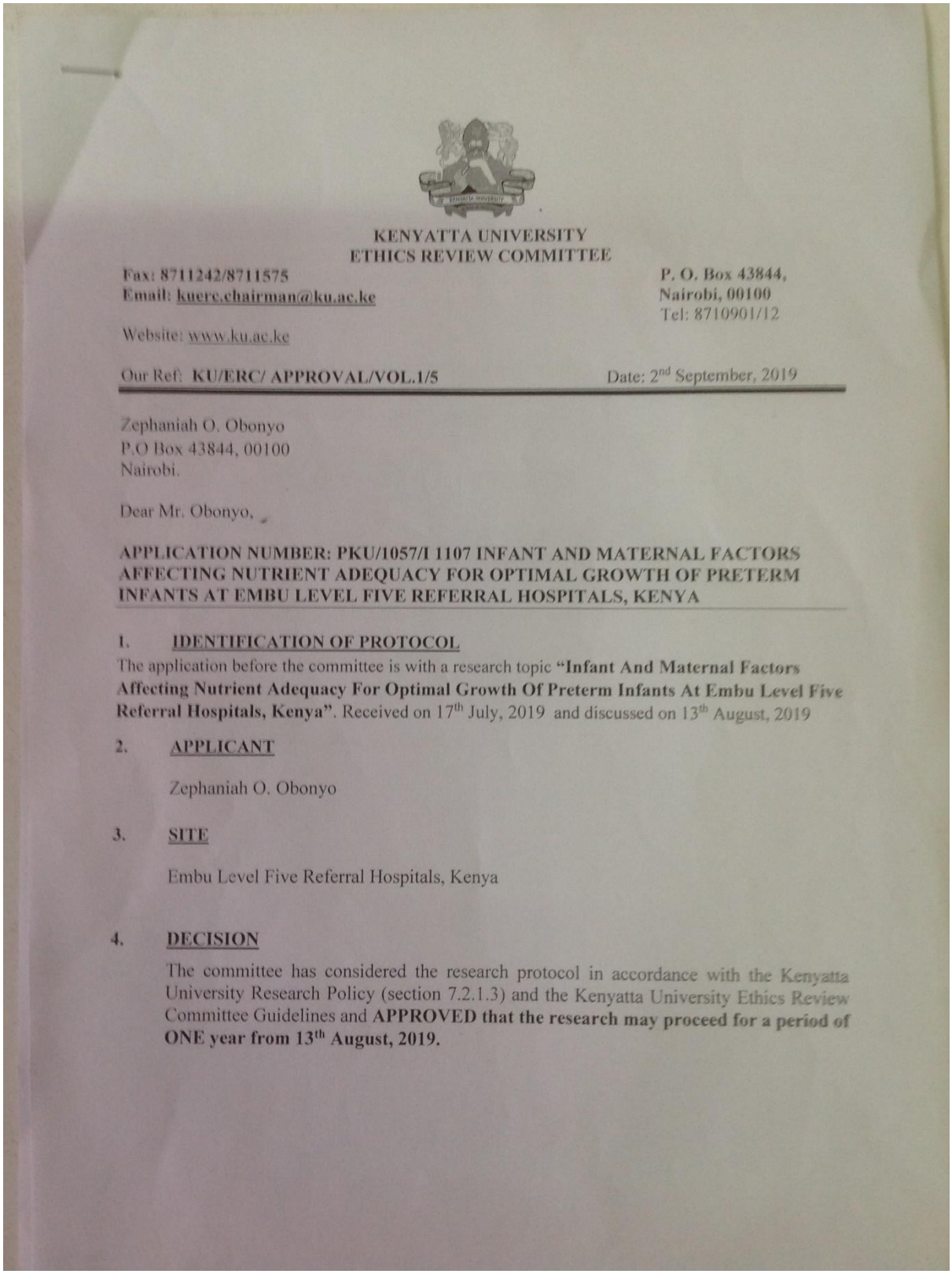
APPENDICES

Appendix A: KUERC Approval Letter



KENYATTA UNIVERSITY
ETHICS REVIEW COMMITTEE

Fax: 8711242/8711575
Email: kuerc.chairman@ku.ac.ke

P. O. Box 43844,
Nairobi, 00100
Tel: 8710901/12

Website: www.ku.ac.ke

Our Ref: KU/ERC/ APPROVAL/VOL.1/5 Date: 2nd September, 2019

Zephaniah O. Obonyo
P.O Box 43844, 00100
Nairobi.

Dear Mr. Obonyo,

APPLICATION NUMBER: PKU/1057/I 1107 INFANT AND MATERNAL FACTORS AFFECTING NUTRIENT ADEQUACY FOR OPTIMAL GROWTH OF PRETERM INFANTS AT EMBU LEVEL FIVE REFERRAL HOSPITALS, KENYA

1. **IDENTIFICATION OF PROTOCOL**

The application before the committee is with a research topic **"Infant And Maternal Factors Affecting Nutrient Adequacy For Optimal Growth Of Preterm Infants At Embu Level Five Referral Hospitals, Kenya"**. Received on 17th July, 2019 and discussed on 13th August, 2019

2. **APPLICANT**

Zephaniah O. Obonyo

3. **SITE**

Embu Level Five Referral Hospitals, Kenya

4. **DECISION**

The committee has considered the research protocol in accordance with the Kenyatta University Research Policy (section 7.2.1.3) and the Kenyatta University Ethics Review Committee Guidelines and **APPROVED that the research may proceed for a period of ONE year from 13th August, 2019.**

5.

i. Progress reports are submitted to the KU-ERC every six months and a full report is submitted at the end of the study.
ii. Serious and unexpected adverse events related to the conduct of the study are reported to this committee immediately they occur.
iii. Notify the Kenyatta University Ethics Committee of any amendments to the protocol.
iv. Submit an electronic copy of the protocol to KUERC.

When replying, kindly quote the application number above.
If you accept the decision reached and advice and conditions given please sign in the space provided below and return to KU-ERC a copy of the letter.

KENYATTA UNIVERSITY OFFICE OF THE CHAIRMAN ETHICS REVIEW COMMITTEE P.O. BOX 43844-00100 NAIROBI
05 SEP 2019

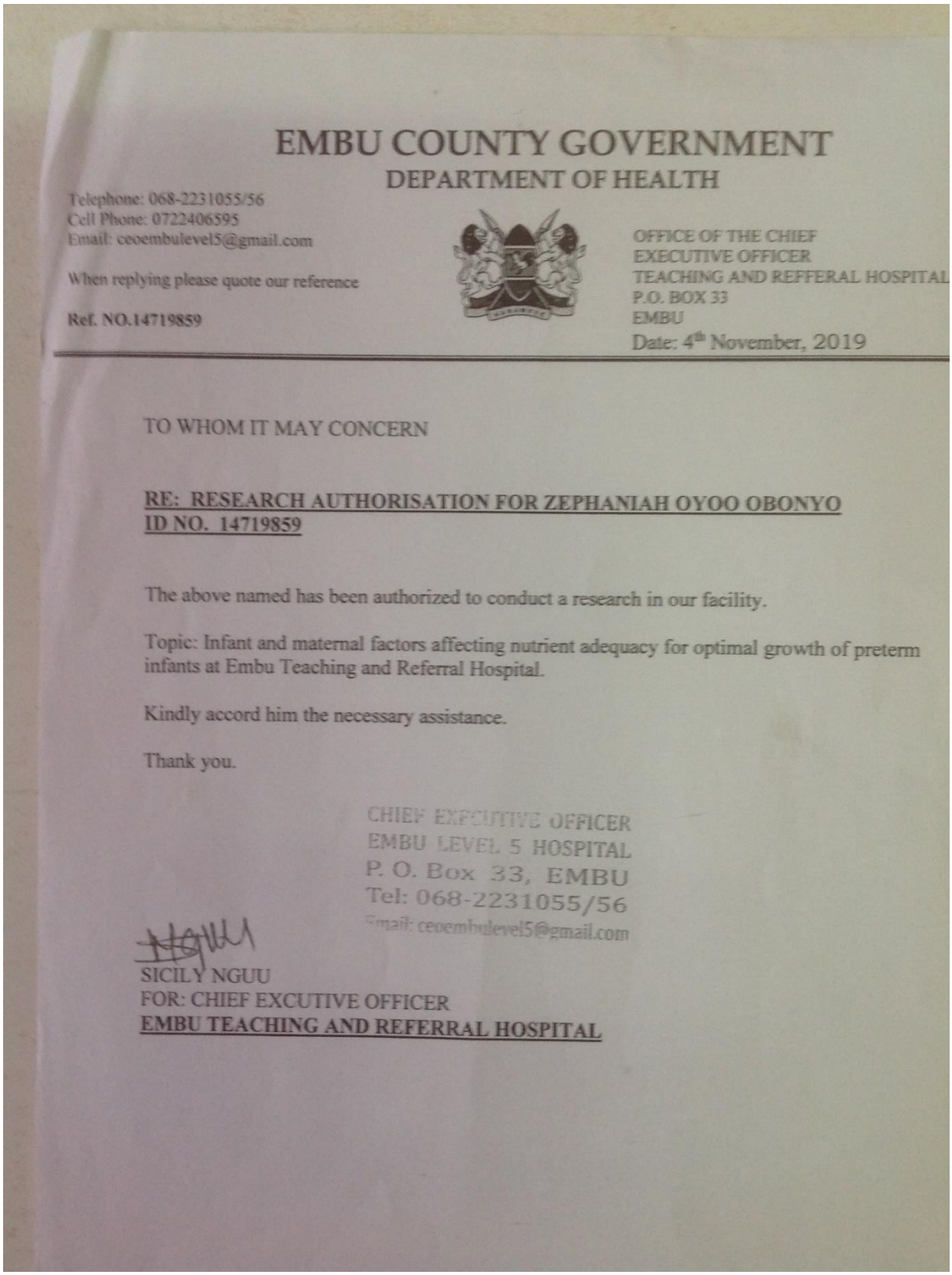
Dr. Peterson Warutere
AG. CHAIRMAN - ETHICS REVIEW COMMITTEE

I ZEPHANIAH O OKOTH accept the advice given and will fulfill the conditions therein.

Signature..... Dated this day of 05/09 2019.

cc.
DVC-Research Innovation and Outreach

Appendix B: ELFRH Approval Letter



EMBU COUNTY GOVERNMENT
DEPARTMENT OF HEALTH

Telephone: 068-2231055/56
Cell Phone: 0722406595
Email: ceoembulevel5@gmail.com

When replying please quote our reference

Ref. NO.14719859

OFFICE OF THE CHIEF
EXECUTIVE OFFICER
TEACHING AND REFFERAL HOSPITAL
P.O. BOX 33
EMBU
Date: 4th November, 2019

TO WHOM IT MAY CONCERN

RE: RESEARCH AUTHORISATION FOR ZEPHANIAH OYOO OBONYO
ID NO. 14719859

The above named has been authorized to conduct a research in our facility.

Topic: Infant and maternal factors affecting nutrient adequacy for optimal growth of preterm infants at Embu Teaching and Referral Hospital.

Kindly accord him the necessary assistance.

Thank you.

CHIEF EXECUTIVE OFFICER
EMBU LEVEL 5 HOSPITAL
P. O. Box 33, EMBU
Tel: 068-2231055/56
Email: ceoembulevel5@gmail.com

SICILY NGUU
FOR: CHIEF EXCUTIVE OFFICER
EMBU TEACHING AND REFERRAL HOSPITAL

Appendix C: NACOSTI Authorization Letter (Permit)

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 318003

Date of Issue: 26/September/2019

RESEARCH LICENSE

This is to Certify that Mr.. zephaniah oyoo of Kenyatta University, has been licensed to conduct research in Embu on the topic: INFANT AND MATERNAL FACTORS AFFECTING NUTRIENT ADEQUACY FOR OPTIMAL GROWTH OF PRETERM INFANTS AT EMBU LEVEL FIVE REFERAL HOSPITAL, KENYA for the period ending : 26/September/2020.

License No: NACOSTI/P/19/1463

318003

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

Appendix D: Introductory letter

(Mothers aged 18 to 49 years)/Guardian/ Caretaker (<18 years)

Principal Investigator: Zephaniah O. Obonyo

Informed consent

My name is **ZEPHANIAH O. OYOO**. I am a MASTERS student from Kenyatta University. I am conducting a study on "**INFANT AND MATERNAL FACTORS AFFECTING NUTRIENT ADEQUACY FOR OPTIMAL GROWTH OF PRETERM INFANTS AT EMBU LEVEL FIVE REFERRAL HOSPITAL, EMBU COUNTY, KENYA**" The information will be used by the Ministry of Medical Services and Ministry of Public Health and sanitation to improve access and quality of preterm infant care in hospitals as well as in other regions of Kenya.

Procedure to be followed

Participation in this study will require that I ask you some questions and I also examine your baby to identify nutrient adequacy for optimal growth of your baby.

Some anthropometry assessments will be taken from your baby. I will record the information from your baby in a questionnaire.

You have the right to refuse participation in this study. You and your baby will get the same care and medical treatment whether you agree to join the study or not and your decision will not change the care you will receive from the clinic today or that you will get from any other clinic at any other time.

Please remember the participation in this study is voluntarily. You may ask questions related to the study at any time.

You may refuse to respond to any questions and you may stop an interview at any time. You may also stop being in the study at any time without any consequences to the services you receive from this clinic or any other organization now or in the future.

Discomfort and Risks

Some of the questions you will be asked are on the intimate subject and may be embarrassing or make you uncomfortable. If this happens, you may refuse to answer these questions if you so choose. You may also stop the interview at any time. There

are no foreseen risks associated with this study as there will be no medications or chemicals given, and no blood samples will be taken.

Benefits

If you and your baby participate in this study you will help us to learn how to provide effective preterm infant care and feeding practices that can improve the health of preterm infants and reduce the risk of deaths associated with preterm deliveries.

Confidentiality

The interviews and examinations will be conducted in a private setting within the newborn unit. Your name will not be recorded on the questionnaire. The questionnaires will be kept in a locked cabinet for safekeeping at Kenyatta University. Everything will be kept in private.

Contact Information

If you have any questions you may contact **Prof. Judy Kimiywe. On 0722915459 or Dr. Regina Kamuhu. On 0717655404** or the Kenyatta University Ethical Review Committee Secretariat on chairman.kuerc@ku.ac.ke, secretary.kuerc@ku.ac.ke, secretariat.kuerc@ku.ac.ke

Participant's statement

The above information regarding my participation in the study is clear to me. I have been given a chance to ask questions and my questions have been answered to my satisfaction. My participation in this study is entirely voluntary. I understand that my records will be kept private and that I can leave the study at any time. I understand that I will still get the same care and medical treatment whether I decide to leave the study or not and my decision will not change the care my baby will receive from the staff today or that I will get from any other staff at any other time.

Participant IP Number……..

Signature or Thumbprint Date

Investigators statement

I, the undersigned, have explained to the volunteer in a language she/he understands, the procedures to be followed in the study and the risks and benefits involved

Name of Interviewer……

Signature or Thumbprint Date

Appendix E: Research Instrument

TOPIC: INFANT AND MATERNAL FACTORS AFFECTING NUTRIENT ADEQUACY FOR OPTIMAL GROWTH OF PRETERM INFANTS AT EMBU LEVEL FIVE REFERRAL HOSPITAL, EMBU COUNTY, KENYA

QUESTIONNAIRE NUMBER: …… DATE……..

INSTRUCTIONS FOR FILLING THE QUESTIONNAIRE:

1. Please fill in the date and questionnaire number appropriately
2. Please tick the appropriate box or complete the answer
3. There is no right or wrong answer
4. Answer the questions to the best of your understanding

PART A: SOCIAL AND DEMOGRAPHIC DETAILS

Family History

1.1 How old are you? (Verify age with the records of delivery/antenatal book).

1. 15-21 years ☐
2. 22-28 years ☐
3. 29-35 years ☐
4. 36-42 years ☐
5. 43-49 years ☐

1.2 What is your highest educational level?

1. None ☐
2. Primary completed ☐
3. Secondary completed ☐
4. College graduate ☐
5. University graduate ☐

1.3 What is your income level (Ksh?)

1. <5000 ☐
2. 5000-9000 ☐
3. 10000-14000 ☐
4. 15000-19000 ☐
5. >19000 ☐

1.4 How did you deliver your baby?

1. spontaneous virginal delivery (SVD) ☐
2. breech delivery ☐
3. assisted virginal delivery ☐
4. elective caesarean section ☐
5. emergency caesarean section ☐

1.9 Have you established enough breast milk for your baby? Yes ☐ No ☐

1.10 If NO what is your baby currently feeding on?

1. IV fluids ☐
2. IV fluids & Breastfeeding ☐
3. Cup ☐
4. IV fluids & cup ☐
5. IV fluids /cup/breastfeeding ☐

PART B: Now I want to ask you questions about your baby

2.1 How old is your baby today _____ (days)

2.2 How many weeks did you deliver your baby at

1) <28 weeks ☐
2) 28-32 weeks ☐
3) 32-34 weeks ☐
4) 34-37 weeks ☐
5) > 37 weeks ☐

2.3 What was your baby's birth weight? (If not day 1 of life proceed to question 2.4)

1) < 750 grams ☐
2) 750-1000 grams ☐
3) 1000-1500 grams ☐
4) 1500-2500 grams ☐
5) >2500 grams ☐

2.4 If not day 1 of life, what is your baby's weight today _____ grams?

2.5 What is the length of your baby today _____ cm?

2.6 What of the head circumference _____ cm.

2.7 What mode of feeding are you using to feed your baby now?

1) IV ☐
2) NG Tube ☐
3) Cup feeding ☐
4) Breastfeeding ☐
5) Jejunestomy Tube ☐

2.8 What type of feed is your baby currently feeding on?

1) preterm formula ☐
2) IV fluids ☐
3) Parenteral feeds ☐
4) Term formula ☐

2.9 How much feeds are you giving your baby today _____mls.

2.10 Are you giving your baby the amount the doctor told you to feed the baby?

Yes☐ No ☐

2.11 If No, why are you not feeding your baby the amount you are supposed to feed the bay?

1) I do not have enough milk ☐
2) Baby cannot finish the prescribed amount ☐
3) Baby unwell ☐
4) Baby can take more ☐
5) I was not told ☐

PART C: Now I want to ask you questions about the babies health

3.1 How is your baby feeling today? Sickly ☐ Fine ☐

3.2 has your baby passed stool in the last 24 hours? Yes ☐ No ☐

3.3 If No, how many days has your baby taken without passing stool…….. (Days)

3.4 has your baby experienced any of the following health conditions in the last 24 hours?

1) Constipation ☐
2) RDS ☐
3) Birth Asphyxia ☐
4) BPD ☐
5) Partent ductus arteriosus ☐