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Undernutrition of HEU infants in their first 1000 days of life: A case in the Urban-Low Resource Setting of Mukuru Slum, Nairobi, Kenya.

Jane Nduta Wambura

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AUTHOR: Jane Nduta Wambura

SUPERVISOR: Professor Carmen Brás Silva

INSTITUTION: **Faculdade de Ciências da Nutrição e Alimentação da Universidade do Porto**

CO-SUPERVISOR: Professor Bruno M. P. M. Oliveira

INSTITUTION: Faculdade de Ciências da Nutrição e Alimentação da Universidade do Porto

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Declaration

I, **Wambura Jane Nduta**, declare that this Research thesis is my original work and that it has not been presented in any other university or institution for academic credit.

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Abstract

Background and Aims

With the successful chemoprophylaxis and lifelong antiretroviral therapy programs geared towards elimination of mother to child transmission of HIV, there is a rising number of HIV exposed uninfected (HEU) infants. In resource limited settings, these infants are at a risk of undernutrition due to low birth weight, food insecurity, household composition, income and improper feeding patterns. This study reviewed these predisposing undernutrition factors in relation to HIV exposure among infants living within low resource urban setting of Mukuru Slum, Nairobi, Kenya.

Methods

A retrospective cohort study was performed on 160 mother/guardian-child pairs in Mukuru Slum, Nairobi, Kenya. Growth charts of the HIV exposed uninfected infants were studied against a control group of HIV unexposed uninfected infants (HUU). Interviews to collect information on socio economic status, household composition, HIV exposure, infant feeding practices and food insecurity related challenges were done. Data was analyzed using IBM SPSS version 20 and WHO anthroplus software. Descriptive statistics as well as Chi square, t-tests and multivariate analysis was done.

Results

Stunting among the HIV exposed uninfected infants was the most common form of undernutrition. ***38.9%*** of the HEU infants were mildly stunted (LFAZ), while ***5.6%*** of them were moderately wasted (WFLZ), while, and ***24.4%*** of them were moderately underweight. The mean birth weights of the HEU infants ***(2.953kg)*** was lower than the HUU ***(3.195kg).*** HIV exposure was associated with lower Weight for Length Z score (WFLZ), Weight for Age Z score (WFAZ), Length for Age Z score (LFAZ), BMI for Age Z score (BAZ) and Middle Upper Arm Circumference Z score (MUACZ) ***(p<0.001)***. HEU infants were more likely to live in households with lesser number of adults ***(p=0.016)*** and higher number of children ***(p<0.001)*** as compared to the HUU. Although exclusive breastfeeding was upheld among all infants, the HEU were more likely to rely on Food by Prescription supplements ***(p<0.001)*** to meet their daily energy needs. Households with HEU infants were however, less likely to receive food ***(p=0.041).*** Overall the largest effect sizes on undernutrition of all infants were found in the age of children ($\eta_p^2=0.439$; $p<0.001$), sex ($\eta_p^2=0.135$; $p=0.001$), HIV exposure ($\eta_p^2=0.351$; $p<0.001$) and food aid ($\eta_p^2=0.083$; $p=0.021$).

Discussion and Conclusions

HIV exposed uninfected infants in Mukuru are faced with a high undernutrition risk that is associated with HIV exposure, household composition, food aid and use of food by prescription supplements. These factors provide an insight when managing undernutrition among such infants in other resource limited settings. This study recommends future operational studies to inform HIV programs on exact ways to eliminate undernutrition among the rising number of HEU infants.

Keywords:

- Undernutrition
- HIV Exposed Uninfected Infants
- HIV Unexposed Uninfected Infants
- Urban Settlements
- Low resource settings
- Anthropometry

Resumo

Introduçao e Objectivos

Com a quimioprofilaxia bem sucedida e os programas de tratamento anti-retroviral para a eliminação da transmissão do VIH da mãe para o filho, há um número crescente de bébés não infetados expostos ao VIH (HEU). Em contextos de recursos limitados, estes lactentes correm o risco de desnutrição devido ao baixo peso à nascença, à insegurança alimentar, à composição familiar, ao rendimento familiar e aos padrões de alimentação inadequados. Este estudo teve por objetivo rever esses fatores de desnutrição predisponentes em relação à exposição ao VIH em lactentes que vivem em ambiente urbano com baixos rendimentos em Mukuru Slum, Nairobi, Quênia.

Métodos

Realizou-se um estudo de coorte retrospectivo em 160 pares mãe / tutor-filho em Mukuru Slum, Nairobi, Quénia. Foram estudadas as curvas de crescimento dos lactentes com HEU comparadas com as de um grupo controlo de crianças HUU. Foram realizadas entrevistas para colher informações sobre o estatuto socioeconómico, composição familiar, exposição ao VIH, práticas de alimentação infantil e insegurança alimentar. Os dados foram analisados utilizando o IBM SPSS versão 20 eo software WHO Anthroplus. Foram realizadas estatísticas descritivas, bem como teste de Qui quadrado, testes T e análise multivariada.

Resultados

A magreza (desnutrição crónica grave /*stunting*) entre os recém-nascidos com HEU foi a forma mais comum de desnutrição. 38.9% dos recém-nascidos com HEU apresentavam desnutrição suave (baixo comprimento) (Z score comprimento-pela-idade -LFAZ) enquanto 5.6% deles apresentavam desnutrição moderadamente como demonstrado pelo Z score Peso-pelo-estatura (WFLZ), e em 24,4% o peso médio. Ao nascer dos recém-nascidos com HEU ***(2.953)*** foi menor do que dos HUU ***(3.195)***. A exposição ao VIH foi associada a menores Z scores de WFLZ, Peso-pela-idade (WFAZ), Estatura- pela-idade , IMC-pela idade (BAZ) idade e Perímetro do braço sem contração (MUACZ) ***(p <0,001)***. Os recém-nascidos com HEU apresentaram maior probabilidade de morar em lares com menor número de adultos ***(p = 0,016)*** e maior número de filhos ***(p <0,001)*** em relação ao HUU. Embora o aleitamento materno exclusivo fosse mantido entre todos os bébés, o HEU estava mais propenso a depender de suplementos ***(p <0,001)*** para satisfazer as suas necessidades diárias de energia. No entanto, as famílias com crianças com HEU foram menos propensas a receber alimento ***(p = 0,041)***. Em geral, o maior efeito de tamanho na desnutrição de todos os bébés foram a idade das crianças (($\eta_p^2=0.439; p<0.001$)), sexo ($\eta_p^2=0.135; p=0.001$), exposição ao VIH ($\eta_p^2=0.351; p<0.001$) e ajuda alimentar ($\eta_p^2=0.083; p=0.021$.

Discussão e Conclusões

Os bébés não infectados expostos ao VIH em Mukuru enfrentam um alto risco de desnutrição associado à exposição ao VIH, composição domiciliar, ajuda alimentar e uso de suplementos prescritos. Esses resultados são relevantes para a adoção de estratégias nos sentido de lidar com situações de desnutrição infantil em regiões de recursos limitados . Este estudo recomenda futuros estudos operacionais para informar os programas de VIH sobre formas exatas de eliminar a desnutrição entre o crescente número de crianças com HEU.

Palavras-chave:

- Subnutrição
- Crianças expostas ao HIV não infectadas
- Crianças infetadas com HIV não infetadas
- populações/povoações urbanas
- Baixos recursos.
- Antropometria

Table of Contents

List of abbreviations:

AFASS-Acceptable, Feasible, Affordable, Sustainable, Safe.

ART- Antiretroviral Treatment

ARV-Antiretroviral

BAZ- BMI for Age Z Score.

CCC- Comprehensive Care Clinic

HEU- HIV Exposed Uninfected Infants

HIV-Human Immuno-Deficiency Virus

HUU- HIV Unexposed Uninfected Infants

LFAZ-Length for Age Z Score

MUACZ- Middle Upper Arm Circumference Z Score.

WFAZ- Weight for Age Z Score.

WFLZ- Weight for Length Z Score.

WHO- World Health Organization

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Chapter One: Introduction

Background of the study

Globally, it was estimated that a total number of 36.7 million people were living with HIV by 2015 (UNAIDS, 2015). A third of these people live in the sub-Saharan Africa, which includes about 90% of children living with HIV. Since the year 1996, the use of antiretroviral therapy (ART) therapy among HIV infected expectant women has markedly resulted to the elimination of mother to child risk of transmission globally (Hofer et al., 2016). Subsequently, the number of HEU infants continues to increase with the availability of life-long combined antiretroviral therapies to almost all women across the world. Currently, it is estimated that 1.5 million HIV infected women become pregnant annually, which causes the HEU infants to experience numerous exposures during their fetal and early life. Significantly, the discovery of the ART therapy in the elimination of mother to child transmission during pregnancy, delivery and breastfeeding has been the highlight of success in fighting the HIV epidemic globally.

In resource-limited settings, the use of ART therapies among women living with HIV has closely led to the achievement of 90% decrease in pediatric infections. By the year 2015, it was estimated that about 70% of the 1.5 million expectant women living with HIV were receiving ART (UNAIDS, 2015). This means that millions of infants born to these women have in-utero ARV exposure for the first 9 months of their life. These infants are also exposed to post-partum ART treatment as a prophylaxis for the first 3 months, and thereafter cotrimoxazole drugs until their HIV status tests negative; and most importantly risk factors that revolve around household and maternal challenges. All this happens within 1000 days of their life. Any health problems that could lead to their undernutrition and increase in number of infections could be associated to the HIV exposure, birth weight, household composition, food insecurity-related challenges, improper feeding techniques, or the income available within the settings they live in. However, there have been limited studies linking the exact challenges that cause the HEU infants to be undernourished more than their HUU counterparts living within similar socio-economic conditions. This is especially after the 2015 WHO directive that indicated that all HIV expectant mothers' ought to receive lifelong ART treatment during their conception (AIDSinfo, 2016).

HEU infants in Kenya

Kenya has got a growing number of HEU newborns across the country due to the effective programs set up to eliminate mother to child transmission of HIV. Per HIV and AIDS estimates report in 2015, about 830,000 women were living with the virus in Kenya(UNAIDS, 2015). This means that if all these women who were aged 15 and over would give birth, their infants would add up to the already growing number of HEU children that are about 660,000 in Kenya currently(UNAIDS, 2015). The infants born to families living in resource limited settings are faced with several challenges that affect their nutrition status and potential growth.

Per the country guidelines, all infants born to HIV-positive mothers ought to receive ART treatment as soon as they are born(M. Kenya, 2016). This treatment consists of Nevirapine drug regimen that acts as a prophylaxis as the infant begins to breastfeed or formula feed per the acceptable, feasible, affordable, sustainable and safe (AFASS) criteria(N. Kenya, 2014). The drug is administered for the first 4 to 6 weeks, after which an early infant diagnosis is done to determine the status of the child. Meanwhile the infant receives cotrimoxazole drug as they continue to breastfeed to prevent infections and enhance immunity. Ideally, the infant is pharmacologically set up for optimal growth despite growing in a virologic environment. However, HEU infants are still found to be nutritionally challenged by several factors depending on the environment within which they live. Some of these include: low birth weights, household size, food insecurity, income per-capita, and improper feeding practices. However, these challenges facing the HEU infants have not been studied to provide nutrition solutions that fully eliminate undernutrition simultaneously with viral elimination.

In Mukuru Slum, one of the biggest urban settlements in Kenya, the prevalence of HIV is estimated to be about 12% compared to 5% among non-Slum residents and 6% in the rural settings(UNAIDS, 2015). Women and girls are potentially vulnerable to the increasing rate of new infections in the urban settings, thereby creating a foreseen increase in the number of HEU infants living within this setting. With a population of about 600,000 people, the Mukuru Slum is faced with lack of basic services such as food, housing, sanitation, healthcare, security among others. The efforts of HIV health care services such as the Mater Hospital within the area have led to a considerable elimination of viral transmission up to about 89%. Despite this success, the outcomes of these infants are at stake with the underlying challenges that face them since conception, to birth and throughout their lives. Most crucially, their 1000 first days of life.

Significance of the Study

The information gathered by this study shall be useful to several health stakeholders. In the Comprehensive care centers, it will be useful to identify ways in which growth can be monitored among HEU infants. The study will also be significant to policy makers who design interventions to eliminate undernutrition in the resource limited settings.

Delimitation of the Study

The focus of this study was based on the HEU infants who were born in the Mukuru Slum and were within reach of the Mater Comprehensive Care Clinic. Generalizing of these findings can therefore, only be applicable to populations and health facilities with similar characteristics.

Limitation of the study

The study did not include the mother's stature at conception and the gestational age of the infants because not all infants had mother to child pairs by the time data was collected. This would have influenced the birth weight and perhaps the anthropometric measures of the infants as suggested by other studies. As well, the study did not include the influence that time or different seasons within a year may have had on the feeding practices of the infants since the data was only collected at a static point in time. Considering these aspects would have influenced the food insecurity constraints that the respondents recorded.

Statement of the Problem

Early growth and health of HEU infants has generally been considered poorer than that of HUU counterparts. However, there is little information about the undernutrition underlying factors facing this number of HEU as compared to the HUU especially in low resource settings. It is possible that these infants in utero and post partum ARV exposure affects their optimal growth. The limitation caused by lack of resources could also be another predisposing factor towards their undernutrition status. This study therefore, seeks to highlight crucial underlying factors that cause a higher rate of undernutrition among HEU infants, compared to their HUU counterparts despite living within similar socio-economic conditions.

Purpose of this study

The main aim of this study is to explore prompting factors that cause undernutrition among HEU infants as compared to the HUU counterparts within the first 1000 days of their life, and contribute to possible interventions that could help in eliminating undernutrition among them.

Objectives of the study

General Objective

To investigate undernutrition among HEU infants within their first 1000 days of life in Mukuru Slum in Nairobi, Kenya.

Specific objectives

- To identify the relationship between undernutrition and **HIV exposure** among HEU infants.
- To examine how **birth weight,** affects undernutrition outcomes of the HEU infants.
- To evaluate the extent to which certain **food insecurity- related constraints** affected nutrition status among HEU infants in the resource limited settings.
- To determine the extent to which **household composition** affects nutrition in households with HEU infants.
- To identify the relationship between **infant feeding practices** and undernutrition of HEU infants compared to their HUU counterparts.
- To determine how **income** affected nutrition in households where HEU infants lived.

CHAPTER TWO: LITERATURE REVIEW

Undernutrition of HEU Infants

The hallmark of undernutrition among all infants is growth failure. In resource limited settings, under-nutrition is because of several factors that include: improper feeding practices, timing within which complementary foods are introduced, infections and other micronutrient deficiencies. Undernutrition can therefore, be classified as either stunting, wasting or underweight that has been reported in the postnatal period in infants who live within an increased burden of HIV infection (Sudfeld et al., 2016). Several studies have associated undernutrition more frequently with HIV infected infants. However, it also occurs in HEU infants and has been reported to have an early detection at about 3 months of age. Low resource communities across the globe are faced with poor socio-economic backgrounds unconducive environments and other immunological factors. As well, infant and young child controversies in the context of HIV in these communities negatively affect growth and developmental outcomes of the HEU infants.

Early introduction to complementary foods also contributes to poor growth and stunting. Some studies that have reviewed antiretroviral drug exposure in relation to growth have found little or no relationship with impairment of growth among HEU infants (Pintye et al., 2015). These studies however, have associated *in utero* ARV exposure to low birth weights (Hofer et al., 2016). Thus, early growth of infants may be impaired especially to infants born with low weights or are born pre-term. In developed countries, this phenomenon was studied and found that such infants catch up between the ages of 1 and 2, and grow similarly to their HUU counterparts (Isanaka, Duggan, & Fawzi, 2009). Undernutrition in the resource limited settings has also been associated with poor micronutrient intake in HEU infants (Kuhn et al., 2010). Identification and treatment of micronutrient deficiencies is therefore, crucial among these children to secure their optimal growth.

As per a recent study in Ghana, millions of infants living within the Sub Saharan Africa live in households faced by social, emotional and health vulnerabilities that are potential threats to their general health and optimal growth (Amos Laar et al., 2015). This study indicated that HEU infants tend to be stunted as compared to their HUU counterparts. Ideally, the Stunting often begins *in utero* as maternal nutrition is the initial determinant of the child's nutritional status (Slogrove, Archary, & Cotton, 2016). This continues during the first two years after birth and contributes to the linear growth faltering of the infant. A study carried out in Tanzania associated the prevalence of linear growth faltering to the incidence of HIV virus in households (McDonald et al., 2012). In the study, households with one or more adults living with the virus had lower productivity due to poor health status and therefore, food insecure, leading to stunting among the infants living in these households. As well, the study showed that infants in their second or third year were more likely to be stunted due to maternal instability and income generation within the household.

Birth weight

The core causes of low birth weights and fetal growth faltering among HEU infants are controversial. While some studies relate the incidence of undernutrition among the HEU infants with their HIV affected parents, the undernutrition vicious cycle among infants could be due to other underlying factors (Hofer et al., 2016). In the context of HIV some of these include: introduction of maternal ART treatment for either prevention or treatment, and the neonatal ART for prevention that has presented further complexities in discerning the relationship between the incidence of the HIV virus with the birth outcomes (AIDSinfo, 2016).

As ART treatment expands within sub Saharan Africa, the number of HEU infants whose birth outcome will be uncertain continues to rise. Studies carried out within this region indicate that most HEU infants are born either pre-term especially if their mothers did not attend their prenatal care on time, or have low birth weights because they did not receive ample maternal nutrition when they were conceived (Trehan, O'Hare, Phiri, & Heikens, 2012). Consequently, they end up having lower weights and lengths for their age, even though it is not certain if they may always catch up by the time they are two years and above. In sub Saharan Africa, maternal HIV infection has been described to affect pregnancy outcomes adversely (Oddo et al., 2016). Linear growth retardation may be severe in these children. However, their birth weight is not affected since the highest transmission occurs close to their delivery (Muhangi et al., 2013). Other findings report no birth weight interferences caused by HIV exposure *in utero* or otherwise to HEU infants (Afran et al., 2014). With these controversies, of importance is that, maternal health status represents the survival status of an infant despite viral exposure.

Food insecurity- Related Variables

Originally, food security was a term used to describe a country's ability to meet dietary needs that were enough to sustain its citizens (Pinstrup-Andersen, 2009). Such capability was considered to explain a future oriented self-sufficiency of food to citizens. In a household setting, food security has been used extensively as a measure of welfare and the ability to acquire food needed by all its members to be nutritionally secure (Fielden et al., 2014). A household can either be transitory or permanently food secure depending on the availability, accessibility, affordability and utilization of food by the households. Studies that review food security among households affected by HIV enumerate coping mechanisms adopted by the caregivers to sustain the infants (Gillespie & Kadiyala, 2005; A. Laar et al., 2015; Oldewage-Theron, Dicks, & Napier, 2006). In the first place, the HIV virus strikes the household's most productive persons initially. When this happens, there is an almost immediate strain in the ability of the family to afford proper care and nutrition.

Family members tend to strain on the amount of income earned within their households, which directly affects the affordability of food (Reddi, Powers, & Thyssen, 2012). With time, the ill persons may decide to seek options such as migrating to look for work elsewhere to provide for their families. Such a phenomenon is short-lived and unsustainable, rendering the homesteads to food insecurity. Food insecurity directly causes undernutrition which can aggravate or falter the growth of infants in the households (Ivers et al., 2009). HEU infants who would have otherwise grown normally compared to their HUU counterparts are consequently affected regarding their weight and Height and general nutrition status. Thus, most CCC programs adopt food programs that are intended to ease the burden of food accessibility (Nosek et al., 2016).

A pilot study conducted in Zambia suggested that food assistance is a crucial factor among HIV infected families that enables adherence to ART treatment (Fawzy et al., 2011). However, food assistance was not associated with significant changes in the anthropometric measures of the HEU infants living in households that received food. In Kenya specifically, about 50% of the citizens live below the poverty line earning about one dollar per day (Statistics, 2015).In households affected by HIV, such a situation is aggravated. The effect of the virus on the structure of family and economic status has an impact on the health and dietary practices. In most homes, the quality of diet is compromised either because of the low purchasing power, or the low quality of the food received from donations (N. Kenya, 2014). The exact food security phenomena that causes an imbalance in nutritional security that affects infants living within the informal settlements is however, not well documented.

Household Size

In a report published in 2016, the lancet indicates that long term nutritional and neurodevelopmental outcomes are highly influenced by the household environmental factors of an infant during the first 1000 days of life (Bahwere, Deconinck, Banda, Mtimuni, & Collins, 2011; Evans, Jones, & Prendergast, 2016). HIV exposure during this time thereby, could affect birth, growth and development. The lancet advocates for further research on the growth of the HEU infants as compared to their HUU counterparts.

Other Studies confirm this concern by demonstrating that the family environment in which the HEU infants are brought up in, pose a risk to their nutritional status (Ansell, Robson, Hajdu, Blerk, & Chipeta, 2009; Bukusuba, Kikafunda, & Whitehead, 2007; Parker, Jacobsen, & Komwa, 2009). In fact, it is estimated that about 17million children have lost their parents to AIDS since the beginning of the pandemic(Organization, September 2016). Today, for every woman who dies from the pandemic an average of two children are orphaned. Thus, these offspring are left to experience extreme poverty and homelessness that predisposes them to undernutrition. The National AIDS and Sexually Transmitted Infections Control Programme (NASCOP) documents that the largest populations of orphans in the country are from homes affected by HIV (N. Kenya, 2014). Informal settlements are the worst hit with infants as young as one month being abandoned by their parents and left to foster care.

Income

As emphasized above, several research studies have shown that HIV initially affects the welfare of households through illnesses that then lead to the diversion of resources from savings and earnings into disease care and treatment (Kalimang`asi, Majula, & Florent, November 2014). Due to the burden of disease, income circulating in the homes for basic needs becomes limited since household members who would have otherwise performed tasks to provide basic needs become incapacitated to the extent that they have to divert their assets into their health. Social exclusion from employment has also been associated with low income in HIV affected households (Bachmann & Booysen, 2003). In a south African study, it was found that household composition changes occurs concurrently with the incidence of the disease (Collins & Leibbrandt, 2007). Infants are either abandoned or transferred to other healthier members of the family, who are burdened with the care of children who are most likely HEU (Feulefack et al., 2013). As a result, such infants may end up malnourished either because their new homes have to take care of a new burden, or if such an infant ends up in foster care with many other children dependents.

In the year 2000, the UNAIDS identified some coping strategies preferred by the households affected by the virus (UNAIDS, 2013). These included the reduction of food consumption by either replacing certain food items with cheaper ones, or sending infants away to live with relatives. As well, such families may choose to migrate to search for better jobs or seek for programs that could help them to begin small businesses to sustain their livelihoods. In extreme cases, these members may choose to put in extra hours in the jobs or seek help from their relatives when the situation becomes challenging.

Infant Feeding Practices

The challenging background of low income, food insecurity and an unstable household environment situation, all play a part in the practices adopted to feed HEU infants (Kalimang`asi et al., November 2014; Oldewage-Theron et al., 2006). Optimal infant and young child feeding lays the basis for nutritional status and growth and the ultimate survival of infants. Through the WHO, nations have strived to encourage the exclusive breastfeeding of all infants regardless of their status (N. Kenya, 2014; Kuhn et al., 2010). Mothers are educated on the importance of choosing an appropriate method of feeding their infants, introducing solid foods to them at the appropriate age, preferably at six months. However, in the case of HIV, mothers are left with the dilemma of the right method to feed their infants. Instead, they rely on their most convenient modes of feeding at their disposal (Goldberg & Short, 2016).

In a South African study, the widespread use of ARV treatment and programs to eliminate mother to child transmission triggered an investigation of the feeding practices of the HEU infants in Western Cape (Rossouw, Cornell, Cotton, & Esser, 2016). The study concluded that adherence of breastfeeding and appropriate introduction of solid food was affected by availability of the mother right from birth, stigma within the community, maternal ART as well as improper knowledge of when to introduce solid foods to the HEU infants. As a result, some HEU infants tend to be introduced into solid foods as early as one or two months after their birth due to the improper knowledge of their mothers, or the unavailability of an AFASS method of feeding these infants (Fawzy et al., 2011; Sint et al., 2013). While the WHO recommendations of exclusive breastfeeding for 6 months, and thereafter introduction of solid foods, with continued breastfeeding of upto 1 year, most mothers and care givers taking care of HEU infants do not adhere to these guidelines (WHO, 2007). A retrospective cohort study done in Kenya identified HEU infants who benefited from exclusive breastfeeding, that prevented the incidence of pneumonia from occurring, per their hospitalization records (Asbjornsdottir et al., 2013). On the other hand, a Breastfeeding, Antiretrovirals and Nutrition (BAN) study in Malawi whereby all infants were breastfed, found an increased risk of morbidity among those infants after weaning (Nosek et al., 2016). These findings were similar to another study in Zambia that explored the effects of early introduction of solid foods (Fawzy et al., 2011).

Chapter 3: Methods
Methodology

Scope and Design

This study was a retrospective cohort study of HEU infants participating in past perinatal HIV studies. The growth and development of these infants was monitored from the time they were born through to 2 years of age and compared to their counterpart group of HIV unexposed (HUU) infants using growth records from the Mater hospital. Anthropometric measurements were conducted, and determination of feeding habits was done within the households of infants in the study to determine their current nutrition status.

Study location

The study was carried out within Mukuru Slums in Nairobi. Mukuru Slum is characterized by a population of about 1 million people and is reported to be the leading region with the highest poverty levels in Nairobi. Mukuru is an informal settlement and a fast- growing Slum that is located about 5 kilometers from the city center. The Mater comprehensive care clinic serves to provide care and treatment for the households affected by HIV.

Target population

The target population of this study consisted of 2917 households in the Slum who live within a ten-kilometer radius of the Mater hospital, from which sampling was conducted. The study targeted households with infants 2 years and below who lived with at least one adult within the household, either directly or indirectly affected with HIV for the HEU group, or living within the Slum and unaffected by the virus for the HUU group.

Sampling procedures

Mukuru location was randomly selected among other resource poor settings of Nairobi. In specific the region of Hazina that consists of six villages had a random selection of 3 villages. Multistage sampling technique was used to select the study sample. The technique was useful because there was no adequate list of individuals in the population since the study was set in an urban settlement, with nomadic residents. A list of households in the area was obtained from the area chief during the first stage. Households with children below the age of 2 years was identified using snowball sampling technique. Through this sampling, the first subjects in the HUU group was identified, who then helped in naming others who also had households with infants 2 years and below until the number of cases needed was reached. The HEU sample was also randomly selected from the hospital records, matching the entry characteristics of mother/guardian-infant matches. Records from a food aid program running within the area were also used to identify households at risk of food insecurity.

Sample size

A sample size of 10% of the accessible population was used. From data collected from food security programs and health care centers in the area, it was expected that a total of 1604 children lived within the study area.

Selection Criteria

The households that were targeted were strictly those with infants aged 2 years and below whose mother/guardian-infant pairs were enrolled in the facility at the time of birth for the HEU group. Infants in the HUU category were recruited from health care and food security programs within the area. Infants were excluded if they died or were termed as lost to follow-up. The sample size was distributed as follows:

Villages	**Households with children 2 years and below**	**Children 2 years and below**		
		HEU	HUU	Total
Kisii	653	33	32	65
Maasai	521	41	11	52
Hazina	430	16	27	43
Total	**1604**	**90**	**70**	**160**

Table 1: Sample Size

Data collection instruments

Interviews

The interviews were administered to mothers and care givers in cases where the mother was unavailable. The interviews were done orally and included: review of demographic information, growth monitoring charts of the infants, household dietary practices, morbidity of children under 2 years, nutrition knowledge, food security related aspects, feeding practices since birth and the time of introduction of complementary foods.

Observation

Through observation, the researcher gathered information of what the household members practiced regarding their nutrition and not just what they reported during the study. This formed a crucial basis of evaluating the nutrition adequacy and status of the infants since their time of birth.

Pretesting of the research instrument

Pre-testing of the interview was conducted among 10 respondents before the research. These were obtained from a different urban settlement in Kibera Slum. The sample tested acted as a guide to any improvements of the interview. Pretesting helped to improve on the validity, reliability and clarity of the research instrument.

Data collection procedures

Data was collected using growth chart records obtained from the Mater Hospital, anthropometric measurements were also done using equipment from the hospital facility. These included collecting data about:

- Weight of the infants- A salter scale was used, and the weight of the infants taken with as little clothing as possible. The readings were taken to the nearest 0.1kg.
- Length of the infants- a height board was used and the length of infants taken with the back of their head leaning on the board, and feet touching the board since they could not stand up steadily. The reading was taken to the nearest 0.1 cm
- Age was obtained from the growth card given to the child at the time of birth to ensure accuracy.
- Birth weight was also collected from the growth card issued at the time of birth

- Middle upper arm circumference- Arm circumference measurements were taken using a MUAC tape, and recorded to the nearest 0.1cm

The researcher also used a questionnaire (Annex 1) to inquire information about:

- Income- to identify whether the amount of income influenced the availability and accessibility of food within the households. The respondents were asked to answer questions that regarded to their income by answering whether their average income in a month fit within a certain range.

- Number of meals per day- to enumerate the number of meals taken by the infants in a typical day after their introduction into complementary food. This was specifically to infants who were six months of age and above.

- Household size- The respondents were asked to enumerate the number of adults who live within the household within a typical month. This was to assess whether this influenced the food security of the households due to the amount of income generated. As well, the study inquired about the total number of children living within the household in a typical month to assess how food was distributed and utilized among the infants.

- Food insecurity related variables- the study utilized some food security parameters to assess variables such as food availability, food utilization and food aid within households which would directly affect the quality, amount and feeding practices that could be adopted for infants within the study.

- Number of infants either breastfed or formula fed- The mothers or caregivers were asked whether they chose to breastfeed or formula feed their infants since birth. This was to quantify the number of infants breastfed or formula fed, for both the HEU and HUU infants, to compare and correlate any relationships with their nutrition outcomes.

- The number of hospital visits of each child- The number of hospital visits was recorded to find out if it correlated with nutrition status or not. The study did not consider the reasons for hospital visits or admittance.

- Complementary food introduction- The mothers and the care givers were asked to respond about the time within which they chose to introduce solid foods to their infants. The data would allow for a better understanding of feeding practice preferences for the infants within the study.
- Mother/guardian knowledge about the interaction of ARVs and food intake- The study recorded whether the mothers or guardians of the infants in the study attended classes on the knowledge of ARV and food intake interaction of both the infants and the mothers. These classes were mostly carried out within the hospital settings and other programs within the Slum area.
- ARV Exposure- Even though the Infant ARV exposure corresponded with Mother's exposure to ART treatment for the HEU group of infants, this information was useful to find out if this ARV exposure affected the infants in any way, regarding their birth weight and growth faltering regarding stunting, wasting or underweight.

Some of the questions that featured in the Questionnaire were not presented in the results because they were either used to eliminate the respondents from the study, or the researcher deduced related information from them. These included:

- The number of times the child was fed in a day
- ARV exposure to the infants
- Number of hospitalizations
- Food accessibility in the households

Conceptual framework

Based on the information collected, the study's conceptual framework was structured as illustrated in figure 1 below:

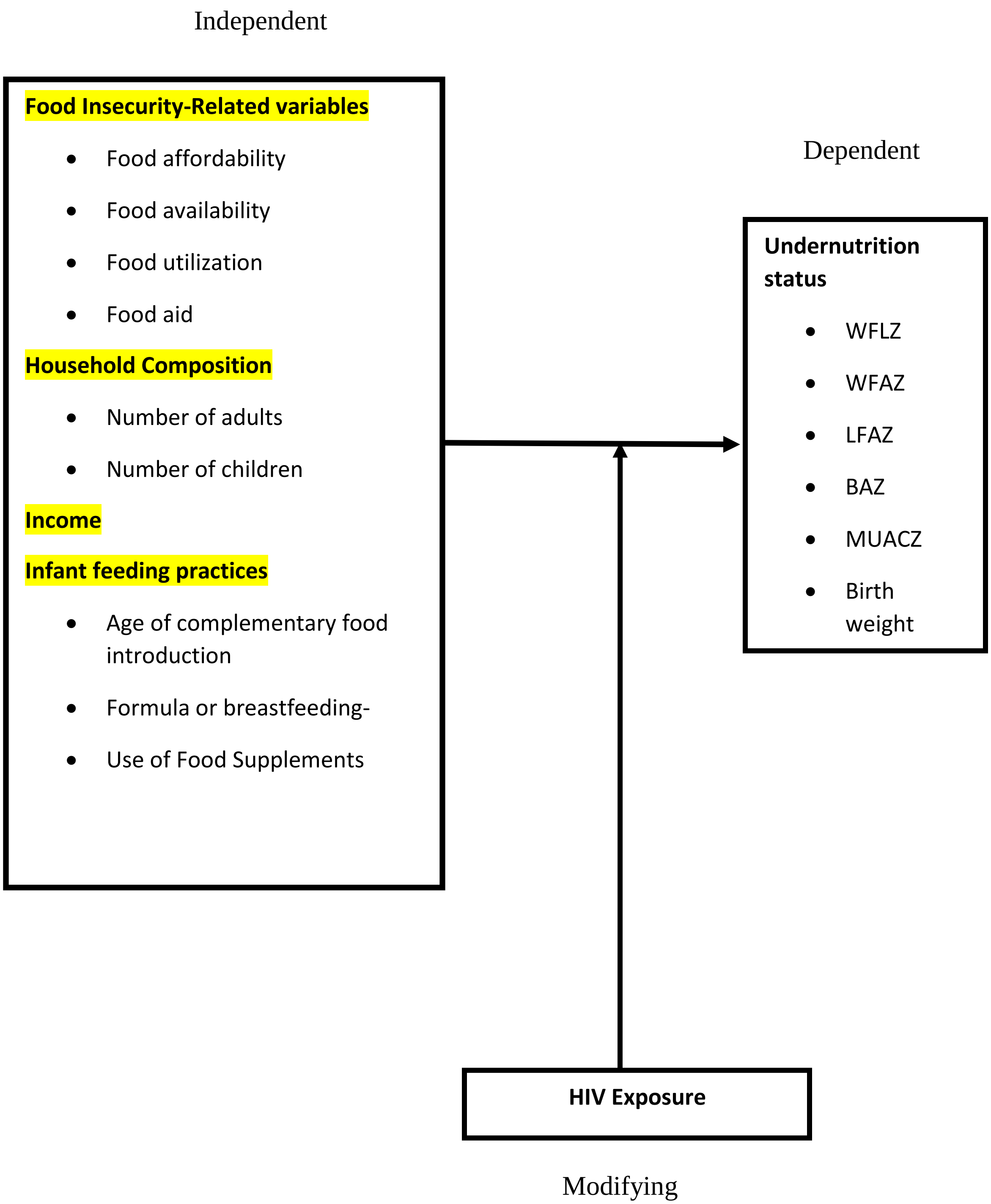


Figure 1: Conceptual Framework 1

Data analysis

Anthropometric measurements were analyzed using the WHO anthroplus software version 3.2.2 to obtain the Z scores of the infants. The Z-scores were used to determine nutritional status of children and categorized as normal, stunted, wasted or underweight. The Nutrition status of the infants was analyzed and was compared to the WHO cut off points that were defined using the following criteria:

Indicator	Weight for Length (Wasting)	Weight for Age(Underweight)	Length for Age (Stunting)	MUAC
Severe	<-3 SD	<-3 SD	<-3 SD	<11.5cm
Moderate	≥-3 SD to <-2 SD	≥-3 SD to <-2 SD	≥-3 SD to <-2 SD	≥11.5cm to <12.5 cm
Low	≥-2 SD to <-1SD	≥-2 SD to <-1SD	≥-2 SD to <-1SD	12.5 cm
Normal	≥-1 SD to < 2 SD	≥-1 SD to <2 SD	≥-1 SD to < 2 SD	>12.5 cm
Overweight	≥2 SD	≥2 SD	≥2 SD	

Table 2: WHO cutoff Points for Undernutrition

Data obtained was analyzed using the IBM SPSS statistics Version 20 software. This included analysis of the frequencies (percentages, means and standard deviation of the study population), t-tests, and correlation tests and multivariate tests. Pearson correlation was used to determine the degree of relationship between pairs of continuous variables.

Multivariate analysis of variance (MANOVA) was performed using a general linear model (GLM). The model was used to analyze the simultaneous effects of the predisposing factors on undernutrition represented by the Z scores. The factors that were analyzed in the model included: sex, exposure to HIV, Income, use of supplements, food aid, food utilization, food accessibility, food affordability, birthweight, age of infants, number of children in the household, number of adults in the household, and the number of meals. The study evaluated the effect size using the values of Pillai's trace partial eta squared (η^2).

Variables without significant effect were removed through a backward procedure. Cohen's effect size index was computed to summarize the qualitative effects between the variables (Cohen, 1977). This evaluation served as a reference to identify the overall effect size of the analyzed variables. As such, an indication of a large effect size meant that the evaluated variable had a great influence on the under-nutrition status of the infants. P-values for the study were considered statistically significant at 95% confidence levels ***(p=0.05)***.

The effect sizes were classified as follows:

- small ($\eta_p^2 < 0.030$),
- medium ($0.030 \leq \eta_p^2 < 0.100$) and
- large ($\eta_p^2 \geq 0.100$).

Ethical considerations

Permission to undertake the research was obtained from the Ministry of Health through the Project manager of the Comprehensive Care Clinic of the Mater Hospital (Annex 2). Informed consent to the mothers and care providers was provided both in English and Swahili. Confidentiality of all those who chose to participate was maintained. Information collected was also within confidentiality parameters. In return, caregivers of participating infants in the study received information about the nutritional status and referrals made for follow up about their status where necessary.

Chapter 4: Results and Discussion

Results

Nutrition Status

Figure 2 below shows the distribution of the sample that the study evaluated. Out of 160 infants, 90 were HEU and 70 HUU:

HEU (n=90) Female: n=48; Male: n=42

HUU (n=70) Female: n=39 ; Male:n=31

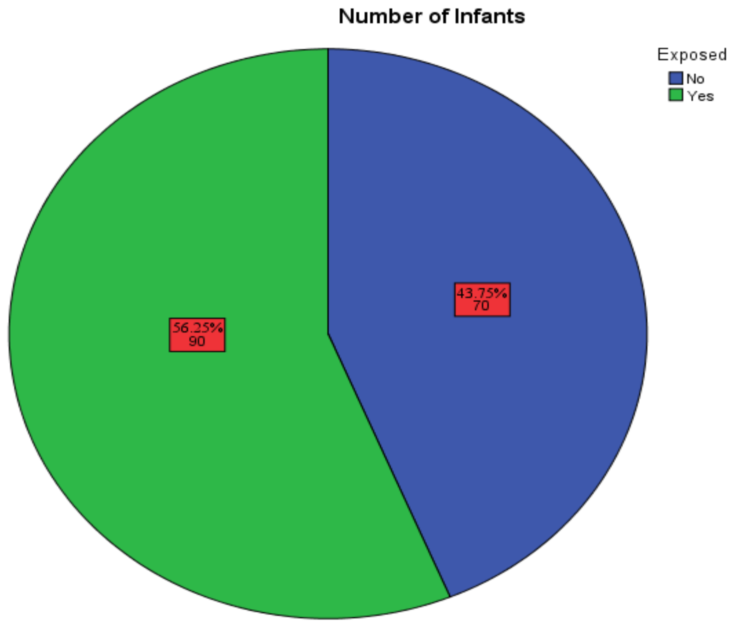


Figure 2: HEU vs HUU Infants

The mean age of the infants was almost similar for better comparisons. The two groups of infants, HEU and HUU had an average age of 12 months and was distributed as shown on Table 3 below:

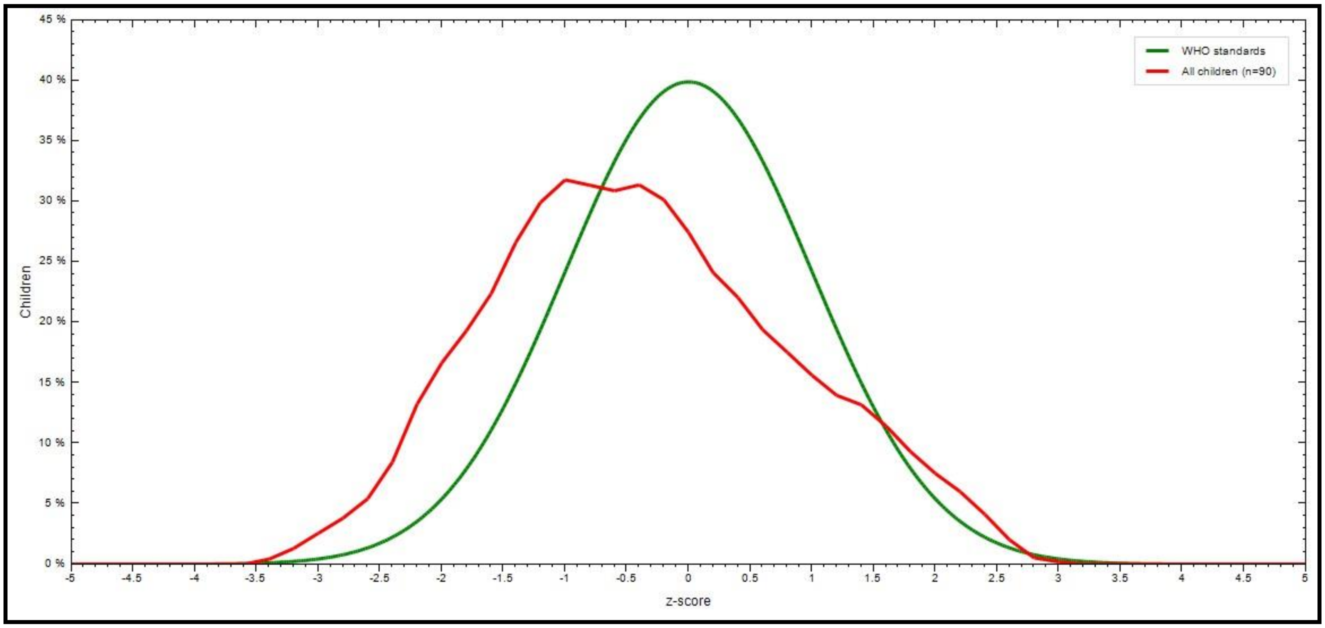
	Exposed	N	Mean
age of children (months)	No	70	11.951
	Yes	90	12.573

Table 3: Mean Age of Infants

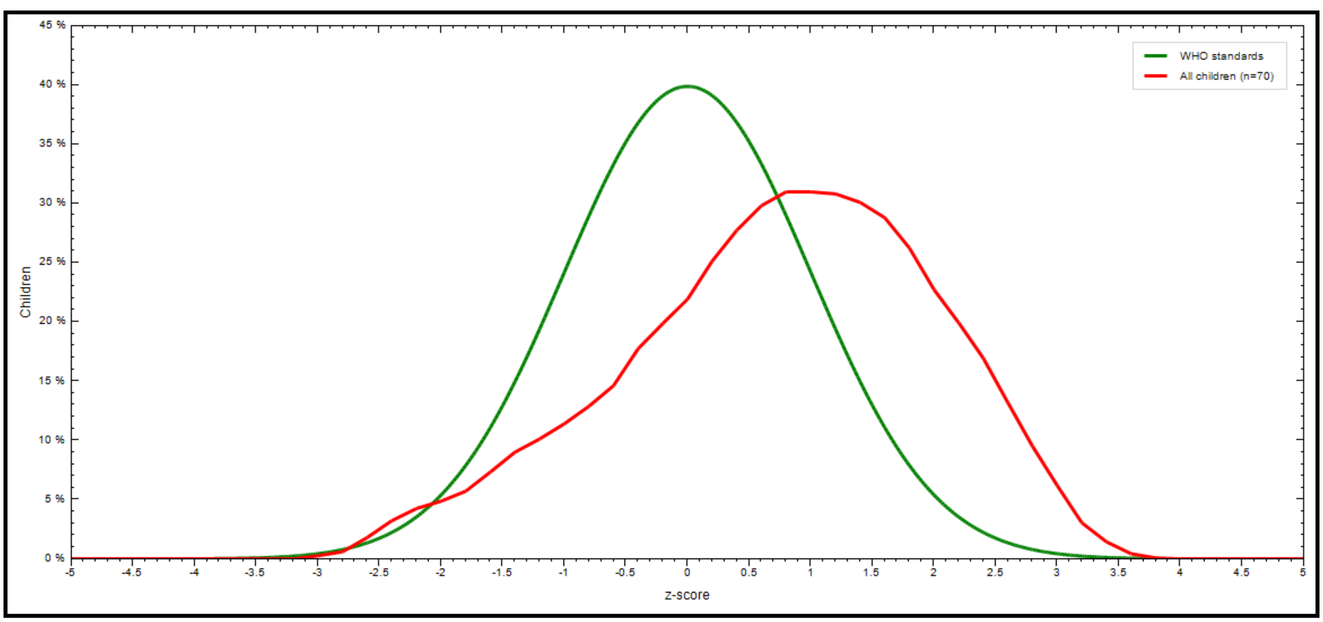
After computation of the Z scores, the study recorded differences in curve distribution between the study subjects and the WHO growth curves. These differences in distribution were also noted when comparing growth between the sexes.

Weight for Length:

HEU



HUU



Key: WHO standards: Sample:

X axis- Z Score Y Axis-Percentage of children

Figure 3: Distribution of the Study population according to the Weight and length indices

Figure 3 above shows that the HEU distribution curve shifted to the right when compared to the WHO standards. The HUU distribution curve shifted to the left when compared to the WHO reference curves. Thus, the median of the two groups, HEU and HUU was lower than that of the WHO standard.

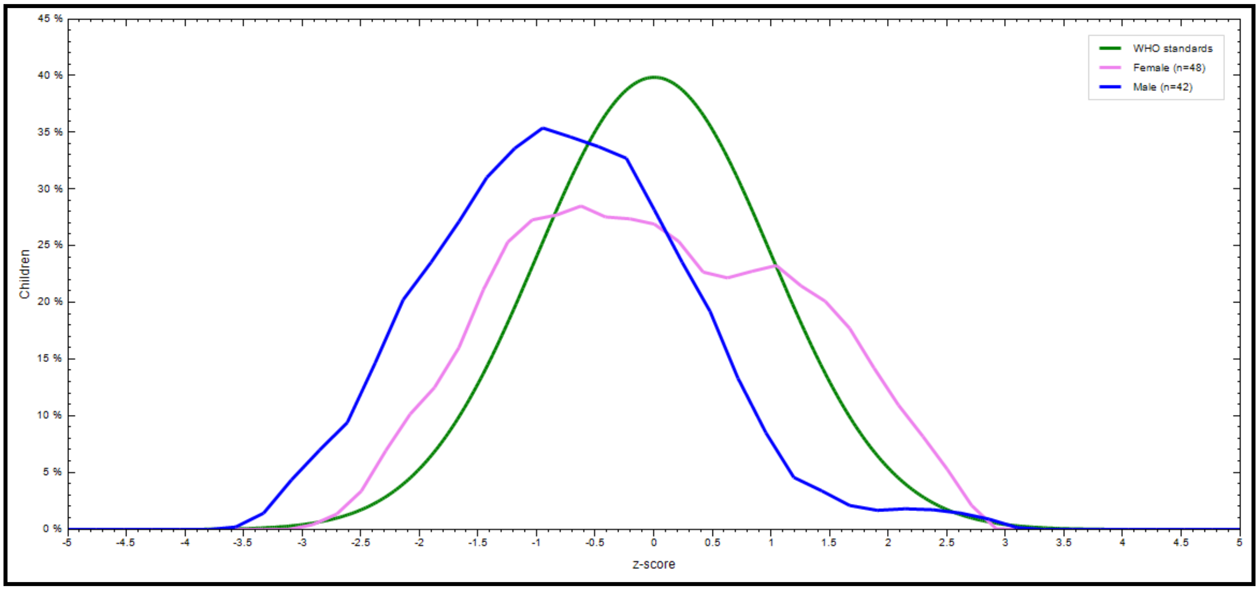
Exposed		**N**	**Mean**	**Std. Deviation**	**P values**
	No	70	.7320	1.18601	**<0.001**
	Yes	90	-.3760	1.15402	**0.003**

Table 4: Comparison of the mean Weight for Length of HEU VS HUU

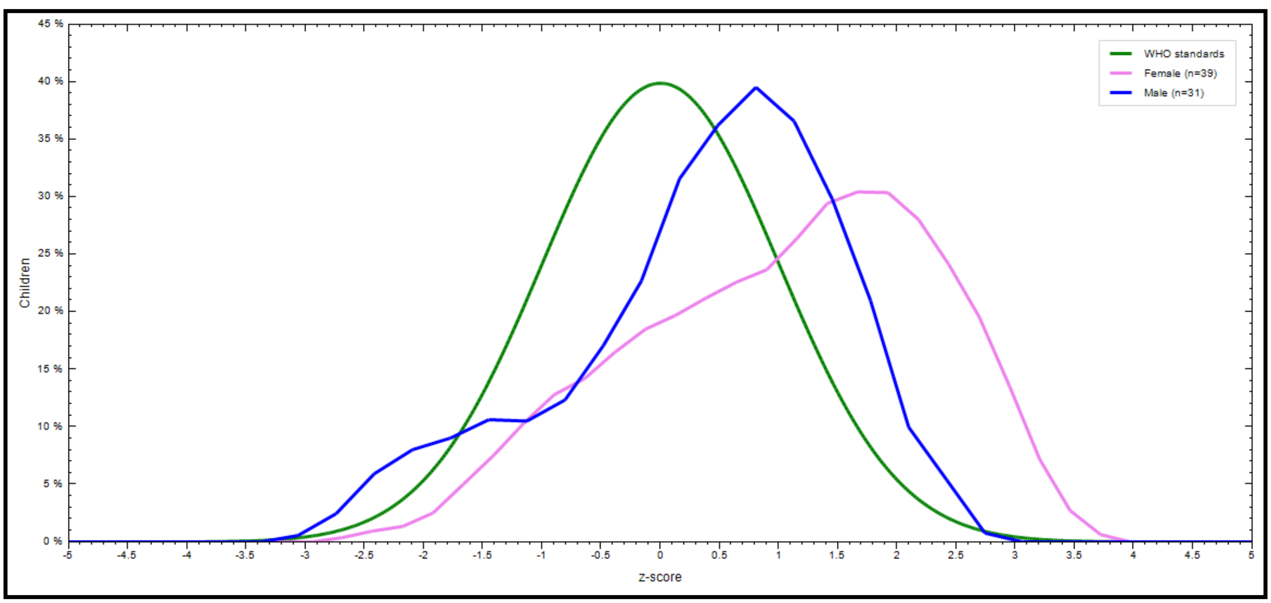
Table 4 above indicates that the mean of the exposed infants ***(-0.3760)*** was lower than that of the unexposed infants ***(0.7320)***. The HEU infants were found to have a lesser mean than the HUU group. The weight for length were significantly lower for HEU **(*p<0.001*)** and higher for HUU **(*p=0.003*)** infants when compared with the WHO standards.

Comparisons between Genders:

HEU



HUU



Key: WHO standards: Female: Male:

X axis- Z Score Y Axis-Percentage of children

Figure 4: Distribution of the study population per the weight for length and gender

From the figure 4 above, the study observed that in the HEU group, the curve of the male infants was shifted to the lower side more than that of the female infants ***(p<0.001).*** In the HUU group, the female curve was shifted to the higher side more than that of the male infants the curve of the female infants ***(p<0.001).***

Exposed			N	Mean	Std. Deviation	P values
	No	F	39	1.0374	1.19035	<0.001
		M	31	.3477	1.08009	0.083
	Yes	F	48	-.0090	1.14707	0.957
		M	42	-.7955	1.02205	<0.001

Table 5: Comparison of the mean Weight for Length of HEU/HUU to Zero according to Gender

Table 5 above shows the comparison of each group with the WHO standards. The study found that in the HEU group, male infants had a lower mean ***(-0.7955)*** than the WHO reference while the female infants had a slightly lower mean ***(-0.0090)*** than the WHO standards. Both the female and male infants in the HUU group had a higher mean ***(1.0374)*** and ***(0.3477)*** respectively than the WHO standards.

From the data collected, the weight for Length Z scores was distributed as follows:

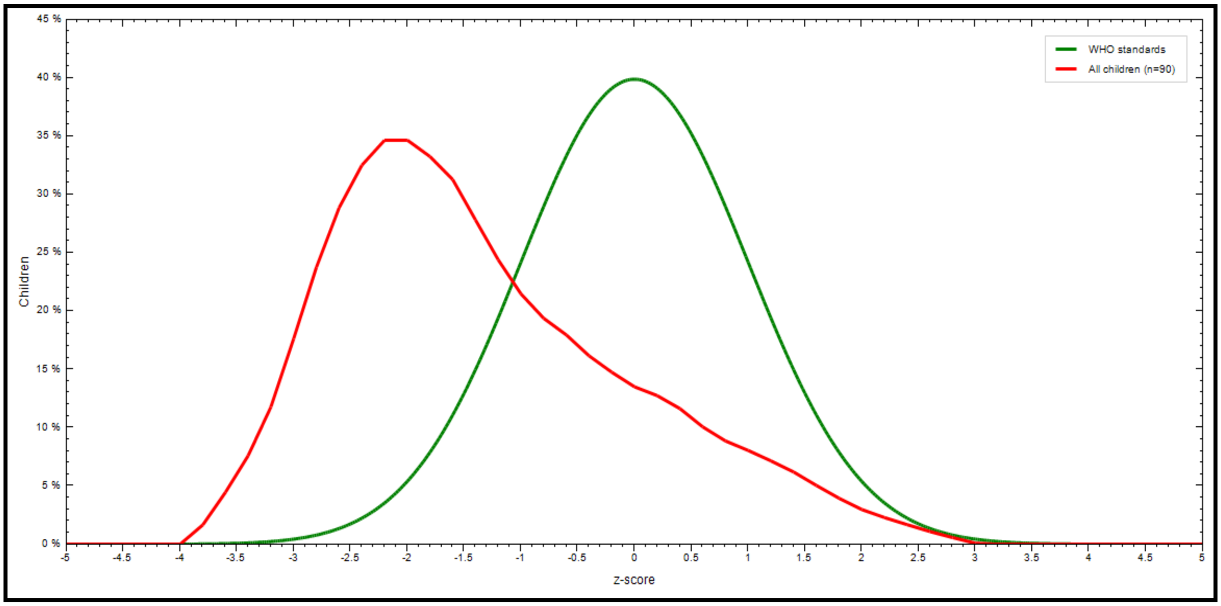
	Exposed		**P values**
	No % (n)	Yes % (n)	
Z in [-3; -2[	1.4% (1)	**5.6% (5)**	**0.001**
Z in [-2;2]	81.4% (57)	**93.3% (84)**	
z>2	17.1% (12)	1.1% (1)	

Table 6: WFLZ Score Distribution of the sample

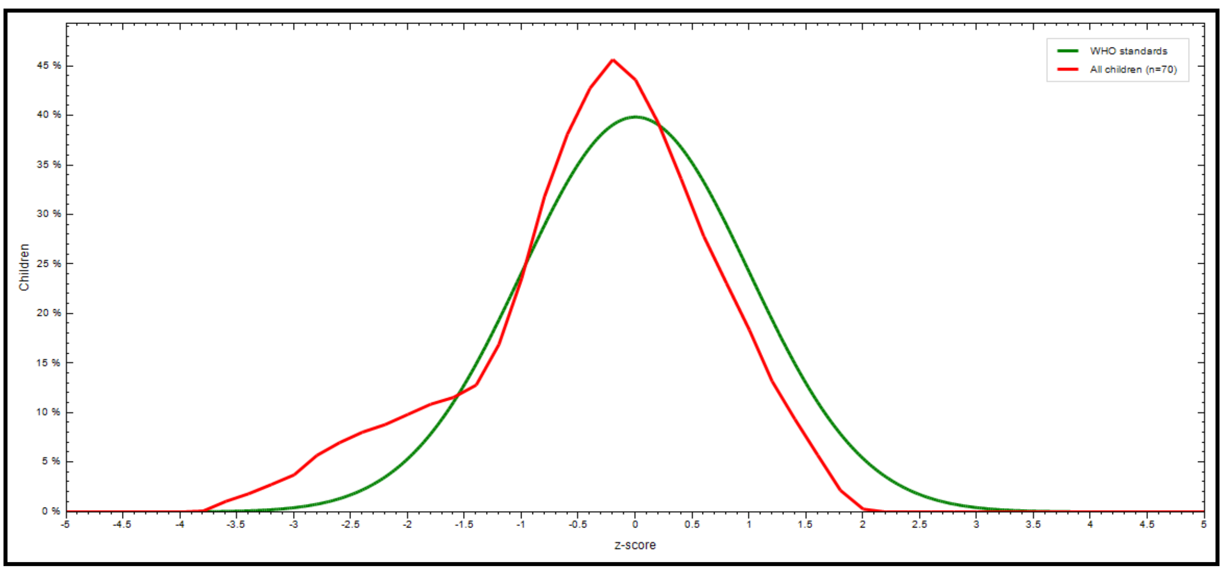
From Table 6 above, ***P=0.001*** was less than ***p=0.05***. Thus, the study concluded that, at 95% confidence levels, there was a significant relationship between wasting and HIV exposure to infants. More HEU infants were mildly **(93.3%)** wasted and moderately wasted **(5.6%)** as compared to the HUU infants.

Length for Age:

HEU



HUU



Key: WHO standards: Sample:

X axis- Z Score Y Axis-Percentage of children

Figure 5: Distribution of the study population according to the Length for Age

Figure 5 shows that the length for age curve of the HEU infants was shifted towards the right and had a lower median as compared to the WHO reference curve. However, there was an almost coincidence on the sides of the curve of the HUU study group with that of the WHO reference curve, but with a shift in the curve of the study population towards the top.

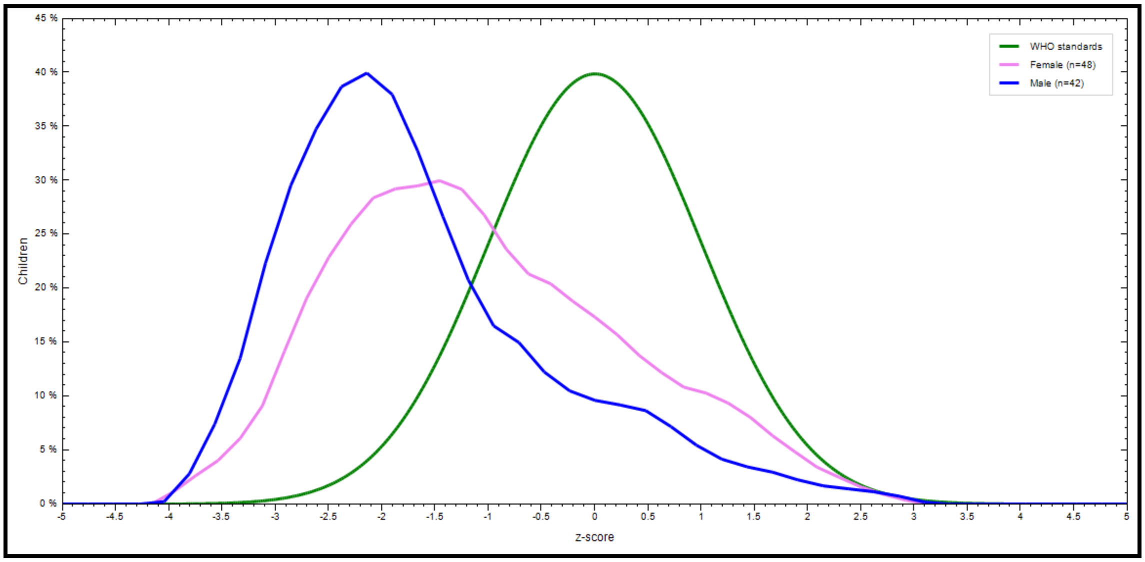
Exposed		**N**	**Mean**	**Std. Deviation**	**P values**
	No	70	-.3597	.98155	**0.003**
	Yes	90	-1.3173	1.25977	**<0.001**

Table 7: Comparison of the mean Length for Age of HEU VS HUU

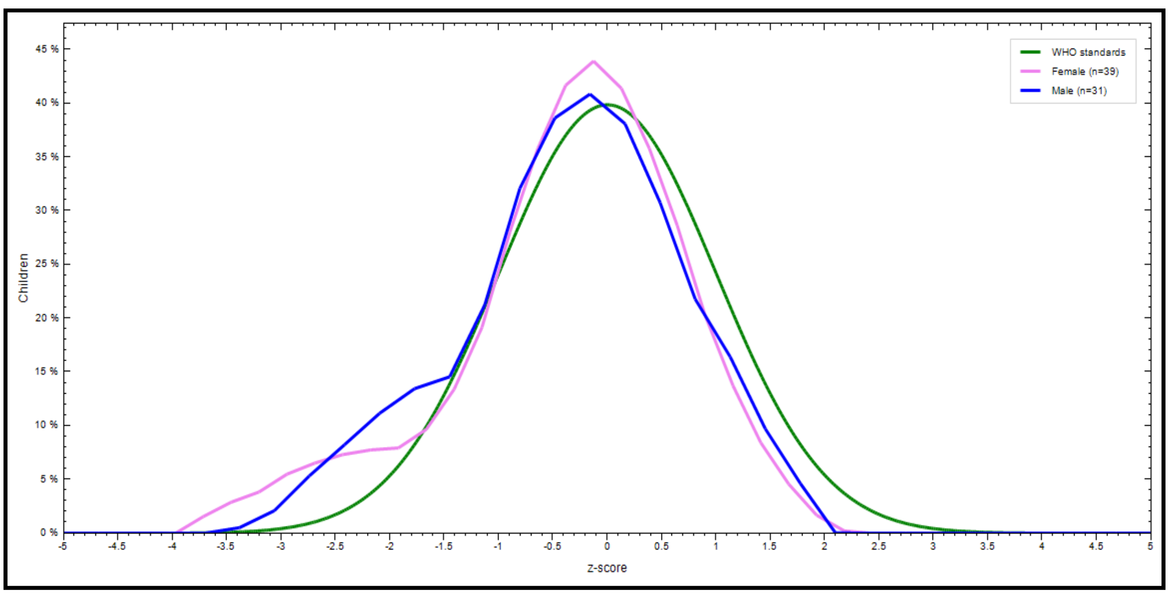
Table 7 shows that the mean of the exposed infants ***(mean= -1.3173; p<0.001)*** was significantly lower than that of the unexposed infants ***(mean= -0.3597; p=0.003)***.

Comparison with Gender

HEU



HUU



Key: WHO standards: Female: Male:

X axis- Z Score Y Axis-Percentage of children

Figure 6: Distribution of the study population according to the Length for age and gender

From the figure 6 above, the study observed that in the HEU group, the curves of both the male ***(p<0.001)*** and female ***(p<0.001)*** infants was shifted to the right side. In the HUU group, the female and male curves almost coincided with the WHO reference curve.

Exposed			N	Mean	Std. Deviation	P values
	No	F	39	-.3703	1.00835	0.027
		M	31	-.3465	.96316	0.054
	Yes	F	48	-1.0494	1.26875	<0.001
		M	42	-1.6236	1.19144	<0.001

Table 8: Comparison of the mean LFAZ of HEU/HUU to Zero according to Gender

Table 8 shows the comparison of each group with the WHO standards. The study found that in the HEU group, male infants had a lower mean ***(-1.6236)*** than the WHO reference while the female infants also had a lower mean ***(-1.0494)*** than the WHO standards. Both the female and male infants in the HUU group had a lower mean ***(-0.3703)*** and ***(-0.3465)*** respectively than the WHO standards.

From the data collected, Length for Age Z Scores were distributed as follows:

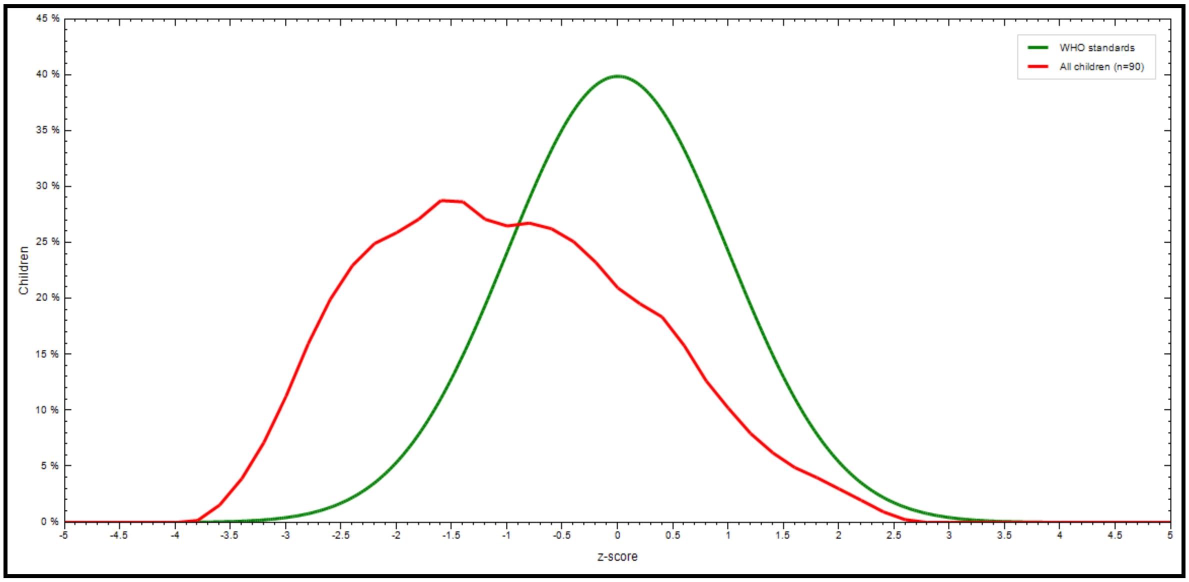
	Exposed		**P values**
	No % (n)	Yes % (n)	
Z in [-3; -2[	10.0%(7)	38.9% (35)	**<0.001**
Z in [-2;2]	90.0% (63)	60.0% (54)	
z>2	0.0% (0)	0.6% (1)	

Table 9: LFAZ Score Distribution

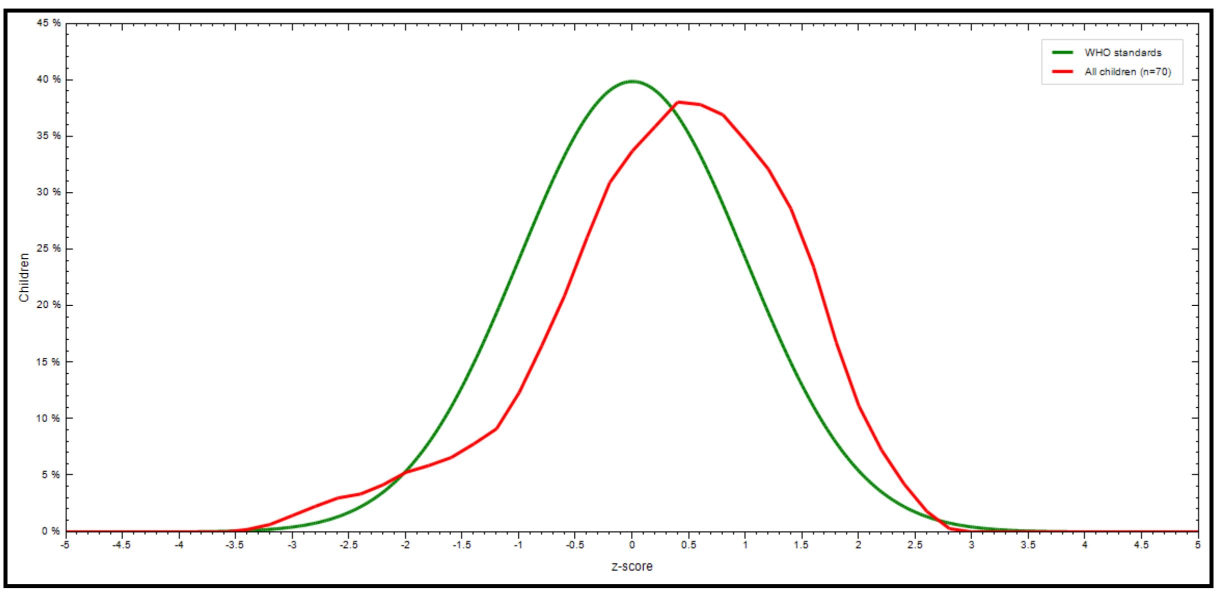
Table 9 shows that, from the data collected, ***(p=<0.001)*** was lower than (***p=0.05)***. Consequently, there was a statistical significant relationship between stunting and the HIV exposure among the infants at 95% confidence levels. There were more HEU infants **(38.9%)** who were moderately stunted as compared to the HUU infants **(10.0%)**.

Weight for Age:

HEU



HUU



Key: WHO standards: Sample:

X axis- Z Score Y Axis-Percentage of children

Figure 7: Distribution of the study population according to their weight for Age

From figure 7 above, the Weight for Age curve of the HEU infants shifted towards the lower bound and had lower medians as compared to the WHO reference curves. The HUU curve however, had a minor shift on the lower bounds as compared to the WHO reference curve.

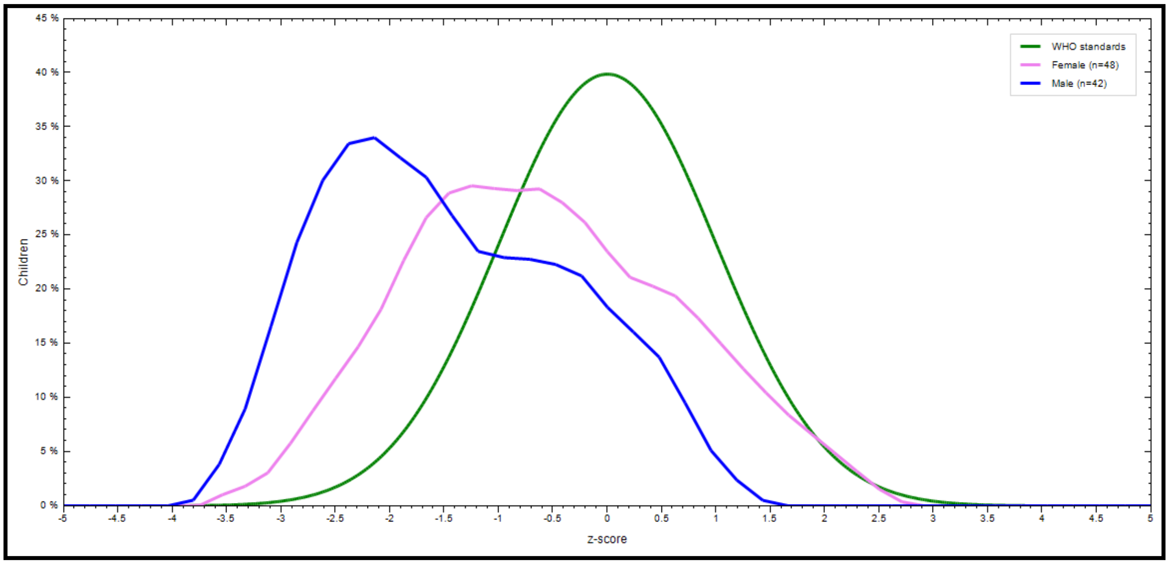
Exposed		**N**	**Mean**	**Std. Deviation**	**P values**
	No	70	.3259	1.01573	**0.009**
	Yes	90	-.9850	1.18927	**<0.001**

Table 10: Comparison of the mean Weight for Age of HEU VS HUU

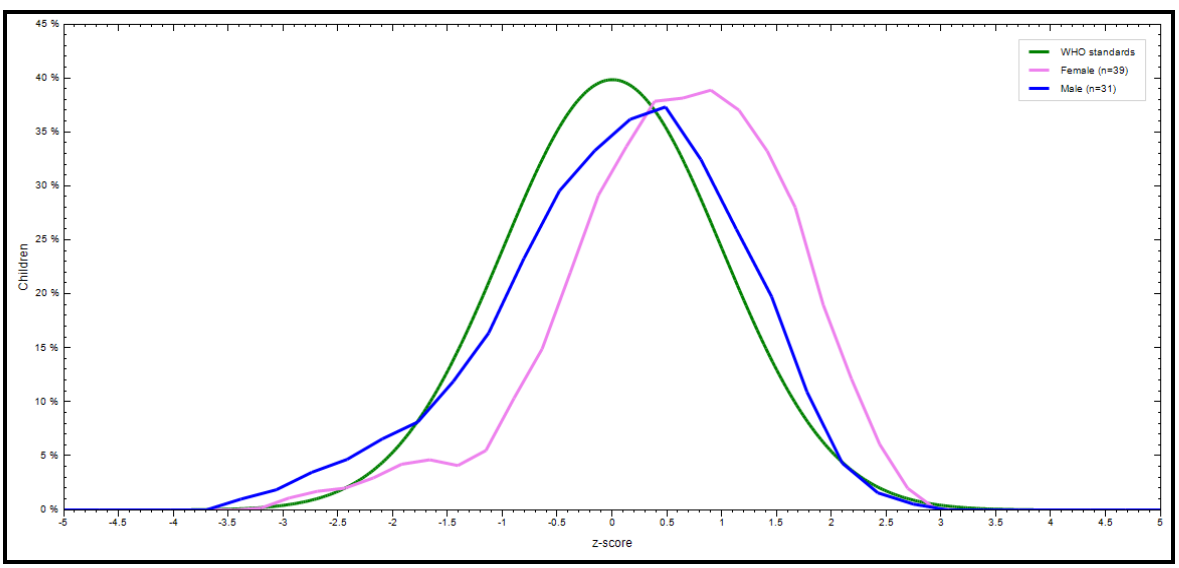
Table 10 shows that the mean of the exposed infants ***(mean= -0.9850; p<0.001)*** was statistically lower when compared to the reference population than that of the unexposed infants ***(mean= 0.3259; p=0.009)***.

Comparison with Gender

HEU



HUU



Key: WHO standards: Female: Male:

X axis- Z Score Y Axis-Percentage of children

Figure 8: Comparison of the weight for age with gender

From the figure 8 above, the study observed that in the HEU group, the female curve shifted lower than that of the male curve ***(p<0.001).*** The male curve in the HUU group however, shifted lower than the female curve and almost coincided with the WHO reference curve ***(p=0.001)***.

Exposed			N	Mean	Std. Deviation	P values
	No	F	39	.5605	.95981	**0.001**
		M	31	.0306	1.02196	**0.869**
	Yes	F	48	-.5877	1.16667	**<0.001**
		M	42	-1.4390	1.05542	**<0.001**

Table 11: Comparison of the mean Weight for Age of HEU/HUU to Zero according to Gender

Table 11 shows the comparison of each group with the WHO standards. The study found that in the HEU group, male infants mean ***(-1.4390)*** and the female infants mean ***(-0.5877)*** were lower than the WHO reference. In the HUU group the mean of the female ***(0.5605)*** and male infants ***(0.0306)*** were slightly higher than the WHO reference curve.

The WFAZ was distributed in the sample as follows:

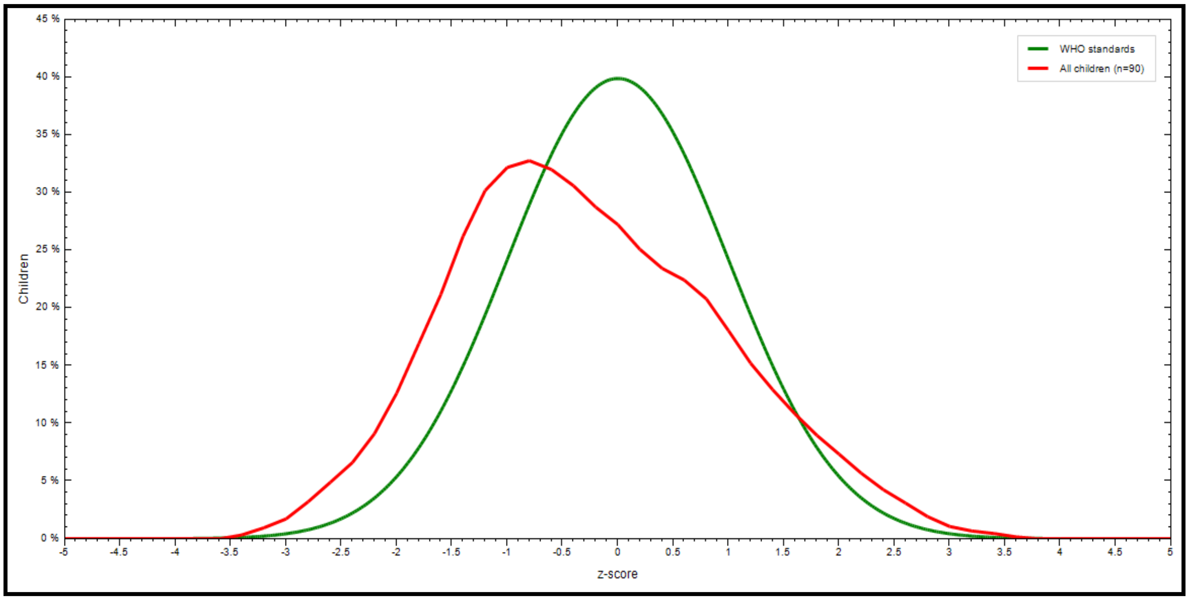
	Exposed		**P values**
	No % (n)	Yes % (n)	
Z in [-3; -2[	4.3%(3)	24.4% (22)	**0.001**
Z in [-2;2]	94.3% (66)	75.6% 68)	
z>2	1.4% (1)	0.0% (0)	

Table 12: WFA-Z Score Distribution

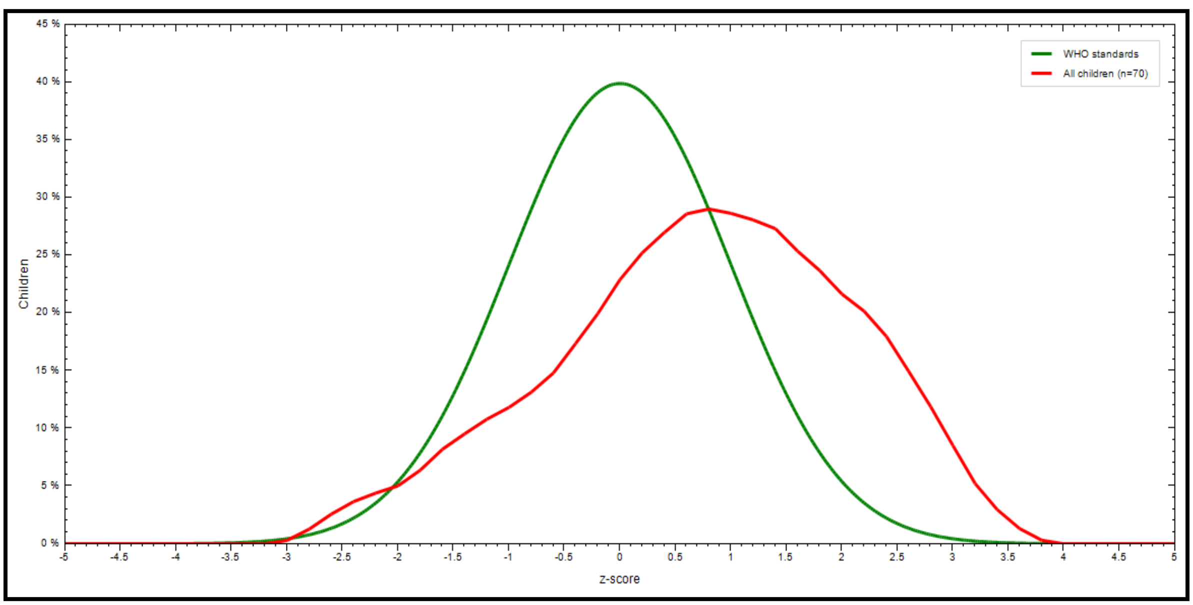
Table 12 shows that ***P=0.001*** was less than ***p=0.05***, therefore at 95% confidence levels, there was a significant relationship between the incidence of underweight and HIV exposure among infants. Consequently, more infants in the HEU group **(24.4%)** were considered moderately underweight as compared to those in the HUU group **(4.3%)**.

BMI for Age:

HEU



HUU



Key: WHO standards: Sample:

X axis- Z Score Y Axis-Percentage of children

Figure 9: Distribution of the Study Population According to their BMI for Age

From figure 9, the BMI for Age curve shifted to the lower bound as compared to the WHO reference curve for the HEU infant group. This was also similar in the HUU infant group that had their BMI for Age curve shifting on the lower bound as compared to the WHO reference curve.

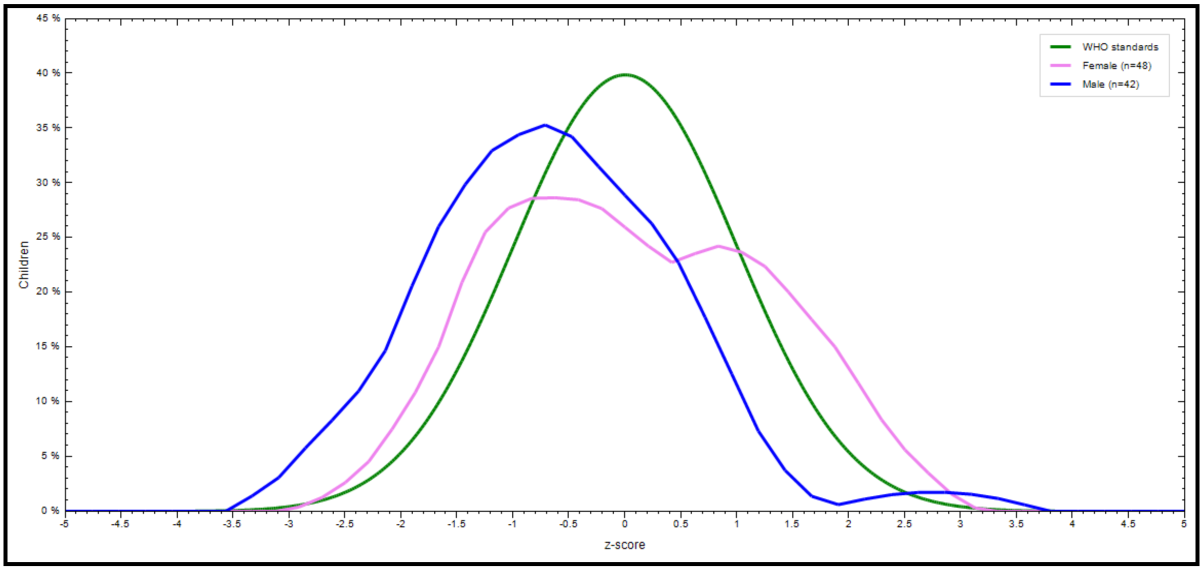
Exposed		**N**	**Mean**	**Std. Deviation**	**P values**
	No	70	.7373	1.25471	**<0.001**
	Yes	90	-.2701	1.15457	**0.029**

Table 13: Comparison of the mean Weight for Age of HEU VS HUU

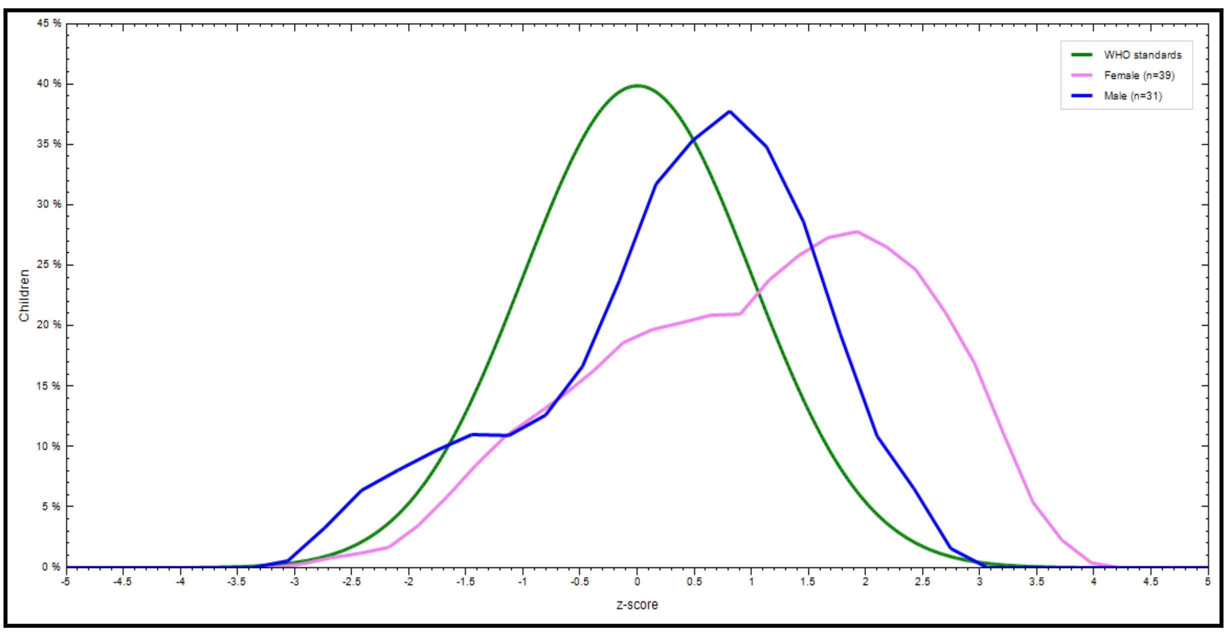
Table 13 shows that the mean of the exposed infants ***(mean= -0.2701; p=0.029)*** was significantly lower when compared to the reference population than that of the unexposed infants ***(mean= 0.7373) (p<0.001)***.

Comparison with Gender

HEU



HUU



Key: WHO standards: Female: Male:

X axis- Z Score Y Axis-Percentage of children

Figure 10: Distribution of the BMI for Age in Comparison with Sex

From the figure 10 above, the study observed that in the HEU group, female curve ***(p=0.725)*** among the HEU infants shifted lower than that of the male infants ***(p<0.001)*** in reference to the WHO curve. This was similar to the HUU infant group that had the female curve (***p<0.001)*** shift lower than that of the male infants ***(p<0.001)*** in comparison with the WHO reference curve.

Exposed			N	Mean	Std. Deviation	P values
	No	F	39	1.0638	1.27902	**<0.001**
		M	31	.3265	1.11162	0.112
	Yes	F	48	.0583	1.14325	0.725
		M	42	-.6455	1.06052	**<0.001**

Table 14: Comparison of the mean BMI for Age of HEU/HUU to Zero according to Gender

Table 14 shows the comparison of each group with the WHO standards. The study found that in the HEU group, male infants had a lower mean ***(-0.6455)*** than the WHO reference while the female infants also had a slightly higher mean ***(0.0583)*** than the WHO standards. Both the female and male infants in the HUU group had a higher mean ***(1.0638)*** and ***(0.3265)*** respectively than the WHO standards.

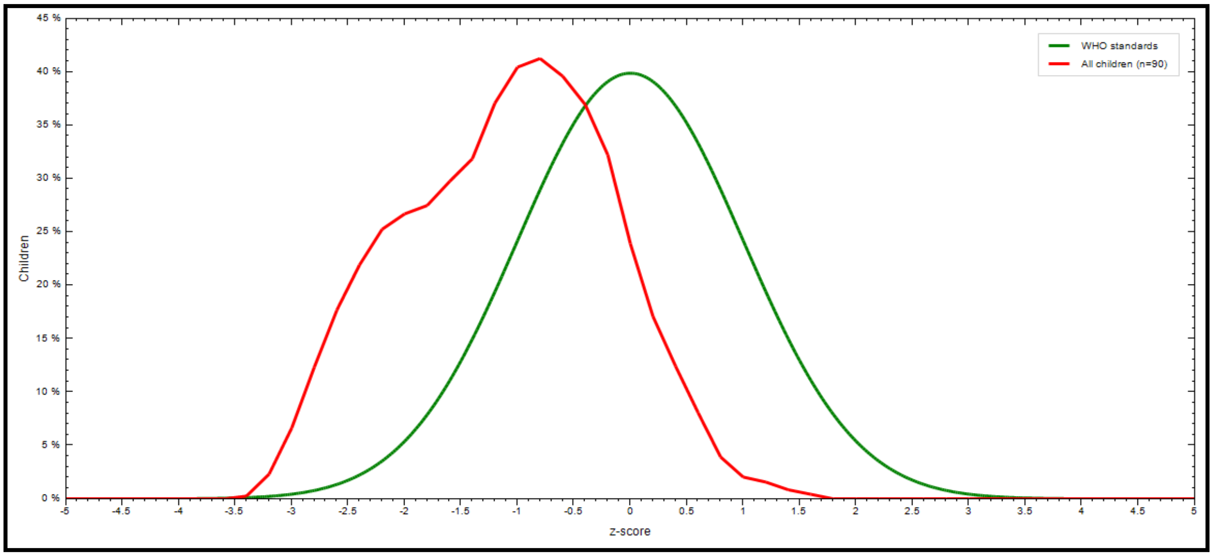
	Exposed		**P values**
	No % (n)	Yes % (n)	
Z in [-3; -2[	1.4%(1)	5.6% (5)	**0.002**
Z in [-2;2]	78.6%(55)	91.1% (82)	
z>2	20.0%(14)	3.3% (3)	

Table 15: BAZ Score Distribution

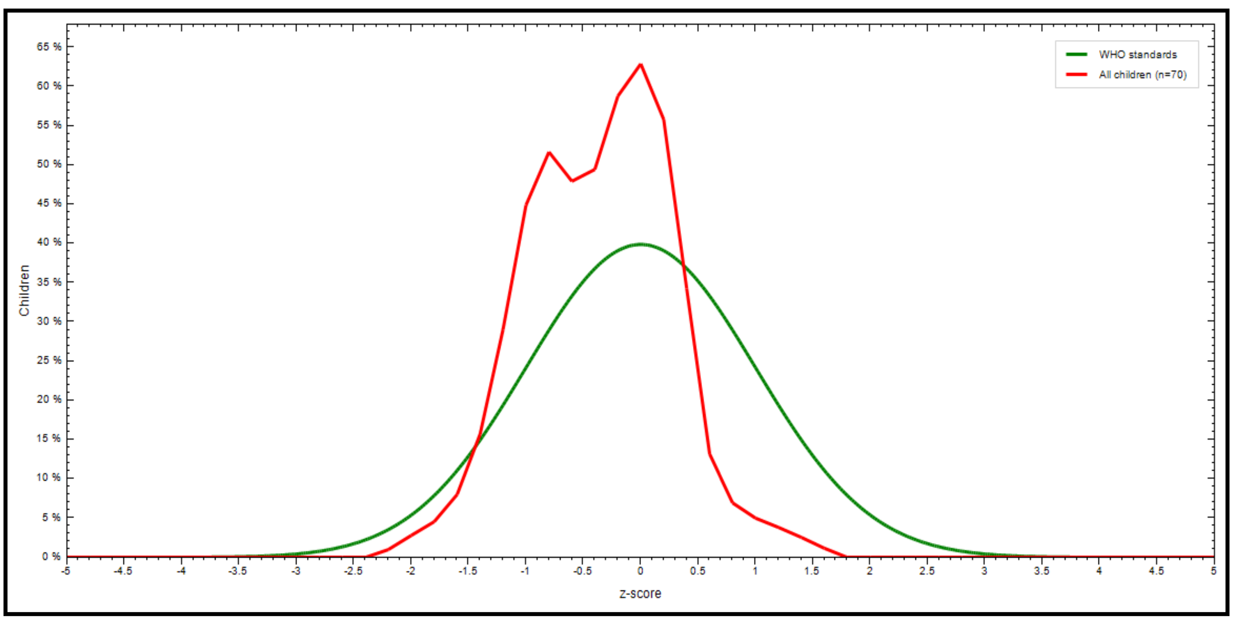
Table 15 demonstrates that, from the data, ***p=0.002*** was less than ***p=0.05***. Therefore, at 95% confidence levels, the study concluded that there was a significant relationship between lower BMI levels and the incidence of HIV exposure to infants. There was a higher number of mildly underweight infants **(91.1%)** and moderately underweight infants **(5.6%)** in the HEU group as compared to **(78.6%)** and **(1.4%)** in the HUU group respectively.

MUAC for Age:

HEU



HUU



Key: WHO standards: Sample:

X axis- Z Score Y Axis-Percentage of children

Figure 11: Distribution of the MUAC Z score with age

Figure 11 demonstrates that the MUAC curve for the HEU infants shifted to the right as compared to the WHO reference curve and had a lower median. The MUAC curve for the HUU infants had a higher median with fluctuations of the MUAC values at the top.

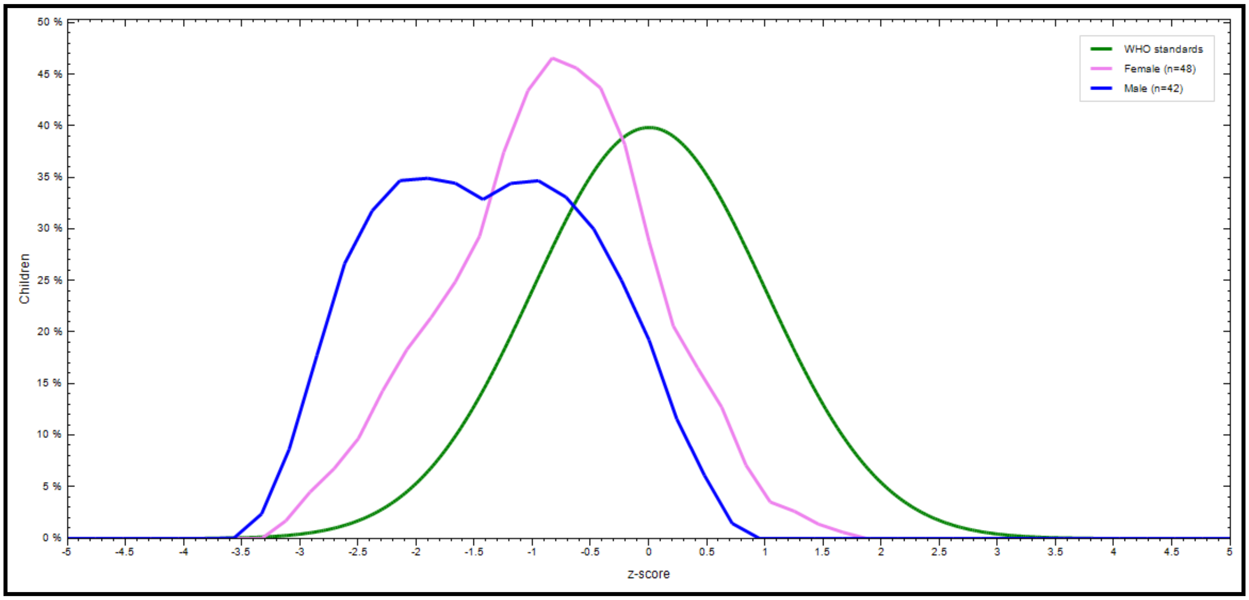
Exposed		**N**	**Mean**	**Std. Deviation**	**P values**
	No	70	-.3566	.59604	**<0.001**
	Yes	90	-1.1066	.87646	**<0.001**

Table 16: Comparison of the mean MUAC measures of HEU VS HUU

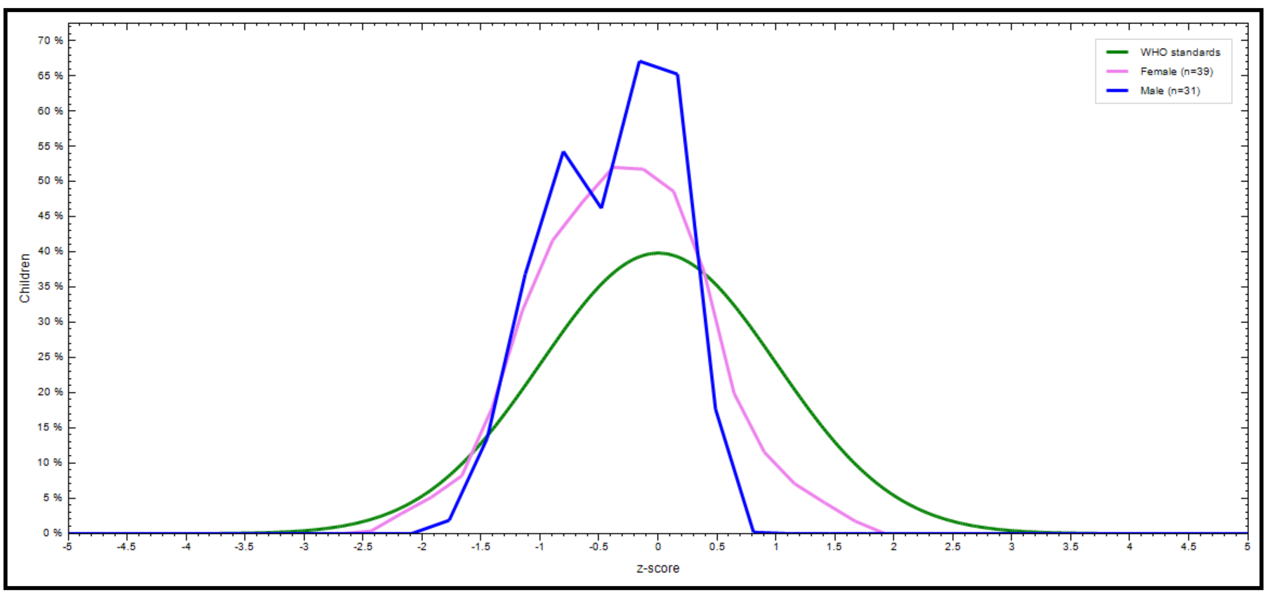
Table 16 illustrates that the mean of the exposed infants ***(mean= -1.1066; p<0.001)*** was lower than that of the unexposed infants ***(mean= -0.3566; p<0.001)***.

Comparison with Gender

HEU



HUU



Key: WHO standards: Female: Male:

X axis- Z Score Y Axis-Percentage of children

Figure 12: Distribution of the MUAC Z scores as compared with Gender

From the figure 12 above, the study observed that in the HEU group, the female infants ***(p<0.001)*** had a shifted on the higher side as compared to that of the male infant's curve ***(p<0.001).*** The female MUAC curve ***(p=0.005)*** in the HUU infant group shifted on the lower side than that of the male infants ***(p<0.001).***

Exposed			N	Mean	Std. Deviation	P values
	No	F	39	-.3210	.67197	**0.005**
		M	31	-.4013	.49136	**<0.001**
	Yes	F	48	-.8490	.82238	**<0.001**
		M	42	-1.4010	.85193	**<0.001**

Table 17: Comparison of the mean MUAC measures of HEU/HUU to Zero according to Gender

Table 17 shows the comparison of each group with the WHO standards. The study found that in the HEU group, male ***(-1.4010)*** and female infants ***(-0.8490)*** had lower mean values than the WHO reference, while the female ***(-0.3210)*** and male infants ***(-0.4013)*** also had lower mean values than the WHO standards in the HUU group.

	Exposed		**P values**
	No % (n)	Yes % (n)	
Z in [115;125[mm	1.4% (1)	16.7% (15)	**0.001**
Z >=125mm	98.6% (69)	83.3% (75)	

Table 18: MUAC-Z Score Distribution

Table 18 confirms the trend on the growth curves, indicating that the ***(p=0.001)*** was lower than ***(p= 0.05)*** set for the study. Thus, the study concluded that at 95% confidence levels, there was a significant relationship between wasting and exposure to HIV among infants. More HEU infants **(16.7%)** were considered moderately malnourished as compared to the HUU infants who were moderately malnourished **(1.4%)**.

Birth Weight

Birth weight was classified as follows according to the World Health Organization methods (Organization, 2004).: >2.5kg: Normal Birth Weight

≤ 2.5 kg: Low Birth weight

The mean birth weight of the HEU infants was 2.953 while that of the HUU infants was 3.195. Birthweight measures of the sample size were as shown on table 19 below:

Birth Weight	Number of Children (n=160)	Percentage
>2.5 kg	133	82.1
≤2.5kg	27	16.7

Table 19: Birthweight Distribution among the HEU and HUU infants

There was no statistical significant relationship between HIV exposure and low birth weight. However, the birth weight of all the infants determined their anthropometric measures and was statistically significant in determining their WFLZ, LFAZ, WFAZ, and their BAZ scores and not the MUACZ score as shown in the table 20 below:

		WFLZ	LFAZ	WFAZ	BAZ	MUACZ
Birth Weight	Pearson Correlation	0.245	0.200	0.291	0.239	0.093
	P values	0.002	0.011	<0.001	0.002	0.243

Table 20: Birthweight and HEU infants' Z Scores

Food Insecurity-Related Variables

Food Affordability

Regarding Food affordability, the study found out the following as shown on table 21:

	Exposed		**P values**
	No % (n)	Yes % (n)	
Could afford Food	85.7% (60)	82.2% (74)	**0.553**
Could not afford Food	14.3%(10)	17.8%(16)	

Table 21: Relationship between food Availability with HIV Exposure

There was no significant relationship between HIV exposure and food affordability. Households that were exposed to HIV recorded slightly lower numbers of food affordability (82.2%) as opposed to the unexposed homesteads (85.7%).

Food accessibility

From the data collected, the respondents indicated that:

	Exposed		**P values**
	No % (n)	Yes % (n)	
Can access food	41.7%(48)	58.3%(67)	**0.412**
Cannot access food	31.4%(22)	25.6%(23)	

Table 22: Relationship between food accessibility and HIV Exposure

Table 22 shows no significant statistical relationships between HIV exposure and food accessibility. There was a higher number of HIV exposed households (58.3%) that indicated ease of food accessibility as opposed to the unexposed households (41.7%). But this difference was non-significant.

Food utilization

This was classified into:

- Slow- food was considered to stay longer after purchasing due to HIV exposure
- Normal- Food stayed for periods considered normal in the households to HIV exposure
- Fast- Food was used faster than normal due to the HIV exposure

	Exposed		**P values**
	No % (n)	Yes % (n)	
Slow	24.3% (17)	30.0% (27)	**0.728**
Normal	47.1% (33)	52.2% (36)	
Fast	28.6% (20)	30.0% (27)	

Table 23: Relationship between Food Utilization and HIV Exposure

According to table 23**,** there was no statistical significant relationship between food utilization and HIV exposure among the households evaluated in the study.

Food aid

	Exposed		**P values**
	No % (n)	Yes % (n)	
Receive food	45.7% (32)	30.0% (27)	**0.041**
Do not Receive food	54.3% (38)	70.0% (63)	

Table 24: Relationship Between food aid and HIV Exposure

In this case, as shown on table 24, there was a statistically significant relationship between food aid or donations and HIV exposure in the households. Households that were exposed to HIV were less likely to receive food donations **(30.0%)** than those that were not exposed.

As well, the study evaluated food aid and how it affected undernutrition in general.

	Receive food	N	Mean	Std. Deviation	P values
Birth Weight	No	101	3.043	.5277	0.628
	Yes	59	3.086	.5664	
WFLZ	No	101	-.0109	1.21878	0.125
	Yes	59	.3136	1.38626	
LFAZ	No	101	-.8304	1.23738	0.365
	Yes	59	-1.0147	1.24189	
WFAZ	No	101	-.4675	1.23387	0.474
	Yes	59	-.3156	1.38727	
BFAZ	No	101	.0400	1.24605	0.096
	Yes	59	.3942	1.36006	
MUACZ	No	101	-.6948	.78741	0.104
	Yes	59	-.9217	.93873	

Table 25: Relationship Between Food Aid and Nutrition Status

The table 25 above shows that the infants who were in households that received food, were most likely to have higher BFAZ, WFAZ and WFLZ; lower birth weights, LFAZ and MUACZ, however without any statistical significance.

Household Composition

Number of adults

This was classified per the number of adults living within the households in the study sample. This was presented as shown on table 26 below:

	Exposed		P values
	No	Yes	
Number of Adults	% (n)	% (n)	
1	8.6% (6)	24.4% (22)	**0.016**
2	42.9% (30)	45.6% (41)	
3	40.0% (28)	16.7% (15)	
4 and above	8.6% (6)	13.3% (12)	

Table 26: Relationship between number of Adults and HIV Exposure

There was a significant relationship between the number of adults in a household and HIV exposure. Households that were exposed to HIV and had HEU infants, were most likely to have lesser number of adults as compared to those who were not affected by the virus. Most of the HEU infants lived with either 1 or 2 adults in their homes as opposed to HUU infants who lived with either 2 or 3 adults.

Number of children

	Exposed		P values
	No	Yes	
Number of Children	% (n)	% (n)	
1	51.4% (36)	23.3% (21)	**<0.001**
2	24.3% (17)	33.3% (30)	
3	18.6% (13)	31.1% (28)	
4 and above	5.7% (4)	12.2% (11)	

Table 27: Relationship between number of Children and HIV Exposure

As shown on table 27 above, there was a significant relationship between the number of children and HIV exposure. Households with higher number of children were most likely to be affected by HIV and vice versa. HEU infants therefore, were more likely to live with a higher number of siblings or infants either ≥2 as compared to the HUU group who were more likely to be with 1 infant.

Income

The study predefined the levels of income as follows:

</= 10,000 Kenya shillings per month- Low Income

10,001 to 20,000 Kenya shillings per month- Normal Income

>20,000 Kenya shillings per month- High income

	Exposed		**p**
Income Range	No % (n)	Yes % (n)	
<=10000	50.0% (35)	43.3% (39)	**0.222**
]10000; 20000	32.9% (23)	25.6% (23)	
>20000	17.1% (12)	30.0% (27)	

Table 28: Relationship Between Income and HIV Exposure

There was no significant relationship between HIV exposure and the income levels within the households. Most of the households with HEU infants had either normal or high income as compared to the households with HUU infants.

Infant feeding practices

Age of complementary food introduction

This was classified into the number of months that the infants in the study population were introduced to solid foods. The study predefined the age of complementary food introduction as follows according to Kenyan national guidelines on nutrition and HIV among infants (N. Kenya, 2014):**0-5 months- Unacceptable**; **6 months and above- Acceptable.** This is illustrated in table 30 below:

	Exposed		P values
	No	Yes	
Number of months	% (n)	% (n)	
0	0.0%(0)	1.1% (1)	**0.544**
2	0.0%(0)	1.1% (1)	
3	0.0% (0)	3.3% (3)	
4	4.3% (3)	4.4% (4)	
5	5.7% (4)	3.3% (3)	
6	87.1% (61)	83.3% (75)	
7 months and above	2.9% (2)	3.3% (3)	

Table 29: Relationship Between Age of Complementary food introduction and HIV Exposure

As shown on table 29 above, there was no significant relationship between HIV exposure and the age of food introduction. Being that most of the sample size was collected from the hospital records, the acceptable age (6 months) of introduction of solid foods was adhered to by most of the mothers/ guardians. However, the study noted that there were still some HEU infants who were began on solid foods at very young ages of 0, 2,3, 4 and 5^{th} months.

Formula or breastfeeding

	Exposed		**P values**
	No % (n)	Yes % (n)	
Breast Milk	75.7%(53)	86.7% (78)	**0.074**
Formula Milk	24.3% (17)	13.3% (12)	

Table 30: Relationship Between formula of breast feeding and HIV Exposure

As illustrated on table 30 above, there was no significant relationship between HIV exposure and Breastfeeding. Notably, both groups had higher number of infants who were Breastfed as compared to those who were formula fed.

Use of Food Supplements

Food supplements in this case relate to the administration of Food by Prescription (FBP) supplements to the infants in the study population.

	Exposed		**P values**
	No % (n)	Yes % (n)	
Consume Supplements	32.9% (23)	94.4%(85)	**<0.001**
Do not Consume Supplements	67.1%(47)	5.6% (5)	

Table 31: Relationship Between Use of Food Supplements and HIV Exposure

There was statistical significance between the use of food supplements and HIV exposure within the households. Almost all households with HEU infants received the FBP (94.4%) as opposed to 32.9% who were within the unexposed group.

Multi Variate Analysis

The table below show the mean values of the variables relative contribution to undernutrition. The variables that significantly affected undernutrition (WFLZ, LFAZ, WFAZ, BAZ, MUACZ) included sex, exposure to HIV and food aid. Large effect sizes were found in:

- The contribution of Sex on WFLZ, WFAZ and BAZ.
- The Contribution of exposure to HIV on LFAZ, WFAZ, MUACZ.

Medium effect sizes were found for:

- The contribution of Sex on LFAZ and MUACZ
- The contribution of exposure to HIV on WFLZ, BAZ
- The contribution of food aid on MUACZ.

Table 32 below represents this contribution:

	Age		Exposed		Sex		Food Aid	
	$\eta_P{}^2$	**P Values**	**$\eta_P{}^2$**	**P Values**	**$\eta_P{}^2$**	**P Values**	**$\eta_P{}^2$**	**P Values**
Overall Effect Size	0.439	<0.001	0.351	<0.001	0.135	0.001	0.083	0.021
WFLZ	0.048	0.006	0.200	<0.001	0.110	<0.001	0.004	0.442
LFAZ	0.017	0.107	0.161	<0.001	0.019	0.083	0.024	0.052
WFAZ	0.024	0.051	0.280	<0.001	0.107	<0.001	0.001	0.668
BAZ	0.099	<0.001	0.171	<0.001	0.105	<0.001	0.007	0.289
MUACZ	0.009	0.249	0.225	<0.001	0.055	0.003	0.057	0.003

Table 32: Overall Effect Size of the Variables on Undernutrition

From table 33 above, the contribution of age was only statistically significant in WFLZ ***($p=0.006$)*** and BAZ ***($p<0.001$)***. Being exposed to HIV was significantly related with all anthropometric measurements. The contribution of sex was statistically significant ***(p<0.001)*** in WFLZ, WFAZ, BAZ and MUACZ. Food aid on the other hand, was only statistically significant in MUACZ ***(p=0.003)***.

Discussion

According to the current Lancet report, successful interventions for elimination of pediatric HIV infection have led to concerns in the health outcomes of HEU infants (Evans et al., 2016). Among these concerns include the increased reported impaired growth among these infants when compared to the HUU infants. Nutrition being the hallmark of this growth therefore, plays a key role in the future interventions to accelerate growth of this increasing number of infants in the past decade.

The data collected from this study was from infants with an average age of 12 months which was crucial to determine the feeding methods of the infants because at this age, they would already have begun complementary foods according to Kenyan nutrition guidelines (N. Kenya, 2014). The data demonstrated that the HEU infants had lower Z scores than HUU infants. Some of the infants in the study had considerably lower mean Z scores compared to the WHO reference curves. Although this was related to HIV exposure, the WHO growth standards that have previously been recommended as growth key standards for infants globally, do not consider the ethnicity, socio-economic status and type of feeding (Group, 2006). In Kenya, this is one of the crucial elements of undernutrition that is constantly reported in hospitals (N. Kenya, 2014). The results collected were congruent with studies that have formerly concluded that HEU infants are at an increased risk of stunting compared to their HUU peers(Sudfeld et al., 2016).

38.9% of the HEU infants were mildly stunted(LFAZ), while 5.6% of them were moderately wasted (WFLZ), and 24.4% of them were moderately underweight. The study owed moderate and mild wasting and stunting to reports that have been documented in Kenya in the past (Chege, Ndungu, & Gitonga, 2016). According to the reports, undernutrition presented by either wasting, stunting or underweight was as a result of predisposition to conditions such as HIV exposure, food insecurity that could be due to poor socio-economic backgrounds or geographical location in the country (Keino, Plasqui, Ettyang, & van den Borne, 2014). Infants living in urban settlements also have poor accessibility to safe water and high quality of food to meet their energy needs (Maxwell et al., 2000).

On reviewing the birth weight of the infants, the study found that the HEU infants were born with lower weights than the HUU infants. The mean birth weight of the HEU infants was 2953 grams as compared to 3195 grams of the HUU infants. While 54% HEU infants reviewed in the study had birth weight of 2500 grams and above as compared to 87.1% of the HUU infants, the study noted that 20% of the infants were born with weight 2500 grams or below as compared to only 12.9% of the HUU infants. Studies revolving around pre-term and low birth weights among HEU infants record that low birth weights among these infants could result either from the lifelong ART exposure, low maternal weight due to the viral burden that could lead to reduction of the number of meals taken by the mother (Ramokolo et al., 2014). Although this study documented the ARV exposure of infants, it was not able to record the maternal stature of the mothers that could predispose the HEU infants to low birth weights (Muhangi et al., 2013). This was because data collected was done at one static point and some infants were living with guardians rather than their biological mothers. Moreover, the study noted that although the birth weight of the HUU infants correlated with their WFLZ (p=0.02), WFAZ (p=0.008), and BAZ (p=0.017), this was not the case among the HEU infants. Although a previous study (Oddo et al., 2016) linked small for gestational age with stunting among the HEU infants, this study did not find any relationship because the number of infants who had low birth weights in the study was only 20%.

Furthermore, the study reviewed food insecurity related variables in relation to HIV exposure that led to undernutrition of the HEU infants. Of importance was to evaluate the food affordability, food accessibility, food utilization and food aid (Pinstrup-Andersen, 2009; Weiser et al., 2012). The study found out that food aid was the most crucial element of food insecurity among the study population (Fielden et al., 2014). Households that were exposed were less likely to receive food ***(p=0.041)***. This was because of the several income-generating programs open to the households within the study location. Although it was not the main of this study, respondents that were affected by HIV indicated that they had access to an income generating program that improved the affordability of food therefore, they were not reliant on food aid. This finding was consistent with a study done on the coping mechanisms of households affected by HIV (Bukusuba et al., 2007). Despite the recorded affordability of food, the HEU infants did not record better nutrition status than their HUU counterparts.

To understand food insecurity variables in the households, the study evaluated household composition regarding the number of adults and number of children living with both HEU and HUU infants. The study added up to other studies that demonstrated that HEU infants are categorized as orphans and vulnerable children (Goldberg & Short, 2016). In a study carried out in Ghana, infants born to HIV positive mothers are most likely to be abandoned by their biological mothers or left under the care of their relatives due to the burden of disease (A. Laar et al., 2015). In this study, HEU infants were most likely to be found in households with one or two adults ***(p=0.016)***, while living with either 2,3 or 4 more children ***(p<0.001)*** in the household. Similarly, the study did not find any significant relationship between income earned in the households and HIV exposure. This is because the respondents could not voluntarily give the exact amounts they earned and instead gave wide ranges of their income. Households of both HUU and HEU infants had an almost similar response in the amount of income earned.

The study also evaluated the infant feeding practices in relation to the HIV exposure. In relation to these practices, the study reviewed the age within which the infants were introduced to solid foods, the mode of infant feeding whether infant or breastfeeding as well as the extent to which infants used Food by prescription supplements (Nagata et al., 2014; Rossouw et al., 2016). Both the HEU and HUU infants recorded high percentages of exclusive breastfeeding. In fact, a slightly higher number of HEU infants breastfed as compared to the HUU infants. this was congruent with the WHO and Kenyan guidelines on infant and young child feeding in the context of HIV (N. Kenya, 2014; WHO, 2007). The study also noted that there was a small number of HEU infants who were began on solid foods as early as by the time of birth, 2,3,4 and 5 months. Some previous studies have shown that some HEU infants are introduced to solid foods early because their mothers do not have enough breast milk (Sint et al., 2013). Exclusive breastfeeding for HEU infants is recommended for the first six months and thereafter an introduction of solid foods only if they are AFASS (Victora et al., 2016).

This study sought to know the magnitude of effect that each of the variables had on undernutrition among the HEU infants. Overall, sex, HIV exposure and food aid had the most notable effect size on undernutrition of the infants. HIV exposure significantly affected the undernutrition status of the infants which was depicted by WFLZ, LFAZ, WFAZ, BAZ and MUACZ. HEU infants had lower Z scores as compared to the HUU infants because they were exposed to the virus. Previously, research has shown that HEU infants are prone to linear growth faltering as well as stunting when compared to the HUU infants (Sudfeld et al., 2016).

The study also focused on the sex of the infants. Female infants had higher Z scores when compared to the male infants in terms of weight and MUAC measurements. Female infants tended to receive a better health attention in general as compared to the male infants. This was also concluded in a study in Guatemala that reported that nutritional interventions tend to favor female infants more than the male infants (Tumilowicz, Habicht, Pelto, & Pelletier, 2015). The scope of this study did not lodge on this finding although future studies would evaluate such a gender perception to favor equality in growth among all infants regardless of HIV exposure or socio-economic conditions.

The overall effect of food aid was significantly correlated with thinness depicted by MUACZ score ***(p=0.003).*** In general, those households that received food were not necessarily well nourished. While food aid interventions eliminate immediate food insecurity, some households ration or hoard the food in lieu of future days where they may not have enough food (Rawat, Kadiyala, & McNamara, 2010). As well, since HEU infants rarely receive food, they may end up purchasing less expensive food that may be of low quality, that might not meet their energy needs, therefore, resulting to Food by prescription supplements (Nagata et al., 2014). Food aid was directly related to food affordability and accessibility in the study population. This means that those who responded that they received food donations, could not access or afford it and vice versa.

Chapter 5: Conclusions and Recommendations

Conclusion

This Study concluded that HIV exposure to infants significantly predisposed them to undernutrition during their first 1000 days of life. HEU infants are likely to be either stunted, wasted, underweight and thin despite the socio-economic conditions. The fact that these infants live in susceptible situations either in children's homes or with their guardians renders them to vulnerability that causes their undernutrition. Although HEU infants are exclusively breastfed, as they grow up, it is crucial to evaluate their living conditions to ensure that their daily energy needs are met. Offering food donations does not necessarily mean that the infants nutrition status will improve. In any case, blanket education on the types of the right quality of food for the HEU infants should be scaled up to eliminate undernutrition. Since most of the HEU infants do not meet their energy needs, they rely on supplements such as Food by Prescription to complement their daily meals.

Recommendations

The study recommends closer monitoring of infants living in the low socio-economic settings to ensure that undernutrition is eliminated simultaneously with HIV mother to child transmission. As well, food aid programs ought to constantly re-evaluate the utilization of food in vulnerable households to achieve optimum nutrition among targeted infants.

HIV programs ought to be more vigilant to ensure that affected households are not over-reliant on Food by prescription supplements to meet the energy needs at the expense of utilizing food as a source of their energy to eliminate undernutrition.

The study also proposes further research to develop growth charts tethered to infants living in harsh conditions such as developing countries like Kenya. This would enhance national growth monitoring of the HEU infants when compared to their HUU counterparts. A further investigation on factors that cause undernutrition among the HEU infants in low socio-economic urban settings on a larger scale is recommended.

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Annexes

Annex 1: Questionnaire

Date of Evaluation:

ANTHROPOMETRIC DATA OF THE INFANT

Measurements	1st	2nd	Average	W F H/L
Current Weight to the nearest 0.1 kg				
Current Length to the nearest 0.1 cm				

SOCIO ECONOMIC DEMOGRAPHICS

SD1	SEX	MALE………..1 FEMALE……..2
SD2	BIRTH DATE (From Documentation)	Day/Month/Year
SD2	WEIGHT AT BIRTH	IN KGS
SD3	NUMBER OF MONTHS AT BIRTH	IN MONTHS
SD4	PLACE OF BIRTH	AT HOME……1 IN HOSPITAL…..2 LOCAL MID WIFE….3
SD5	MOTHER/CAREGIVERS PARITY	1…………………………1 2-3………………………..2 >3…………………………3
SD6	MOTHER'S CAREGIVER MARITAL STATUS	SINGLE……………………1 MARRIED…………………2 LIVING TOGETHER………3 WIDOWED…………………..4 DIVORCED/SEPARATED……….5

INFANT FEEDING PRACTICES

IF 1	BREASTFEEDING SINCE BIRTH	YES……………………….1 NO…………………………2 DON’T KNOW………..3	IF ANSWER IS 2 GO TO IF 2
IF 2	OTHER FORMS OF FEEDING SINCE BIRTH	FORMULA FED………..1 COW’S OR GOAT’S MILK……….2 OTHERS(E.G PORRIDGE,JUICE,WATER OR SOLID FOODS)……………………3	
IF 3	EXCLUSIVE BREASTFED FOR 6 MONTHS	YES……………………………..1 NO………………………………2	IF NO GO TO IF 4
IF 4	TIME WHEN BREASTMILK WAS STOPPED	1 MONTH………………………..1 2MONTHS………………………..2 3 MONTHS………………………..3 4 MONTHS…………………………4 5 MONTHS……………………………5	
IF 5	TIME OF COMPLEMENTARY FOOD INTRODUCTION	1 MONTH………………………..1 2MONTHS………………………..2 3 MONTHS………………………..3 4 MONTHS…………………………4 5 MONTHS……………………………5 6 MONTHS…………………………….6 DON’T KNOW…………………………7	
IF 6	CHILD HAS TAKEN SUPPLEMENTS FROM THE HOSPITAL(E.G FBP PORRIDGE FLOUR,PLUMPY NUT ETC)	YES……………………………………………1 NO……………………………………………2	
IF 7	NUMBER OF TIMES THE CHILD IS FED IN A DAY	<1 TIME………………………..1 1-2 TIMES………………………2 2-3 TIMES……………………….3 >3 TIMES…………………………4	

HIV and ARV EXPOSURE

HA 1	MOTHER’S/CARE GIVER STATUS	SEROPOSITIVE……..1 SERONEGATIVE………2	IF SERONEGATIVE SKIP TO HA 5

HA 2	MOTHER/CAREGIVER EXPOSURE TO ART DURING PREGNANCY	YES…………………………1 NO…………………………..2	
HA3	INFANT EXPOSURE TO POSTPARTUM ART	YES…………………………..1 NO……………………………2	IF YES GO TO HA 4
HA 4	DURATION OF ART EXPOSURE TO INFANT	0-6 MONTHS……………..1 6-12 MONTHS……….2 12-18 MONTHS……….3	
HA 5	NUMBER OF HOSPITALIZATIONS SINCE BIRTH	0-5……………………..1 5-10……………………2 >10………………………3	
HA 6			

INCOME AND FOOD SECURITY STATUS

IF 1	ESTIMATE THE MONTHLY FAMILY INCOME	0-10,000……………………1 10,000-20,000……………2 >20,000……………………..3	
IF 2	NUMBER OF PEOPLE IN THE HOUSEHOLD		
IF 3	NUMBER OF MEALS SERVED IN THE HOUSEHOLD PER DAY		
IF 4	NUMBER OF CHILDREN IN THE HOUSEHOLD		
IF 5	NUMBER OF ADULTS IN THE HOUSEHOLD		
IF 6	DO YOU RECEIVE FOOD FROM	YES………………………..1 NO…………………………2	IF NO GO TO IF 7

	DONATIONS OR WELL WISHERS		
IF 7	HOW MUCH MONEY DO YOU USE TO PURCHASE FOOD IN A MONTH	0-1000……………………….1 1000-5000……………….2 >5000……………………….3	
IF 8	WHEN YOUR FAMILY EATS DO THEY SATISFY THEIR HUNGER?	YES……………………………1 NO……………………………..2	IF YES GO TO IF 9
IF 9	BETWEEN NOW AND THE NEXT MONTH HOW MUCH WILL YOUR FAMILY HAVE ENOUGH TO SATISFY HUNGER?	NOT ENOUGH…………….1 ENOUGH……………..2 PLENTY…………………3	
IF 10	DO YOU ATTEND NUTRITION CLASSES AT A FACILITY NEAR YOU?	YES………………………..1 NO…………………………2	

Annex 2: Consent to Conduct Research

The Mater Hospital
we care more

P. O. Box 30325 - 00100
Dunga Road, Nairobi, Kenya
Telephone: (254) (020) 6903000
Mobile Lines: 0719 - 073000, 0732 - 163000
Fax: (254) (020) 6534289
Email:inform@materkenya.com
Website: www.materkenya.com

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2-2-2017

FACULTY OF FOOD AND NUTRITION SCIENCES,
UNIVERSITY OF PORTO
RUA DR. ROBERTO FRIAS,
4200-465,
PORTO, PORTUGAL.

Dear, Scientific Review Board,

RE: PERMISSION TO CONDUCT RESEARCH

The purpose of this letter is to inform you that the Mater Comprehensive Care Clinic has consented **Jane Nduta Wambura** to conduct the research titled: "*Challenges facing malnutrition among the HEU infants 24 months and below*" at the University of Porto.

This also serves as an assurance that this facility shall ensure the authenticity, confidentiality and documentation of information collected for the research. All help accorded to the researcher shall be highly appreciated.

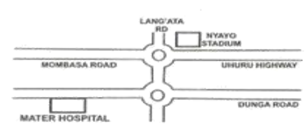
Sincerely,

Sister Brigid Marnane,

Sr Brigid MARNANE

Program Coordinator

Mater Comprehensive Care Clinic.



Undernutrition of HEU infants in their first 1000 days of life: A case in the Urban-Low Resource Setting of Mukuru Slum, Nairobi, Kenya.

Jane Nduta Wambura

FACULDADE DE CIÊNCIAS DA NUTRIÇÃO E ALIMENTAÇÃO