

**EVALUATING FACTORS ASSOCIATED WITH CHILD MALNUTRITION AND  
ASSESSING UTILITY OF MID UPPER ARM CIRCUMFERENCE IN THE URBAN  
INFORMAL SETTLEMENT OF NAIROBI**

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## DECLARATION

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This research project is my original work and to the best of my knowledge has not been submitted to any other university for award of a degree.

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## **DEDICATION**

Am grateful for the valuable support from my dear Mum and Dad Mr. & Mrs. Athiambo, my brother and friend Mr. Caleb Ouma Ongongá, classmates and the entire Population Studies and Research Institute (PSRI) family for their support and hope this work adds to the existing knowledge. To my two beautiful daughters Whitney and Britney for giving me the inspiration to pursue this education to the greatest heights and hope this serves as a guide in their future endeavors.

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## ABBREVIATIONS AND ACRONYMS

<b>BMI</b>	Body Mass Index
<b>CHV</b>	Community Health Volunteer
<b>DDG</b>	Digital Data Gathering
<b>GPS</b>	Global Positional System
<b>HFIAS</b>	Household Food Insecurity and Access Scale
<b>HHH</b>	Household Head
<b>HHS</b>	Household Hunger Score
<b>ICSU</b>	International Council for Science
<b>KDHS</b>	Kenya Demographic and Health Survey
<b>KNBS</b>	Kenya National Bureau of Statistics
<b>M&amp;E</b>	Monitoring and Evaluation
<b>MUAC</b>	The Mid Upper Arm Circumference
<b>NGO</b>	Non-Governmental Organization
<b>ODK</b>	Open Data Kit
<b>OECD</b>	Organization for Economic Cooperation and Development
<b>PEV</b>	Post-Election Violence
<b>SD</b>	Standard Deviation
<b>SDG</b>	Sustainable Development Goals
<b>UN</b>	United Nations
<b>UNAIDS</b>	United Nation Aquired Imune Deficiency Sundrome
<b>UNDP</b>	United Nations Development Program
<b>UNFPA</b>	United Nations Population Fund
<b>UNICEF</b>	United Nations Children's Fund
<b>USAID</b>	United States Aid
<b>WAZ</b>	Weight-for-age z-score
<b>WHZ</b>	Weight-for-height z-score

## CHAPTER ONE: INTRODUCTION

### 1.1 Background Information

The developing world is rapidly urbanizing, the urban growth rate from 2005 to 2016 in the least developed countries was 4.1 percent, compared to 2.0 percent, globally (UNFPA, 2009). Majority of this urbanization is poor rural residents moving into informal settlements in cities with hopes of finding employment and greater access to services (Agesa, 2004). The situation that meets them however is fraught with challenges; almost entirely dependent on the market for food, slum dwellers are highly vulnerable to food insecurity due to price increases, most of them lack consistent income, face high crime levels and violence occur in most informal settlements, this can also explode into acute skirmishes as witnessed in Kenya in 2008 (Mohiddin, Phelps, and Walters, 2012). Mosner(2004) states that the high population density of occupants in the informal settlements combined with poor or no sanitation and limited access to health services means that slum dwellers face much higher disease burdens than their other urban or rural counterparts (WorldBank 2010). Slum dwellers are also politically marginalized; have no security of tenure to the land they occupy, are vulnerable to abrupt eviction and lack access to basic services such as waste collection, water, and electricity (UN-Habitat, 2003).

A Combination of all these factors only means that several residents of the informal settlements live on the verge of survival and urban slum inhabitants are highly susceptible to shocks, from increase in food prices, to disease outbreaks, to political unrest, to a more delicate combination of all of these that cause a considerable number of them to tip over the edge and experience a rise in food insecurity, malnutrition, morbidity and mortality.

Despite these risks, urban atmospheres and players who are working with them are overwhelmed with scarcity of information and tools for responding in such settings. One of the key gaps is in early warning indicators of crisis. Without evidence-based guidance on how to detect and classify urban slow-onset emergencies, Governments, NGOs and UN agencies are ill-equipped to identify urban crises and respond in a timely manner. This brings one central question that

need to be addressed which is, ‘How can the urban actors know when a condition has moved from chronic poverty to a humanitarian crisis?’

Monitoring and evaluation (M&E) is a process that helps assess the performance of projects or programs set out by institutions such as Non-Governmental Organizations (NGOs, Governments and International Organizations so as to improve their performance and achieve the desired results(Statistics 2009). Monitoring and evaluation of the project helps the management to know what is working and what is not working out, with the information the project management can determine what changes should be made towards achieving and/or improving the project goals (UNAIDS 2010).

An indicator is a parameter which is traced over a period and provides facts on the trends in the situation of any project occurrence (OECD 1994). Indicators deliver critical facts on how the project is performing, its achievements and to provide for accountability; this is the foundation of operative monitoring and evaluation. Indicators provide data that provide strategic insights that are vital for effectively managing projects and actions. Basically, an indicator provides a sign or a signal that something really exists or is true. It shows the existence or state of a circumstance or situation. In the perspective of monitoring and evaluation, it is a quantifiable measure which gives information to monitor performance, measure accomplishment and define accountability. They are standardized measures that allow for comparisons over time, over diverse geographic regions and/or across programs. Indicators have the capacity to relate sequential and spatial differentials from fresh data, as does the capability to aggregate data for higher-level consumption (UNAIDS 2010).

A good practice in M&E is that periodically there should be maintenance and review of indicators through dialogue and reviews to capture changes in the objectives, the appearance of different new concerns and enhancement in procedures for measurement and availability of data. It is of more use to have a standard device or procedure for indicator review that would give room for establishment of other fresh indicators and/or amendment of prevailing indicators. Stakeholders should fully be involved, and the process openly conducted to include technical and subject matter experts, data collectors, the target audience for the indicators, friends of the project and the community.

## **1.2 Statement of problem**

An idea was conceptualized by Concern worldwide after several meetings and discussions with different stakeholders and looking through the existing gaps to implement a project (Prospective surveillance system) in the urban informal settlements to identify, develop and test potential indicators that can be used to detect early emergency warnings and monitor the surveillance of slow onset emergencies in the urban informal settlements, this was because in the backdrop of Kenya's December 2007 election, in which the outcome was marred with election violence there were high food/fuel prices, there was a humanitarian malnutrition emergency in the urban informal settlements with no clear and distinct indicators to help measure or even define the state of what was happening on the ground. Historically, rural context has been focused more by early-warning systems for humanitarian frameworks, abundant information sharing, and coordination platforms have focused on rural food security and livelihoods, in the meantime numerous factors affecting rural communities (such as rainfall, migration and crop yield) have also been comprehensively studied and recognized by stakeholders as affecting the urban too. Due to the similar, largely agricultural, livelihood activities undertaken in rural areas, shocks tend to affect most of the population (in both rural and urban) equally, while the capability to survive is alike across all communities (Budde et al 2010).

Urban vulnerability focusing on food and nutrition security is fairly precise and different compared to what the rural areas go through, however high dependency on food production conducted outside cities can create vulnerability in urban populations to famines, flooding and other life-threatening weather proceedings that happen distance away (ALNAP 2012). Most of the vulnerable groups live in informal settlements often referred to as slums. Slum residents lack steady access to income, more so relying on casual labour or petty trade fluctuating on a daily or weekly basis. Ruel (2004) states that the rise in level of crime rate and violence always observed in most informal settlements can flare up into skirmishes as experienced in Kenya in 2008 and India in 2002. Mosner (2004) stated that the high number of slum inhabitants together with poor or no sanitation and limited access to health services means that they incur much higher disease burdens than their other urban or rural counterparts. UN Habitat (2010), the rural indicators and

their corresponding thresholds cannot simply be transposed onto an urban context due to the high population density, the different coping strategies used in urban versus rural settings, and the high levels of mobility. This is the main reason why the project was conceptualized and its objectives were to develop a range of multidimensional early-warning indicators (more than just malnutrition rates), to incorporate a more complex understanding of urban emergencies, develop a solution to challenges with respect to routine data collection in urban informal settlements with a new surveillance system and to develop a new set of thresholds for these indicators which will allow for early-action for humanitarian and development organizations; thereby enabling more resilient urban communities.

At the beginning, the project had a total of 22 indicators that were collected at the baselines but the number kept reducing with each surveillance conducted, and subsequent reviews of the indicators were: mainly based on indicators that would speak to the issues of the urban informal settlements; indicators sensitive to urban informal context; indicators with a predictive capacity such as anthropometric; indicators showing change/volatility across time such as food prices; household hunger score (HHS) and making a comparison with global indicators so that they could get ownership from different stakeholders.

The changes necessitated a reduction of indicators to five after several intensive workshops with relevant stakeholders from which data is collected and monitored for response. These include; share of households with at least one stable income earner, equalised monthly household income, percentage of households with at least one child (6-59 months) reporting diarrhea, mean number of food basket and percent who experienced at least one shock in the last four weeks.

Radhakrishna and Ravi (2004) talks of a variety of indicators considered appropriate for measuring malnutrition in children, they include anthropometric measures, clinical signs of malnutrition, physical activities and biochemical indicators. These indicators complement one another and one may be better in measuring one thing but a problem in another, in this project only one indicator Mid Upper Arm Circumference (MUAC) was used for child malnutrition and setting of threshold indicators, this study would like to bring out what other malnutrition indicators exist and what MUAC indicator has or missed out. All these malnutrition indicators height-for-age, weight-for-height, and weight-for-age all use heavy equipment's (Weighing scale

and height board) that cannot easily be carry around for measuring malnutrition or require more manpower in case of movements, these equipment's are also quite expensive and cannot be afforded by everyone who is working in the health sectors. Due to high insecurity in the informal settlements they risk being stolen or even get vandalized by criminals in the slums. Unlike MUAC which is light and costs way less than the other equipment and can be carried around easily, most practitioners would use them for convenience. Use of MUAC do not need further learning as it is colour coded to indicate the stages of malnutrition which is easily readable and understood.

### **1.3 Research Questions**

The following research questions guided the study;

- i. What are the appropriate measures to provide a quick and reliable information on the extent of child malnutrition in study sites?
- ii. What are the factors associated with child malnutrition in the study sites?

### **1.4 Objectives of the study**

#### **1.4.1 General objective**

The main objective was to identify indicators that can be used for early detection of malnutrition situations covering multidimensional aspects of well-being for children living in urban informal settlements.

#### **1.4.2 Specific objectives**

Specifically, the study sought to identify under nutrition indicators that can provide quick and reliable information that are useful for child malnutrition surveillance in urban centers. Specifically, it involves:

- i. determine of appropriate measures to provide quick and reliable information on the extent of child malnutrition in study sites;
- ii. identify of factors associated with child malnutrition in the study sites.



## **1.5 Justification of the study**

Most studies and data sets such as KDHS provide information on malnutrition at national level, regional and place of residence (designated as urban and rural) but do not really bring out what happens in the slums. This study concentrated on the urban informal settlement so as to identify indicators that can be used for early detection of humanitarian situation that covers multidimensional aspects of well-being for populations living in urban informal settlements.

Nutritional insufficiency has long-term effects, more-so on children's mental growth and their productivity as adults, and those affected more are those from poor households (Kabubo-Mariara 2009). The effects of good child nourishment go beyond the positive personal health effects and also help attain development objectives, such as growing productivity, decreasing poverty, successful maternal and child health and survival, and increasing gender parity (Kothari, M., and A. Noureddine. 2010). Finding reliable indicators to measure malnutrition in short term is useful to gauge performance of programs as in humanitarian situations that does not require long term trend data.

Selection of informal settlements was done in relation to the existing two sets of secondary data collected by two different organization and this also resulted in collection of primary data in the same areas. The three informal settlements are a representation of eastern side of Nairobi (mukuru), Korogocho to the North and Kibera to the South of Nairobi.

## **1.6 Scope and limitation**

The scope of the study was households with children under five within one urban informal settlements in Nairobi (Korogocho).

The limitations were; insecurity in most informal settlements is high and data collection or surveillance more so by use of digital data gathering (DDG) equipment is challenging as the organized gangs wants the DDG's for their own services thus risking the lives of field officers who always wanted to protect the equipment and data in them, this slightly hindered quality of the study data.

There is no organization that has mapped all stakeholders working in the informal settlements and brought them together to monitor factors associated with malnutrition to act as a team

therefore this was a new research that hadn't been tried anywhere else therefore lacking more information to guide.

Different stakeholders conduct research and response in the informal settlements according to their own indicators so when one comes in to start monitoring the same group there existed variations from the data collected and analyzed in every round of data collection depending on who/which organization was in the place before you and what they implemented to the households, in case of response the stakeholders should pull their resources together to create more impact than when conducted by an individual.

### **1.7 Operational definition of terms**

**Rapid onset emergencies:** Sudden distinct (often external) event leading to rapid crisis, clearly with a defined start date.

**Slow-onset:** accumulation of shocks or stressors leading to a crisis that builds over time, often difficult to identify a start date.

**Household:** Consists of a person or group of persons who live in the same homestead/compound but not necessarily in the same dwelling unit, cook together, and are accountable to the same household head.

**Household Head:** This is the most responsible/respected member of the household who makes key decisions in the household on a day to day basis, and whose authority is honored by all members of the household

**Respondent:** This may be the head of household or any other conversant or accountable household member.

**Malnutrition:** lack of proper nutrition, caused by no enough meals, not eating enough of the right things, or being unable to use the food eaten (Oxford English Dictionary).

**Under-nutrition:** This is the results of inadequate food consumption and frequent infectious sicknesses. It comprises being malnourished for one's age, too short for one's age (stunted), precariously thin (wasted), and deficient in vitamins and minerals (micronutrient malnutrition) (UNICEF 2006).

**Informal settlement:** Are residential areas where 1) residents have no security of tenure vis-à-vis the land or dwellings they inhabit, with modalities ranging from squatting to informal rental

housing, 2) the neighborhoods usually lack, or are cut off from, basic services and city infrastructure and 3) the housing may not comply with current planning and building regulations, and is often situated in geographically and environmentally hazardous areas.

**Morbidity:** Refers to having a disease or a symptom of disease, or to the amount of disease within a population. It can also refer to any medical problem caused by a treatment.

**Rural:** Is a huge and isolated piece of land or area of an undeveloped country frequently with low population density.

**Urban:** Is an area with an increased number of human-created structures compared to the bordering environs and has inhabitants of 2,000 or more. They include; Cities, Municipalities, Town Councils and Urban councils.

## **CHAPTER TWO: LITERATURE REVIEW**

### **2.1 Introduction**

This chapter presents a review of related literature which was done by the researcher on the study based on evaluating factors associated with child malnutrition in the surveillance of urban informal settlement emergencies. The literature review generally examines theoretical and empirical sources relevant to the study. It also bears the review of theories related to the study. The conceptual and theoretical sources reviewed are in relation to malnutrition in the country and the world at large. Last in this chapter is summary, critique of reviewed literature and identification of the research gap.

### **2.2 Theoretical Basis for the project**

The program had a combination framework of indicators as it uses a mixture of issue based framework and causal based framework where it considers the key problems and issues within the urban informal settlements and how they interact with different elements being organized into categories such as food security, malnutrition and responses when a threshold is reached or surpassed.

The project objectives, results and selected indicators were based on the following theory of change; there should be a set of key indicators developed and monitored in hotspot areas within urban informal settlements and thresholds set to provide an early warning system based on surveillance of key indicators in extreme poverty hotspots that provide duty bearers with the relevant and timely information needed to make informed early action responses to slow onset crises in densely populated urban centres. Multisectoral responses discussed and preparedness actions agreed by a broad range of stakeholders to make these responses both fast and efficient. This early action was to significantly improve the lives of those involved as well as dramatically reducing the long term burden on the state.

### **2.3 Malnutrition as a multidimensional measure of well being**

Under-five malnutrition has been identified as one of the deterrent to global development and has been identified under Goal 2 in the Sustainable Development Goal (SDG). This indicator is used

to monitor child health in improving nutrition and ensuring healthy lives and promotion of well-being for all at all ages. Malnutrition includes under-nutrition, obesity and micro-nutrients deficiencies and it targets stunting and wasting in under-five. The SDG states that all forms of malnutrition including obesity, under-nutrition and micronutrient deficiencies should end by 2030. A lot needs to be put in place to monitor and achieve these goals if we need to meet the targets (ICSU et al. 2015).

In 2015, a total of 32 percent, of Kenyan population was urban. Nairobi, the capital and largest urban center had nearly 4 million people representing 25 percent, of national urban population. About 60 percent, of Nairobi's population (5 percent of Kenya's total population) lives in the informal settlements, this is approximately 2 million people. Kenya's yearly slum growth rate stands at 5 percent and also among the highest worldwide, this is expected to multiply within the coming 30 years if no constructive intermediation procedures are set in place to deal with the growth (UNHabitat 2015), (UNDP 2007). This rapid growth in urban population results in a higher proportion of households at risk of an emergency and due to a lack of services less able to cope. It is this trend that underpinned the need for a framework that could detect emerging crises within urban informal settlements.

Urban regions are extremely dependent on market, droughts in rural parts or international food price increases, e.g. could result into high food charges in towns and city markets. Economic recession can affect ability of one to access salaried work predominantly for the low waged, distressing household earnings. Combining the effects of price upsurges and reduction in income can alter the lives of those living in chronic poverty into an emergency situation. The percentages of malnutrition rates have stayed way below the internationally recognized emergency indicator but the numbers of undernourished children have significantly gone up. Reduction in prevalence rates however, can translate into very huge caseloads due to the high population density of urban informal settlements. The urban poor are almost entirely dependent on the market for food, water, and basic services.

Cohen, M. et al. (2009) presented a comprehensive analysis of the processes that leads to food insecurity amongst the urban under privileged by use of the international food price disaster in 2008 as a lens. As net consumers of food, urban deprived are intensely affected by negligible

food price upsurges; they similarly have less elasticity than their rural colleagues to change to other staple foods when expenses rise. Most of the poor in urban centers depend on low inferior jobs: casual, insecure and low payments some of which are again exposed to periodic slow-downs, meaning that even when prices are stable they can face variation in household budgets that leads to food insecurity (Cohen, M., and Garrett, J. 2009).

Ruel et al. (2008) also looked at the main subject matter surrounding food security and nutrition security in urban regions, by use of the conceptual framework done by UNICEF touching on effects of malnutrition as a guide to building effective food security indicators. The authors identify 8 key factors that influence food security of the urban poor; food sources and costs, incomes, urban agriculture, urban diet, child care giving, rural/urban, inter-urban and intra-urban differentials in child mortality, morbidity and malnutrition, health and safety nets. These researchers did argue that urban food markets in most cases can be quite inefficient because they are ill equipped to handle bulks of foods that pass the wholesale markets. Their retail markets on the other hand are usually small and sparsely distributed, this permits accessibility by the urban poor and they make profits from the negligible economies of scale. These poor consumers are more often not able to buy foods in larger quantities and in most cases therefore end up paying a higher price per unit as theirs in a daily purchase of foodstuff. With this pattern of purchase, it leads to the consumer's reliance on heavily on street foods both due to income pattern and constraints in time which do not support cooking at home for the poor households. There are implications that accompany consumption of street foods such as nutritional and food safety. Data from some countries like India show that poorest households spend consistently large amounts on foods cooked on the streets (Ruel, et al. 2008).

Various Kenyan studies from KNBS and Macro (2010), Marinda (2006), Kabubo-Mariara et al. (2009) noted the relationship between food security and malnutrition, any household that is poor will have most if not all of their under five children malnourished. They also recognized the main factors influential to health status and malnutrition as; poverty (food insecurity), disease, mother's age and educational levels, practices related to caring of a child, reduced level clashes which may result in eviction and displacements, water, sanitation & hygiene and ante-natal care and birth spacing.

Majority of the world's poor are currently faced with one of the most devastating problem which is child malnutrition (WHO 2008). Most of the factors causing mortality in children in developing countries can be prevented. Over half of the under five deaths in developing countries are as a result of malnutrition, making it one of the greatest significant problems in the developing world (Pelletier, D.L. et al. 1994; (Heinkens, G.T et al. 2008). According to World Health Organization (WHO) (2008), 35 percent, of mortalities for global children under-five years is attributable to malnutrition.

Under nutrition in children is one of continent's major challenges for enhanced development in mankind and this has been slowing the achievement to reduce child malnutrition goal (Kasirye2010). Malnutrition leads to lower human being output, worsening of healthiness and lowers lifespan (Caulfield, L.E. et al. 2004; Pelletier, D.L. et al. 1994), it also impedes the chances for countries to decrease food scarcity and exploit on socioeconomic progress (Grantham-McGregor, S., Y. B. Cheung 2007). Poverty, poor health and nutrition, and limited healthcare interrupt the likely for cognitive enhancement of nearly 200 million children below-5 years old in developing countries (Ezzati, M. et al. 2002).

In Nairobi, the predominant nutritional problem among under-five children in Kibera informal settlement is stunting and it's elevated in older children showing an indication of failure in growth and development. Severe stunting was at 23.4 percent, diarrhea prevalence being at 11.8 percent, and severely underweight children at 3.1 percent, (B. Olack et al. 2011). Fotso, J. C. et al. (2008) using KDHS data collected in fifteen African countries, compared the data and found out that socioeconomic disparities in malnutrition of children by the place where they reside were higher in urban (Odds ratio 3.4) than rural (Odds ratio 1.8) areas in Kenya.

Census (2009) data defines a household as an individual or group of people who are related by blood or not, and residing together in one compound/homestead/structure, have the same cooking arrangement and identifies with and answerable to one responsible member of the house as the household head. It further defines a household head as the most responsible/respected person in the household and the one that makes crucial choices of the family on a daily basis.

Malnutrition is a broad term commonly used as to both over and undernutrition. When our diets do not contain adequate calories and proteins for growth and maintenance and our body is not

able to fully utilize the foods we eat due to illnesses (undernutrition) then it is said that the person is malnourished. Malnourishment also occurs when the body consumes too many calories (over-nutrition) (UNICEF 2006).

The usefulness of an indicator is measured on the following characteristics; indicator objectives should have a high internal validity, they should not be over complicated to achieve the desired measure, expected changes are closely related to the direct indicators, there should exist a mix of qualitative and quantitative indicators so as to create a more detailed overview of the desired progress, data collection should be divided according to pertinent divisions within the populace more so for progress tracking (Church, Cheyanne and Mark Rogers 2006). Selection process in the case of composite indicators should be iterative putting into consideration consultations from involved stakeholders, this principle ought to be a device for evaluating the projected indicators in different phases for relevance and measurability and sound analysis (Statistics 2009).

## **2.4 Malnutrition Indicators**

Indicators provide flexible and compassionate arrangement for the design of programs, implementation, and their evaluation putting into consideration experience from any other place and making it concurrently sensitive to the context of local happenings. A structured set of indicators enlightens consultants, actors, and researchers with a variety of reference facts and a choice of models used to shape suitable monitoring machinery for every program uniquely (USAID 2010). Components of an indicator include what the project wants to measure, measurement unit, baseline, size, magnitude or dimension of change (targets), quality or standard of change, target population or project beneficiaries, and project duration (Church, Cheyanne and Mark Rogers 2006).

There are a number of indicators that are considered appropriate for measuring malnutrition in children, which include: anthropometric measures, clinical signs of malnutrition, biochemical indicators and physical activities (R. Radhakrishna and C. Ravi 2004). These outcome indicators are considered because they are closely related to wellbeing and functional capacity of these young children.



### **2.4.1 Anthropometric measures**

The assessment of child malnutrition utilizes the age and sex specific norms from the National Centre for Health Statistics using the standard deviation classification. Anthropometric measures include; weight for age (underweight), height for age (stunting), weight for height (wasting) and Mid Upper Arm Circumference(MUAC) (Gillespie, S and G McNeill 1994), Arnold et al. 2003). WHO in 2006 published growth standard generated using data collected in the WHO multicenter growth reference study which can be used to assess children all over the world regardless of their feeding practices, ethnicity, race, social or economic influences (WHO 2006).

The indices height-for-age, weight-for-height, and weight-for-age offers diverse data on growth and body composition, that are used for assessing child malnutrition (Calverton, MD, USA: KNBS and ICF Macro 2014).The perfect anthropometric indicator ought to be highly sensitive to notice malnutrition perfectly and have a good specificity which could assist government facilities and resources intended for malnourished residents. Each of these indicators has their own advantages and disadvantages (B. Joseph et al. 2002).

#### **2.4.1.1 Mid Upper Arm Circumference (MUAC)**

The mid upper arm circumference (MUAC) is a measure used by health workers to speedily define if a child is acutely malnourished. It measures the circumference of the arm at the midpoint between their shoulder and elbow using a typical MUAC band. Children of ages six and 59 months with a MUAC measure of 115mm or below are said to be severely acutely malnourished, while those in the range greater than 115 but less than 125mm are considered to be moderately acutely malnourished (WHO 2006).

MUAC, for a long time have stayed as the most sort of indicator for use during emergency situations. MUAC has been suggested as an alternate index for nutritional status for use where the collection of height and weight is difficult, such as in emergency circumstances of famine or refugee crisis (Izudi, Epidu, Katawera, and Kekitiinwa, 2017). In these situations, low MUAC based on a fixed cut-off point such as 12.5cm, has been used as a proxy for low weight-for-height. Comparisons on these two indicators however show that these are poorly correlated (12,13) (Izudi et al, 2017). MUAC however appears to be a superior predictor to childhood mortality compared to anthropometric indicators based on height-for-weight (14-17) (Izudi et al,

2017). This has led the proposal for MUAC as an additional screening tool in non-emergency situations. Key operational advantages of MUAC include the probability of measuring tapes, and the fact that a single cut-off value (12.5 cm or 13 cm) can be used for children aged less than five years (B. Joseph et al. 2002).

#### **2.4.1.2 Height-for-age (stunting)**

KDHS 2014 states that stunting is an indicator of linear growing retardation and aggregate growth deficits and is represented by low height-for-age. Children whose height-for-age Z-score is below minus two standard deviations (-2 SD) are considered short for their age (stunted) and are chronically malnourished. Children who are below minus three standard deviations (-3 SD) are considered severely stunted (Lundeen et al., 2014). Stunting reflects failure to receive adequate nutrition over a long period of time and is also affected by recurrent and chronic illness. This measure hence signifies the long-standing properties of malnutrition in a population and is not sensitive to current, short-term changes in dietary intake (Calverton, MD, USA: KNBS and ICF Macro 2014).

Stunting, mostly is as a result from prolonged durations of inadequate intake of food, deprived dietary value, increase in prevalence of diseases, or a blend of all these issues (B. Olack, et al. 2011). Stunting is an indicator of chronic deficiency, wasted is an indicator of acute undernutrition and underweight is a compound measure of chronic and acute undernutrition (Gillespie and McNeill 1992, Arnold et al 2003).

KDHS (2014) noted that nationally in Kenya, stunting affected 26 percent of children and in all 8 percent of them were severely stunted. Looking at this analysis and considering age sets, this indicator demonstrates higher cases of stunting in children between the age of 18-23 months (36 percent) and 24-35 months (34 percent). Stunting cases were observed to be higher amongst boys compared to girls, a comparison between children whose mothers reported that they were very small when born and those that were reported average or large at birth, the latter had a higher stunting. According to KDHS 2014 there were many children in rural areas than their urban counterparts and decreases where the caregiver is educated. Children born to mothers who dropped out in primary school are at 34 percent while those who did not attend school totally at

31 percent and these children are more likely to be stunted too unlike the ones whose mothers completed secondary education or higher at 17 percent.

#### **2.4.1.3 Weight-for-height (Wasting)**

KDHS (2014) states that weight-for-height index measures body mass in relation to body height and designates present nutritional position. Z-scores that are lower than minus two standard deviations (-2 SD) are reflected as thinner than their size (wasted) and are acutely malnourished. Wasting signifies lack of sufficient nutrition in the immediate duration prior to the survey period and might be the outcome of insufficient consumption of meals or a recent incident of sickness that has resulted to reduction in weight thus malnourishment. Children whose weight-for-height is below minus three standard deviations (-3 SD) are considered severely wasted (Calverton, MD, USA: KNBS and ICF Macro 2014).

Weight for height replicates body mass index comparative to chronological age, it is influenced by both height of a child (height for age) and his/her weight (weight for height), and its combined nature makes interpretation difficult. Wasting (weight-for-height z-score-WHZ) designates skinniness or thinness and is always a consequence of current lack of nutritional deficiency, more so it is hiked up by shifts seasonally linked to availability of nourishments and/or prevalence of illnesses. A WHZ of less than 2 denotes the existence of acute malnutrition (wasting) (B. Olack et al. 2011).

Anthropometric nutritional status is measured with the weight for height Z-score, which relates a child's weight to that of a healthy reference population of children of the same height or length and is expressed in units of standard deviations from the mean of the reference population. Recently the World Health Organization redefined normal child anthropometry, considering a diversity of ethnicities and recognizing that optimal infant feeding includes exclusive breastfeeding for the first six months of life (Mark J. Manary and Heidi L. Sandige 2008).

In exterior health facilities or in the public, whenever height is not easily measured, the circumference of the upper arm can be used in place of the weight for height z score to identify malnutrition. It changes little between the ages of 6 months and 5 years and is a measure of lean body mass. Prospective studies in Asia found that an upper arm circumference of less than 110 mm was the single best anthropometric predictor of death from malnutrition within 6 months. A

measurement of less than 110 mm is also used to define severe malnutrition. Using arm circumference will recognize a different population more severely malnourished than will using the weight for height z-score. When arm circumference is used, the population designated as malnourished is generally larger by 1.3. Equally, 10 percent of the children identified as severely malnourished by the weight for height z-score are not classified as such when arm circumference is used (Mark J. Manary and Heidi L. Sandige 2008).

KDHS 2014, found out that in Kenya, 4 percent of children whose parents were interviewed are wasted and 1 percent are severely wasted and the levels being high between 6 to 8 months and 9 to 11 months and this so because children are always introduced to complementary foods other than the mother's breast milk and there exist variations in quality and quantity thus they are more susceptible to illnesses during this period. Children whose mothers have not attended any schooling and those whose households are poor have higher chances of wasting.

#### **2.4.1.4 Weight-for-age (Underweight)**

Weight-for-age is a compound index of height-for-age and weight-for-height taking into consideration acute and chronic malnutrition. Children whose weight-for-age is less than standard deviation of negative two are categorized as underweight. Children whose weight-for-age is less than standard deviation of negative three (-3 SD) are concluded as severely underweight (KDHS 2014). Weight-for-age z-score (WAZ) is basically a combination of weight-for-height and height-for-age, therefore a measure of both severe and chronic malnutrition. A WAZ of less than 2 can be used for reporting a child as underweight. A z-score of <-3 defines severe levels of each of the indices (B.Olack et al 2011).

From the data, Kenyan children are under-weight at 11 percent with those classified as severely underweight at 2 percent and this is highly found in children whose age is more than 12 months and more in boys compared to girls. Mothers whose BMI were low (24 percent) during pregnancy have children who are underweight compared to those with higher BMI of 11 percent or less (KDHS 2014).

Latham (1997) ; Leslie (1995); Merchant, K. M. et al. (1993) found out that the single best indicator of malnutrition is a baby born with low birth weight and it doubles up as the single best predictor to childhood malnutrition. A baby with low birth weight often dies, while some who

survive have impaired immune systems that make them more vulnerable to infections. If such a baby has increased incidents of illness, their nutritional intakes will be washed out through diarrhea and vomiting. A washed-out body, together with long-standing malnutrition, will be a root to low-birthweight babies' development to weaken seriously.

## **2.4.2 Micronutrient deficiencies**

These are measured using clinical, biochemical assessments, and commodity testing of Iron, Vitamin A and Iodine. They will not be utilized in the project but are measures of deficiencies.

### **2.4.2.1 Clinical signs**

Clinical approaches of measuring dietary status comprise of examining signs of shortage at precise body areas or probing the patient for any indications that may propose nutrient deficiency. These signs may include; paleness (on the palms of any hand or the conjunctiva of the eye), bitot's spots on the yes, pitting oedema, goiter and severe noticeable wasting.

#### **2.4.2.1.1 Checking for bilateral pitting oedema in a child**

For one to realize the existence of oedema, the researcher needs to gently press both feet for three seconds using their thumb. If you still see the print of your thumb on both feet, then the child has nutritional pitting oedema. Oedema cannot be observed thus must be tested with thumb pressure.

#### **2.4.2.1.2 Bitot's spots**

Bitot spots are signs of deficiency in vitamin A to check on varied signs e.g. spots that may look creamy colored and appear on the white part of the eye.

#### **2.4.2.1.3 Goitre**

This is a swelling on some parts of the body e.g. the neck and can be visibly seen as a sign of deficiency in iodine

#### **2.4.2.1.4 Visible severe wasting**

For visible severe wasting in children below six months to be noticed, the mother/guardian of the child needs to undress the child's outfit to check the arms, thighs and buttocks for loss of muscle bulk. When a flabby skin and bums is observed then it indicates visible severe wasting.

#### **2.4.2.2 Biochemical indicators**

Compared with the other methods of nutritional assessment (anthropometric, clinical methods, and dietary), biochemical examinations offer the most impartial and quantifiable information about nutritional status. Biochemical tests frequently can discover cases of nutrient deficits in time before anthropometric measures are transformed and clinical signs and indications appearing. Most of the examinations are suitable indicators of current nutrient consumption and can be taken together with dietary methods to gauge food and nutrient intake.

Biochemical tests available for assessing nutritional values are assembled into two common and somewhat arbitrary sets: static tests and functional tests. These are occasionally denoted as direct and indirect tests, respectively.

Practical examinations of nutritional value status are based on the idea that “the final outcome of a nutrient deficiency and its biologic importance are not only a measured level in a tissue or blood, but the failure of one or more physiologic processes that rely on that nutrient for optimal performance.” Included among these functional tests are measurement of dark adaptation (assesses vitamin A status).

#### **2.4.2.3 Physical activities**

Physical findings of malnutrition can be seen and felt in nutritional edema which is as a result of severe malnutrition. Edema is the presence of excessive amounts of fluid in the intracellular tissue and it is a clinical sign of severe/acute malnutrition. It can always be seen jointly on the hands and feet. The caregiver needs to gently apply pressure using their thumb to either feet or hands for 3 seconds, if they can still see the print of their thumb on either feet or hands, then the child has Edema. Children with nutritional edema may lack main renal, hepatic, or cardiac disease, and ascites. Nutritional edema is usually linked to monotonous, diets based on maize

where populations are faced with food insecurity, this is not an early indicator to malnutrition as for a child to reach this stage a lot has happened and the malnutrition is now severe therefore not a good indicator (Mark J. Manary and Heidi L. Sandige 2008).

## **2.5 Factors associated with child malnutrition in the informal settlement**

Urban centers are characterized by an economy that is extremely monetized to mean that any one even the extreme poor essentially access all or almost all of their basic requirements through the market; making it even more difficult in accessing income which is an essential factor for a household's well-being. The center piece of urban economies e.g. the informal economy is wage labor and thus a key employer of the urban poor. The slum residents do face higher costs for necessary goods (particularly food) and services and restricted access to the services as compared to their wealthier urban colleagues; slum residents in Nairobi pay 11 times as much for water as those in well off estates (Beall, J., and Fox, S., 2006).

In urban and rural areas alike, consequences from the interaction of food, healthcare and hence the determinants of nutritional standings going beyond income. For example, women in the cities are less likely to work within their homes compared to their rural counterparts, meaning that they have less time and additional struggle in taking care of their children. These restrictions can result to sub-optimal child nurturing practices, most women living in urban areas also tend to stop breastfeeding their children two to three months earlier than their rural ones, this may often leave their children under nourished with deficient immunity to disease (Ruel 2004).

In slum neighborhoods, residents commonly reside in congested surroundings, with poor-quality accommodation, poor or non-existent waste collection, drinking water that is unsafe and not functioning or non-existent sewer systems. In low and middle-income countries, the residents in urban areas suffer a percentage between 25 and 50 lack access to clean water to drink and hygienic sanitation or even drainage systems. The poor in urban center's frequently do not have physical access to healthcare, and when those exist, affordability becomes another challenge (USAID 2010).

### **2.5.1 Household Head's Level of Education**

Frost *et al.* (2005) acknowledged five trails in which a household head's education is associated to the health of the child: enhanced socio-economic standing, health information, modern approaches to health care, independence of women, and child birth history. Females who are educated may create a favorable environment for their children; they are also knowledgeable to and have a positive attitude to health services; principal obligation of making decisions on a child's health and nutrition. The structure of a household does influence child nutrition through variances in psychological wellbeing of the parents and effectiveness in taking care of the kids (Brown 2004). When the HHH's educational achievement levels are lowered, their emotional support donates to hitches in behavior, their personality become less engaging, thus less educational performance for their kids (Thomson E., Hanson T.L., MCLanahan S.S. 1994).

KDHS (2014) states that children from households where heads are educated and those from wealthier households are least likely to be stunted. Kabubo-Mariara *et al.* (2009) Mother's education is positively associated to nutritional results of the child. The factors for maternal education recommend the significance of wealth in successful improvement of children's nutritional standing. The education of a mother is significant than that of a father in a child's nutritional status determination.

### **2.5.2 Food security**

Good nutrition is a requirement for the nationwide growth and development of countries and for the welfare of people. The Kenyan 2010 Constitution recognizes sufficient food and nutrition as a right for its citizens. Additionally, the Government of Kenya's 2011 Food and Nutrition Security Policy recognizes nutrition as core to growth of humans within the country (Government of Kenya, 2011).

According to Thomson E. *et al.* (1994), the two major key resources that households offer to their children are finances and time. Money offers not only the capability of fulfilling the elementary requirements but also the chances that boost mental and societal growth of the child. The "new home economics" theory Becker (1981) too stated that members of a household give wages and funds to the common household *per se* besides all families are overseen by an "altruistic head" to safeguard effective combination and distribution of time, money, and other



resources. (Desai, 1992; Carlson and Corcoran, 2001; Barrett and Turner, 2005; Gennetian, 2005).

### **2.5.3 Sex of Household Head**

Children who reside in households headed by females in most cases are undernourished as their income is much lower than that of men who are sometimes supported by their spouses and they have limited access to health services (Fentaw R., Bogale A., Abebaw D. 2013). Female's heading households frequently encounter economic and limitations in time as a consequence of absenteeism of a companion either from loss of life or divorce (Schiller 1996). In developing countries women earn little income as a result of less favorable labor market environments being exaggerated by the many roles in production, reproduction, and care. With this in mind, they work for longer hours to generate household income and domestic activities accounting for most of their children's disadvantages (Thompson et al. 1994; Schiller 1996).

### **2.5.4 Size of Household**

Ideally, various studies have shown how food availability to larger families was a problem that caused nutritional problems. In a study in Nigeria done by Ajao, Ojofeitimi, Adebayo, Fatusi, and Afolabi in 2010, it was established that women who had above than children under the age of five were at the risk of being underweight. The researchers further noted that the total number of family members was linked to incidence of adverse nutritional circumstances even though this was statistically insignificant.

A study in India assessing the impact of family planning on nutritional status of children and women reliant on diet and nutrition surveys, hematological surveys, anthropometric data as well as hospital statistics revealed good nutritional health in children who were from small-sized households (Das, Chakraborty, and Mitra, 2015).

### **2.5.5 Income levels of Household Head**

Economic growth and income can affect nutrition in a number of ways. Wealthier populations usually are able to purchase diverse foods ranging from animal products that are rich in protein to fruits and vegetables that are rich in essential minerals, vitamins, and other nutrients. On the

contrary, poorer populations usually lack access to variety of foods in the right proportions resulting in inadequate nutrition. Economic growth usually boosts household incomes which results in more spending on foods, education, and health Headey, D. (2011).

Studies done in India and Senegal indicated that malnutrition problems affected both the poor and the wealthy households. In India however, stunting was determined to be 2.5 times more common in children living in the poorest households compared to those that were from wealthy home, while more than a quarter of children from the richest families were established to be stunted. In Senegal, on the other hand, richer families also indicated instances of children who were stunted although the low national poor nutritional health levels masked these differences by wealth (Hagey, 2016). Malnutrition was also established to be associated with low monthly incomes and not maternal educational status or even the employment status of household heads hence the need to address poverty Tette, Sifah and Nartey, (2015).

#### **2.5.5 Child's sickness status prior to data collection**

Sicknesses are commonly considered to result in poor health. Certain sickness for instance may cause poor nutrition. Good nutrition is usually necessary for physical growth, survival, performance, productivity, mental development, and well-being across in every stage of life starting from fetal development, birth, infancy, childhood, and even development into adulthood.

Tette et al., (2015) in their study conducted in Ghana established that health conditions such as developmental delay and diarrhea experienced within a period of six months before their research had an impact on malnutrition. Such conditions in children were determined to cause poor nutritional health.

#### **2.5.6 MUAC as the best measure of malnutrition in children aged between 6 to 59 months**

A number of studies have consistently revealed that MUAC is an effective measure of malnutrition in children. A study by Goossens, Bekele, Yun, Harczy, Ouannes, and Shepherd, (2012) conducted in Bukina Faso concluded that MUAC of less than or equal to 118mm when used as a TFP admission criterion was a beneficial alternative to the weigh for height Z-score (WHZ) tool. The study relied on secondary data on patients collected between 2007 and 2009 on children admitted using the MUAC less than or equal to 118 mm. Their analysis also captured

anthropometric measurements upon admission and discharge, treatment response and program outcomes. The study also established that MUAC was feasible as a criterion both at admission and discharge of children in this age range.

Ralston, and Myatt (2016) in their study relying on secondary data collected in 560 nutritional surveys from 1992 to 2006 where 453,990 children aged between 6–59 months were involved, established that the estimation of weight from height on its own and then height using MUAC classes among children in the targeted age range offered more accurate measures in middle income countries compared to other weight estimation tools. The height-based weight estimating tape that is stratified based on the MUAC classes was considered fit for children in the ages between 6 and 59 months in areas where resources were limited. In Ethiopia, a study by Tadesse, Berhane, and Ekström, (2017) established that MUAC and WHZ were appropriate tools in diagnosing severe wasting in children aged between 6 and 59.

Another study by Mwangome, Ngari, Fegan, Mturi, Shebe, Bauni, and Berkley in 2017 also established that MUAC and weight for age Z-score (WAZ) were strong tools in predicting post discharge and inpatient mortality. The study analyzed data from cohorts of infants who were under 6 months admitted in a hospital in Kilifi County, Kenya. A total of 2882 infant were involved in the study. The study concluded that in infants that are under six months who were at a higher risk of death, MUAC and WAZ were the best tool to use in assessing their health.

Finally, in a study done by Mogendi, De Steur, Gellynck, Saeed, and Makokha in 2015 established that the mid-upper arm circumference was an appropriate tool in the identification of malnourishment in children when being admitted into nutrition rehabilitation programs. The study engaged 156 children aged between 6 and 59 months in selected Health Centres in the Eastern District in Nairobi, Kenya with the recordings of the age, height, weight, and the mid-upper arm circumference measures upon admission, follow-ups and subsequent discharge from the nutrition rehabilitation programs. The study confirmed the appropriateness of the MUAC tool also in the monitoring of recovery trends as well as in discharging children after the program. The researchers concluded that MUAC as a tool had the potential of minimizing the cost of nutrition rehabilitation particularly in community therapeutic facilities in developing countries.

## **CHAPTER THREE: RESEARCH METHODOLOGY**

### **3.1 Introduction**

The methodology is looking at research design, population being targeted, and techniques for sampling, describe the instruments of research, procedure for data collection and data analysis.

### **3.2 Research Design**

Descriptive research design was used in the study. According to Kerlinger (2002), this design is preferred because it is an assortment of numerous statistical procedures or techniques used in coming up with a research study, it further indicates that the design is apprehensively trying to answer questions such as who, how, what, which, when and how much. This method suitably enables the investigator to scrutinize the objectives cautiously and obtain data as they exist from the situational analysis.

### **3.3 Description of Study Areas**

The secondary data from Concern worldwide was from a project that was developing indicators and conducting surveillance of the developed indicators in four urban informal settlements in Nairobi (Mukuru, Korogocho, Viwandani and Kibera). Informal settlements are make-shift residences often made from scrap resources e.g. corrugated iron sheets, polythene sheets and plywood. The slums are constantly densely inhabited and categorized by inadequate basic amenities and infrastructure for provision of clean drinking water, sanitation amenities, solid waste management, roads, drainages and power. With an increase in poverty within the informal settlements a number of factors such as; limited sanitation, congestion, substandard housing, contaminated and inadequate amounts of water adding to their risks of transmittable disease and to significant rate of child malnutrition and mortality (B. Olack, et al. 2011). Informal settlements or slums are initiated by a range of interconnected elements, such as population growth and rural-urban movement, absence of low-priced accommodation for the slum dwellers, fragile governance, financial susceptibility and poorly paid work, discrimination and marginalization, and displacement caused by conflict, natural disasters and climate change (UN Habitat 2015).

The primary data was collected in Korogocho informal settlement and below is a brief profile of the area.

### 3.3.1 Korogocho Profile

Korogocho is characterized by increased levels of casual employment, insecurity, greater susceptibility and a particularly many households headed by females. Korogocho is at the eastern side of Nairobi and is a very compactly inhabited poor slum. The total households in the area are 3,129 with a population of 10,378 people in an area of 0.9 square kilometres (KNBS 2009). It further divided into smaller villages totalling of 9 and bordering Dandora where most residents go to scavenge for remains at the dumpsite.

### 3.4 Target Population

The target population comprised of households in informal settlements of Korogocho with children aged between 6 to 59 months. Williamson (2001) indicated that the target population is a total group of people, entities, occurrence or objects having mutual characteristics that's observable in which the researcher would like to generalize the outcome of the study.

### 3.5 Sample Design

Stratified random sampling design was used in the study. Mugenda & Mugenda (2003), states that it is the method of selecting identified respondents as representatives to the target population, the size of the sample is hence used in minimizing assignments involving massive data analysis by reducing to a sample representation. The data was collected using a sample size of 150 households from three villages within Korogocho Slums in Nairobi to represent the entire population.

**Table 3.1 Sample Design**

Population category	Target Population	Sample size	Percentage
Gitathuru	50	25	25
Grogan B	50	42	42
Korogocho A	50	33	33

<b>TOTAL</b>	<b>150</b>	<b>100</b>	<b>100</b>
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Source: Author 2017

### **3.5.1 Sampling Procedures**

A stratified sample is attained by selecting subdivisions in each stratum or sub-group of the inhabitants. Kerlinger (2002) when selecting samples from a populace having several strata, it generally requires that the fraction of every stratum sampled should be equal as in the population, Kerlinger notes that the advantage of this method (stratified sampling) is to guarantee that every member of the population has participated in the study, this method ensures, the sample is distributed into different stratum of the study site. The slums are marked using villages used as stratum in this case and all households in the villages were counted then randomly sampled. The count was done to ascertain the exact population due to the high morbidity and high dynamics in the number of households, more structures being put up and many people moving in and out of the informal settlement every month, during this process households were listed and labelled at the entrance of each structure to give them a unique household identification that was used to identify a sampled household during data collection. Random sampling was applied for selection of households without replacement, in which each household had the same chance of being selected for interviewing.

### **3.6 Data Collection Instruments**

#### **3.6.1 Questionnaire**

This study used a questionnaire to collect data. According to Mugenda&Mugenda (2003), it is a sequence of questions asked to a person/people to obtain statistically valuable information around a given subject, it is also deliberated that they are low-cost and easy to conduct and easier to analyze. While Kothari (2001) give emphasis to the response choices for a closed-ended question and open-ended questions must be comprehensive and equally exclusive to allow the interviewee to indulge more in their responses, as well as give their individual judgement on a particular issuer. The study embraced a digital data gathering technique in ODK software to collect data for the study. This process was important for minimizing errors associated with data collection and data entry, efficient administration of surveys as the software has skip patterns,

less bulky compared to paper based data collection, allows for faster turnaround time, and mobile devices are GPS enabled which allows for easier geo-tagging of households which allows for geo-spatial analysis.

### **3.6.2 Reliability and Validity of Research Instrument**

A questionnaire consisting of all questions dependent on all the indicators being monitored was prepared in an excel document and uploaded in ODK. This tool was first pre-tested to detect and eliminate any error including skip patterns and structuring of the questionnaire. It was tested on 10 respondents in Mukuru slum which has almost the same features as the study site to get the required duration for conducting the tool and the number of interviewers required. It is from such an approach that instrument results are supposed to show that the questionnaire can be applied in the study.

### **3.6.3 Training of Field Interviewers**

The field interviewers were selected from the Community Health Volunteers (CHV's) in the respective villages in the slum. Before the data collection started, the field interviewers were briefed about the data to be collected, what it was going to be used for and on interviewing skills so that they can collect quality data that can be analyzed and used in the project. Working in the slums is also challenging and more so with the heightened political temperatures in Kenya as we move towards the electioneering period, the interviewers need to know their way around the informal settlement (and that is why the CHV were preferred) and not to engage in any political discussions while collecting data for the study, how to carry themselves around and security for the phones, weighing scales and height boards they were using for data collection and their own personal security.

### **3.7 Data Analysis and Methods**

The objectives of the study were; Determination of appropriate measures to provide quick and reliable information on the extent of child malnutrition in study sites and identifying factors associated with child malnutrition in the study sites. There exist three types of data for analysis of the study objectives identified;

There are three types of datasets that was analysed in the study, two secondary data and one primary data; first secondary data set was collected by an organisation known as Concern Worldwide in their Indicator development for the surveillance of urban emergency project done between 2012 and 2016. The researcher selected sets from every quarter of the surveillance data from 2014 to 2016 and a total of 4,045 datasets were analysed. This data was collected in Mukuru, Korogocho, Kibera, Viwandani and Moroto.

The second secondary data sets are from the SMART survey conducted by Ministry of Health in collaboration with other stakeholder like Save the children, UNICEF, Concern Worldwide among others in February 2017 in all informal settlements in Nairobi. The researcher was able to analyse datasets (477) from three informal settlements of Kibera, Mukuru and Korogocho.

The third dataset is a primary data that was collected by the researcher in Korogocho informal settlements during the month of June 2017. This was only for comparison of results received from the SMART survey analysis. A total of 150 households with children aged six to 59 months were targeted but was able to manage 100 households).

The first analysis supporting objective one was correlation analysis to find the relationship between malnutrition indicators and identify the correlation between them being monitored. It was also to identify under nutrition indicators that can provide quick and reliable information that is useful for child malnutrition surveillance in urban centres. This was conducted on the second set of Secondary data (477) and the primary data (100) collected in the informal settlements. This was trying to find the relationship between these indicators; height-for-age, weight-for-age and weight-for-height to try and identify which under nutrition indicator can provide quick and reliable information on child malnutrition. Logistic regression analysis was performed on the data to try and compare recent data collected (Primary) to the Secondary (SMART survey) data collected early 2017 and if it still speaks the same on quick and reliable nutrition indicators. This information was then presented diagrammatically in form of tables, charts and percentages.

The second is a bivariate logistic regression analysis carried out on the first secondary (4,045) datasets to find out the factors attributed to child malnutrition and the relationship between household characteristics and child malnutrition in the study sites. A bivariate logistic regression



analyses carried out on the factors attributed to child malnutrition was to find out the relationship between household characteristics to child malnutrition in the study sites which were Korogocho, Kibera, Moroto, Mukuru and Viwandani. There was an analysis on the type of household head (HHH) the family has, Household head's education, marital status of the HHH, gender of the HHH, Child's sickness status prior to data collection, income of the HHH, and food security and their linkages to the malnutrition among under five children in the household. This was to find out the correlation between time series and check on consistency of information from the informal settlement over a period of three years, picked on a quarterly basis data collection. Can household factors be associated with malnutrition in under five children in the household?

Logistic regression is a method used to generate odds ratio where there exists more than one explanatory variable. This procedure remains very similar to the multiple linear regression approach, except for the aspect of the response variable being binomial. This therefore causes an impact on the odds ratio for every variable. Using the logistic regression model usually helps in avoiding the confounding effects through the analysis of the association in all the variables together (Hosmer Jr, Lemeshow, and Sturdivant, 2013). In the logistic regression model in this study, the researcher treated MUAC as the dependent variable while the independent variables were the child age, household head level of education, household head marital status, household head gender, household size household head age and child sickness.

### **3.8 Ethical considerations**

The researcher made sure that ethics was observed in the study to control mutual understanding between the researcher and the participants and between the researcher and the field of study. The purpose of the study was fully explained in advance to allow the participants to choose whether to participate or not to participate in the study (Kombo et al, 2006). Informed consent allows the respondents to choose to participate or not to participate.

Confidentiality and anonymity of the respondents was maintained at all times (Urombo, 2000). The researcher maintained confidentiality and anonymity by assigning numbers to the various questionnaires issued to a participant. That is, no respondent was asked to tell the interviewer his or her name nor written on the questionnaires. The researcher never overused certain sources

even if acknowledged and recognized all the sources and authors from where information used to compose the work was derived.

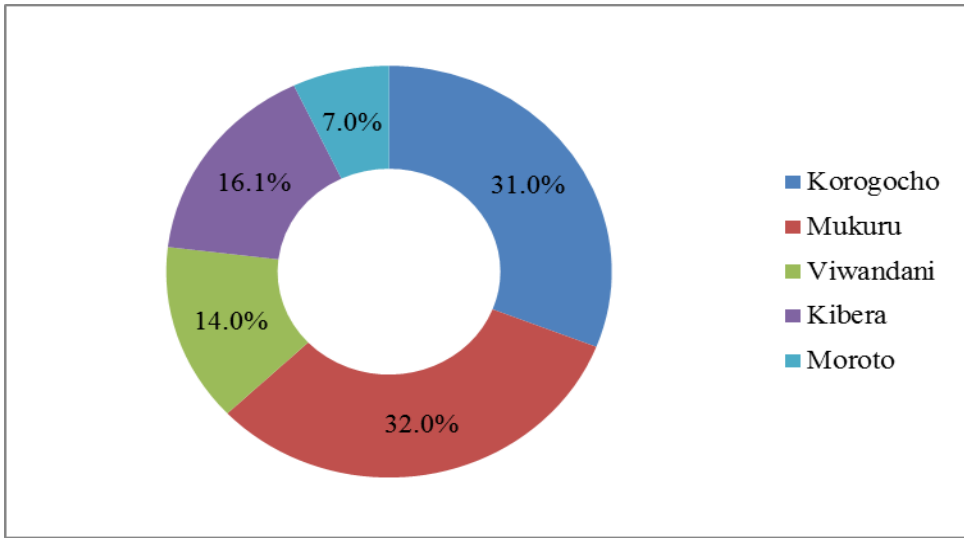
## **CHAPTER FOUR: FACTORS ASSOCIATED WITH CHILD MALNUTRITION AND ASSESSING UTILITY OF MID UPPER ARM CIRCUMFERENCE IN THE URBAN INFORMAL SETTLEMENT OF NAIROBI**

### **4.1 Introduction**

This chapter presents the findings, discussions and interpretation of the factors associated with child malnutrition in the surveillance of urban informal settlement emergencies. The study relied on secondary data collected from households within the informal settlements and primary sources by use of questionnaires. The questionnaires were administered on respondents whose findings are also part of the presentation. Data analysis was done using descriptive statistics with the results presented on graphs, tables and pie charts and the results from inferential statistics presented on tables.

#### **4.1.1 Summary of the data sources**

In order for the research to have been successful, the researcher relied on both primary and secondary sources of data. Primary data was collected from Korogocho with a success rate of 66.7% (100 questionnaires collected out of the 150 administered). The secondary data used in this research was largely collected by the implementing partners in the health sector alongside the Ministry of health and the distribution in the areas of collection presented in figure 4.1 below.

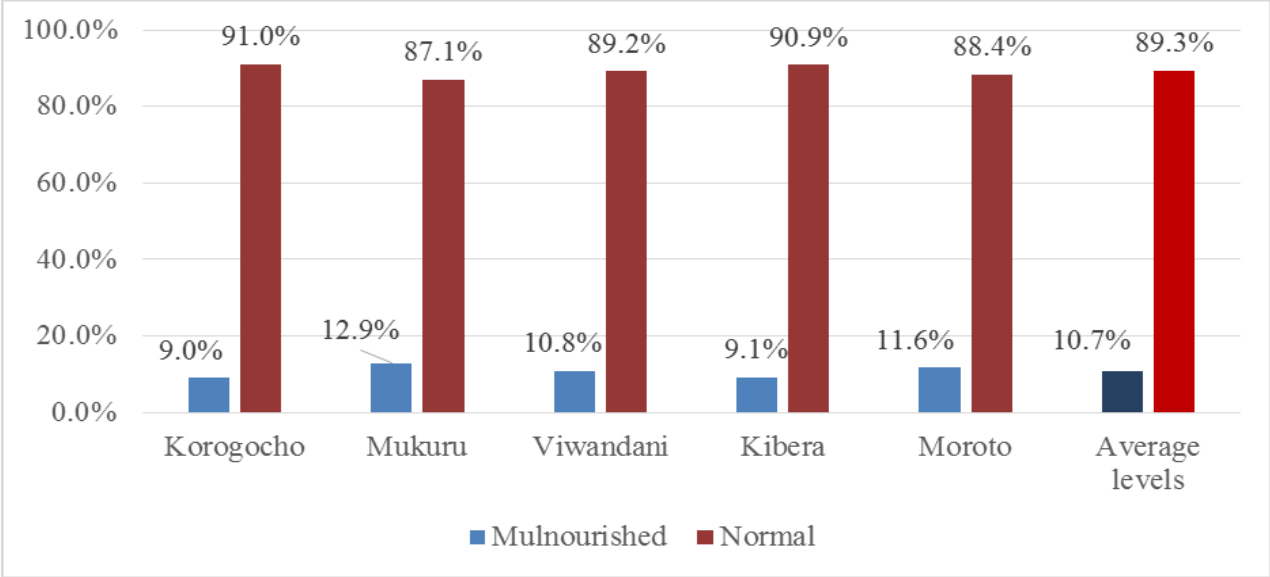


**Figure 4.1: Summary secondary data source locations**

From Figure 4.1 above, 32.0 percent of the total questionnaires collected by Concern Worldwide were drawn from Mukuru, 31.0 percent from Korogocho. Viwandani, Kibera and Moroto had a representative of 14.0, 6.1 and 7.0 percent respectively.

**4.1.2 Proportion of malnourished and non-malnourished children from secondary data sources**

For the secondary data, it was important to analyze the proportion of children that were malnourished in the areas where the study was conducted. This was represented is shown in Figure 4.2.



**Figure 4.2: Proportion of malnourished children from secondary data sources**

From Figure 4.2 above, the average levels of malnourishment were 10.7 percent, with the highest levels of malnourishment witnessed in Mukuru at 12.9 percent. The findings show that malnutrition levels were high in Mukuru slum as compared to other areas. None of the areas fell within the acceptable margins of malnutrition of below 5 percent, according to the ratings provided by Save the Children (2017).

**4.1.3 Educational levels of Household Heads**

Education is a key aspect that usually determines the level of understanding of the need for proper nutrition. As a result, the study sought to get information on the education levels of household heads to ascertain its impact on malnutrition levels in children living in the households. The findings are presented in table 4.1 below.

**Table 4.1 Education levels of household heads according to nutritional status of children in study**

	No	Primary	Secondary	College	Total

		Schooling	Education	Education		
<b>Normal</b>	<b>Frequency</b>	10	238	212	20	<b>480</b>
	<b>Percentage</b>	2.1%	49.5%	44.2%	4.2%	<b>100.0%</b>
<b>Moderate Acutely Malnourished</b>	<b>Frequency</b>	0	12	3	1	<b>16</b>
	<b>Percentage</b>	0.0%	75.0%	18.7%	6.3%	<b>100.0%</b>
<b>Severe Acute Malnourished</b>	<b>Frequency</b>	2	3	2	0	<b>7</b>
	<b>Percentage</b>	28.6%	42.9%	28.5%	0.0%	100.0%

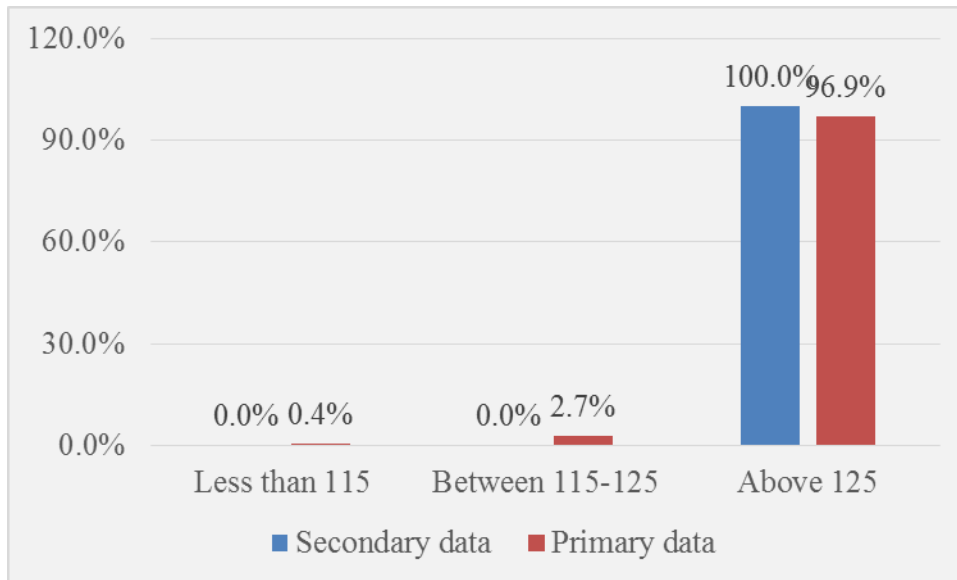
As presented in Table 4.1 above, most of the household heads had their highest educational qualification level as primary schooling levels, followed by secondary level of education. Higher proportions of children suffering from severe acute malnourishment was with those who had attained primary levels of education.

#### **4.3 Objective One: Determining quick and reliable measures on child malnutrition levels**

The study reviewed many techniques used in the determination of the malnutrition levels in children between the ages of 6 and 59 months. The methods considered for this study included the Mid Upper Arm Circumference (MUAC), Height-for-age (stunting), Weight-for-height (wasting), and Weight-for-age (underweight). The main objective of the review was to determine the existence of any significant statistical difference in the measures for both primary and secondary data collected. The findings are presented in according to the measures as follows:

##### **4.3.1 The Mid Upper Arm Circumference (MUAC)**

The Mid Upper Arm Circumference (MUAC) as a measure of malnutrition is used by health workers to speedily determine if a child is acutely malnourished (Reilly, 2017). Data pertaining to this measure was obtained from both primary and secondary sources. The study took measurements from children between the ages of 6 to 59 months and the findings are presented in figure 4.3 below for secondary and primary data respectively.



**Figure 4.3: MUAC estimates of malnutrition levels obtained from primary data**

The MUAC measures used in this study consider a child to be under severe acute malnourishment when the measure is below 115mm, while measures that are greater than 115 and less than 125mm are considered as moderate acutely malnourished and measure above 125 considered as normal (WHO, (2006); Izudi, et al., (2017)). The findings presented in figure 4.3 above show that 96.9% (n=477) and 100% (n=100) of the children suffered no malnutrition cases from both the primary and secondary data respectively. The findings presented in the Table 4.3 also indicate that 2.7 percent suffered moderately acute malnutrition levels while 0.4 percent had MUAC measures less than 115, hence minimal cases of severe acute malnutrition based on the primary data. It is imperative to note that the secondary data used indicated that no child suffered from actuate malnutrition.

The researcher then sought to determine if there was a statistical difference between the MUAC as a measure of nutritional health of children for the primary and the secondary data. The findings are presented below.

$$H_0: \mu_1 = \mu_2 = 125$$

$$H_1: \mu_1 \neq \mu_2 \neq 125$$

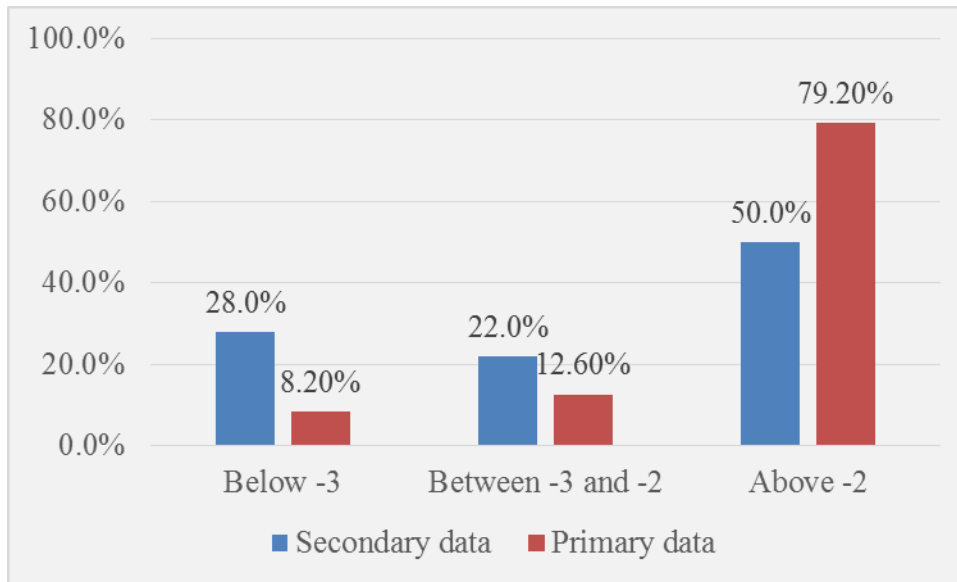
**Table 4.2: Comparison of MUAC measure for primary and secondary data**

One-Sample Test (Test Value = 125)						
	t	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
MUAC primary data	40.60	476.00	0.00	25.22	24.00	26.44
MUAC secondary data	18.03	99.00	0.00	22.50	20.02	24.98

The two samples of MUAC measures on child nutrition levels were tested against the hypothesized breakeven point of 125 below which a person is considered malnourished and otherwise, healthy as presented in Table 4.2 above. Given that  $t(476) = 40.60$ ,  $P=0.00$  and that  $t(18.03) = 99$ ,  $P=0.00$  it is concluded that there is no statistical significant difference in the means of the samples, hence the conclusion was that there was no statistical difference between the MUAC measures obtained for the primary and the secondary.

#### 4.3.2 Height-for-age (stunting)

The researcher also sought to compare the stunting or height-for-weight measures of nutrition for the primary and the secondary data. The measure is derived by getting a standardized z-score for the height and weight of children. From this, measures falling between two standard deviations and three standard deviations to the left of the normal distribution curve generated (between -3 and -2 SD) are considered short for their age or stunted, hence chronically malnourished. Children whose measures fall below three standard deviations to the left of the generated normal distribution curve (-3 SD) are considered to be severely stunted. On this basis, the findings are presented in figure 4.4 below.



**Figure 4.4: Height-for-age (stunting) estimates of malnutrition levels**

Figure 4.4 above show that majority of the children in the study areas (79.2%, n=477 and 50%, n=100) were normal, 12.6% and 22.0% of the children had stunted growths for the primary and the secondary data respectively. KDHS (2014) indicated that the national stunting measures affected 26 percent of children with 8 percent showing severe stunted cases. These findings of this study therefore reflect the existence of stunting even though at lower proportions compared to the national levels. The two samples of data on height-for-age measure were then tested for statistical difference by the researcher. The findings are presented in Table 4.3 below.

$$H_0: \mu_1 = \mu_2 = -2$$

$$H_1: \mu_1 \neq \mu_2 \neq -2$$



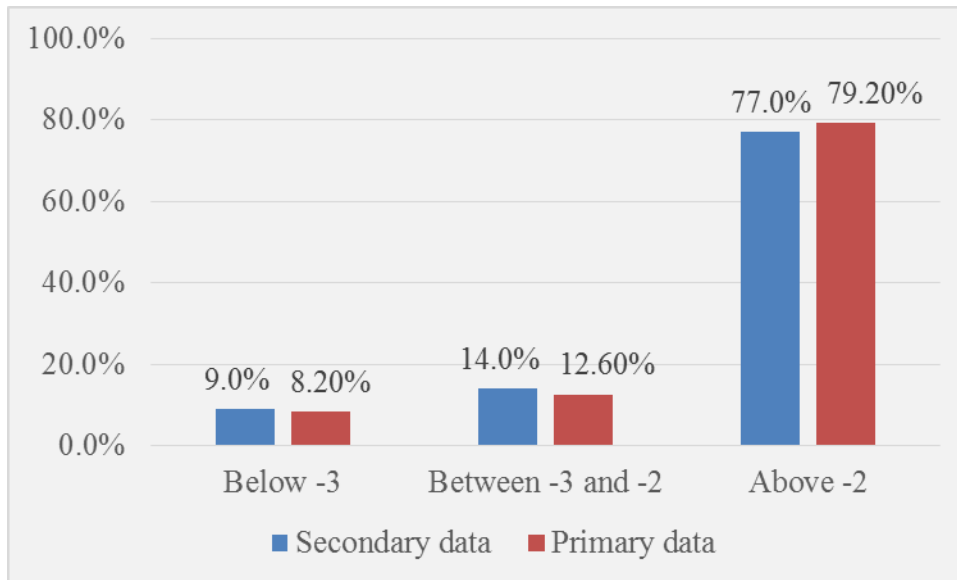
**Table 4.3: SPSS comparison of Height-for-age measure**

One-Sample Test (Test Value = -2)						
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
MUAC primary data	17.73	476	0.00	1.07	0.95	1.19
MUAC secondary data	2.50	99	0.14	0.57	0.12	1.02

The findings presented in figure 4.3 above show that  $t(476) = 17.73$ ,  $P=0.00$  and  $t(99) = 2.5$ ,  $P=0.014$ . With a hypothesized breakeven point of -2 after standardization, below which a person is considered stunted, the researcher was able to conclude that there was a significant statistical difference between the height-for-weight measures obtained for the primary data and the secondary data.

### 4.3.3 Weight-for-height (wasting)

The weight-for-height index was also assessed by the researcher. This measures the body mass in relation to body height to designate the present nutritional position. The findings are presented in figure 4.5 below.



**Figure 4.5: Weight-for-height (wasting) estimates of malnutrition levels**

The study findings revealed that majority of the children (77.0% for primary data and 79.2% for secondary data, n=477 and n=100 respectively) had normal weight-for-height or wasting measures. The findings of this study nonetheless vary from the national statistics that indicate a wasting measure of 4 percent (KDHS, 2014). The researcher also sought to determine if there was a significant statistical difference between the wasting measures obtained for the primary and the secondary data and the findings are presented in table 4.4 below.

$$H_0: \mu_1 = \mu_2 = -2$$

$$H_1: \mu_1 \neq \mu_2 \neq -2$$

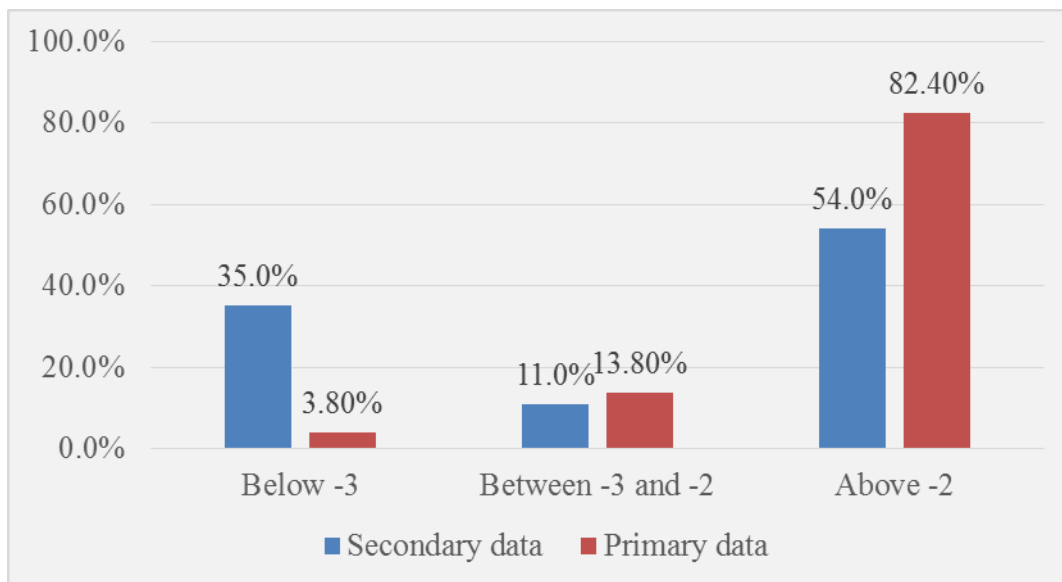
**Table 4.4: comparison of wasting measures for primary and secondary data**

	One-Sample Test (Test Value = -2)					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
MUAC primary data	14.17	476	0.00	0.94	0.81	1.07
MUAC secondary data	7.55	99	0.00	1.26	0.93	1.60

The findings presented in Table 4.4 summarized as  $t(476) = 14.17, P=0.00$  and  $t(99) = 7.55$ , mean that the null hypothesis is not rejected. The researcher, therefore, concluded that there was no significant statistical difference between wasting measures obtained from the primary data and the secondary data.

### 2.3.4 Weight-for-age (underweight)

The weight-for-age measure was also sought for by the researcher for both the primary and the secondary data. The findings are presented in figure 4.6 below.



**Figure 4.6: Weight-for-age estimates for children in the study area**

From the findings presented in Figure 4.6 above, 82.4% (n=477) and 54.0% (n=100) of children in the study area, from the primary and secondary data sources respectively, had normal weight-for-age estimates. This measure basically is a combination of weight-for-height and height-for-age, therefore a measure of both severe and chronic malnutrition. KDHS, (2014) indicates that 11% of children in Kenya have their measure falling in the range of underweight with 2 percent deemed to be severely underweight. These are findings that show a large variation from the findings of this study with the primary data showing severe cases to be low and the secondary data indicating higher cases of severe malnutrition.

$$H_o: \mu_1 = \mu_2 = -2$$

$$H_1: \mu_1 \neq \mu_2 \neq -2$$

**Table 4.5: comparison of weight-for-age measures for primary and secondary data**

One-Sample Test (Test Value = -2)						
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
MUAC primary data	29.36	476	0.00	1.69	1.58	1.81
MUAC secondary data	2.63	99	0.01	0.83	0.20	1.46

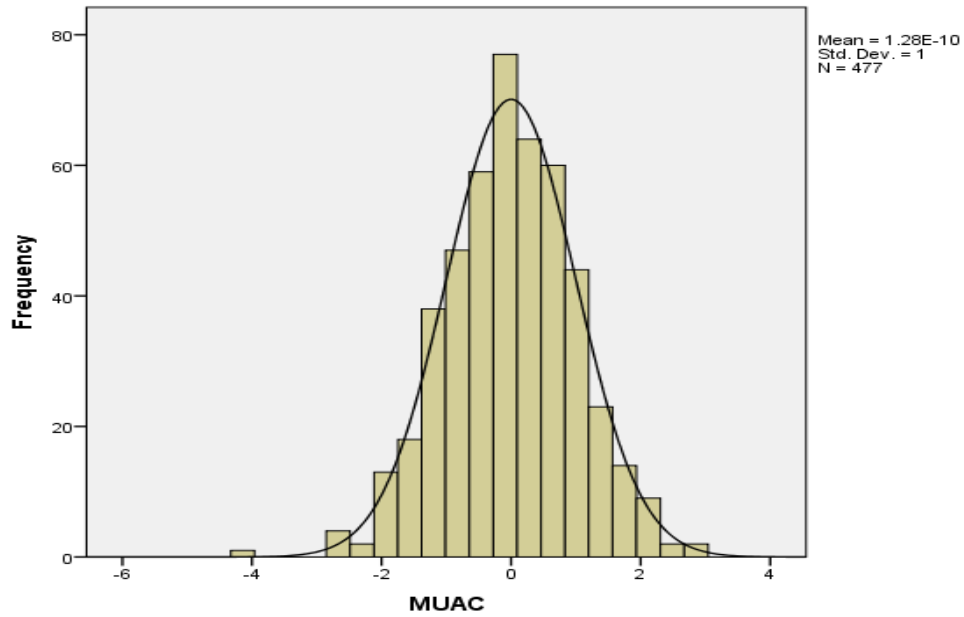
The findings presented in table 4.5 summarized as  $t(476) = 29.36$ ,  $P=0.00$  and  $t(99) = 2.63$ , show that the null hypothesis is rejected. The researcher, therefore, concluded that there was a significant statistical difference between weight-for-age measures obtained from the primary data and the secondary data.

### 4.3.5 Assessing utility of the measure of MUAC

The researcher sought to establish that MUAC is a suitable and convenient measure for malnutrition in children based on the primary and secondary data collected. This was done by generating histograms and normal distribution curves for the normalized data on the four measures used and subsequently generating correlation measures on the standardized measures on malnutrition including, MUAC, height-for-age, weight-for-height, height-for-age and weight-for-age measures.

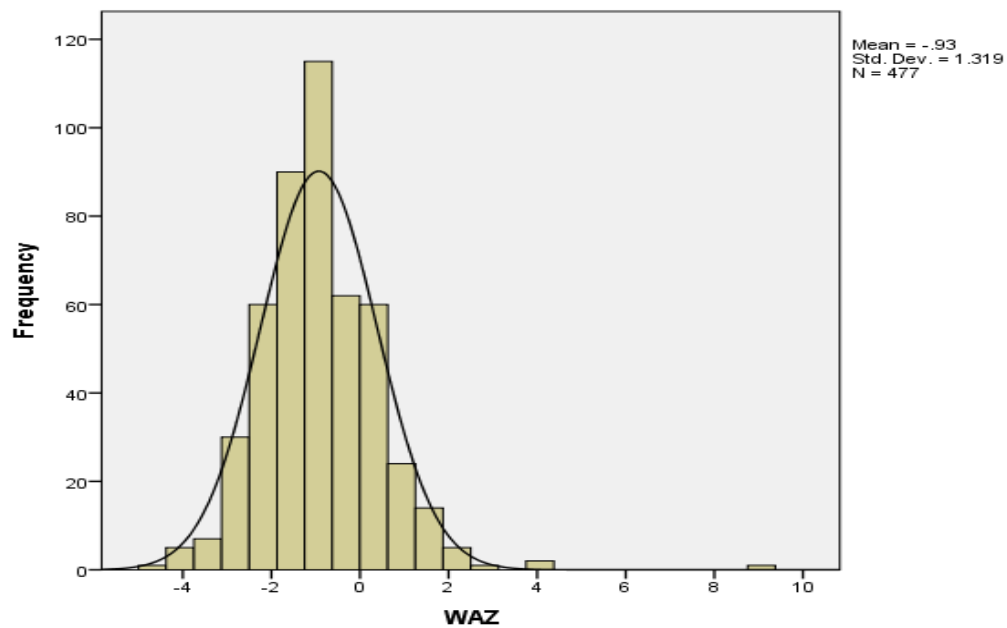
#### 4.3.5.1 Consistency between data sets

The researcher utilized the z-score secondary data to verify the reliability of MUAC by generating histograms and normal distribution curves for the normalized scores from the secondary data. The findings are presented below followed by a summary of the parameters.



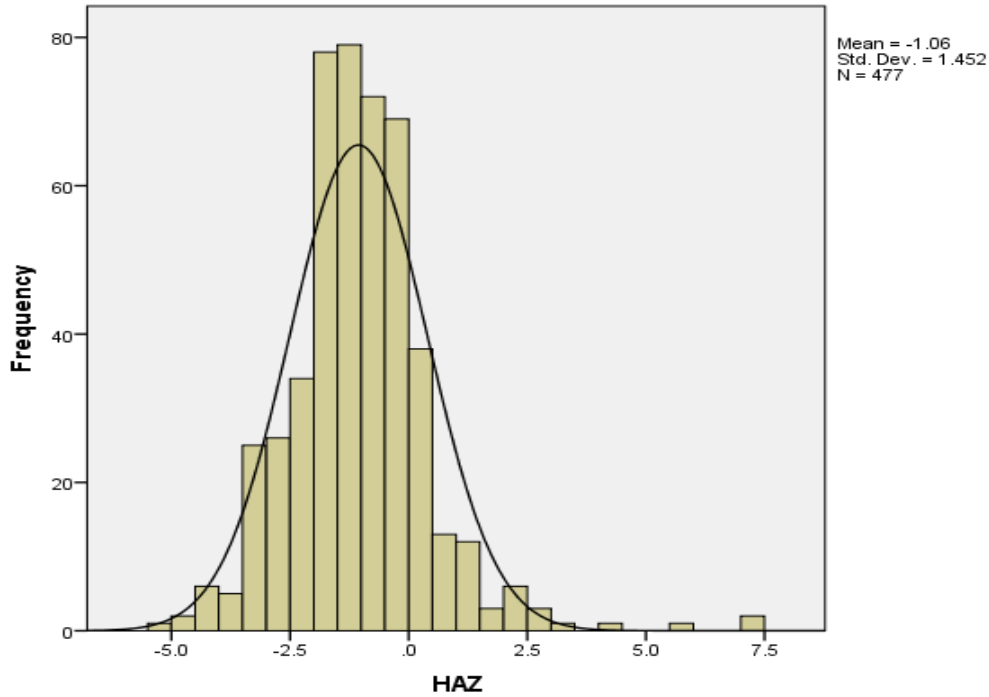
**Figure 4.7: Histogram and normal distribution curve for MUAC Z-scores**

Figure 4.7 above shows the normal distribution curve and histogram for the mid upper arm circumference measures with a standard deviation of 1.



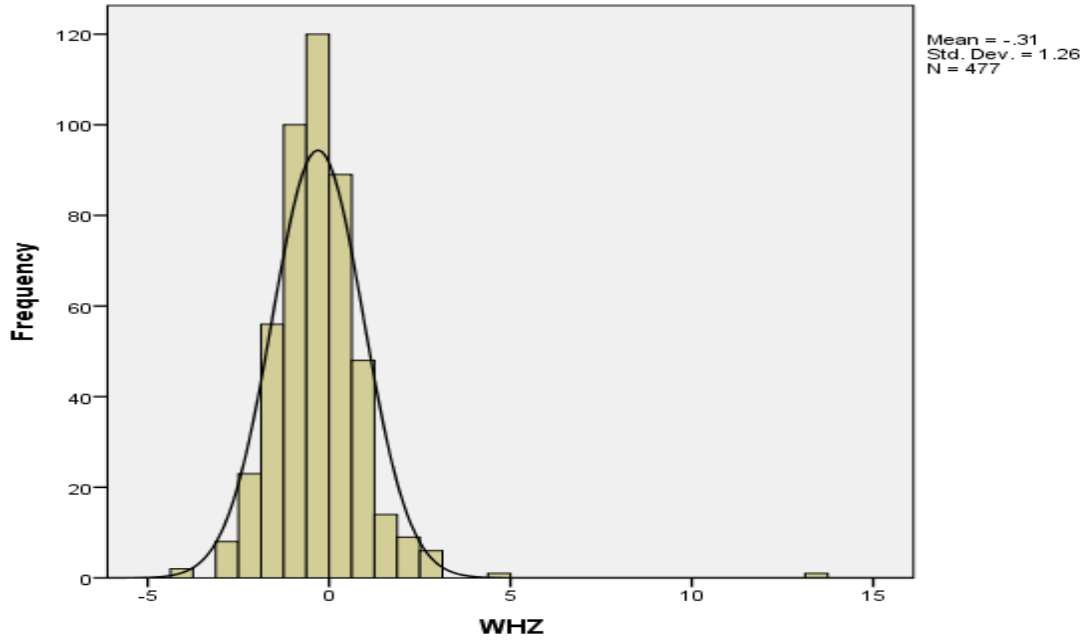
**Figure 4.8: Histogram and normal distribution curve for weight-for-age (WAZ) scores**

Figure 4.8 above shows the normal distribution curve and histogram for the weight-for-age Z-score measures with a standard deviation of 1.32.



**Figure 4.9: Histogram and normal distribution curve for height-for-age (HAZ) scores**

Figure 4.9 above shows the normal distribution curve and histogram for the height-for-age Z-score measures with a standard deviation of 1.45.



**Figure 4.11: Histogram and normal distribution curve for weight-for-height (WHZ) scores**

Figure 4.11 above shows the normal distribution curve and histogram for the weight-for-height Z-score measures with a standard deviation of 1.26.

#### **4.3.5.2 Association with other measures**

Table 4.6 below gives a summary of the data presented in figures 4.7 to 4.11.

**Table 4.6: Descriptive statistics of z-scores on malnutrition measures from secondary data**

		MUAC	WAZ	HAZ	WHZ	
<b>Descriptive Statistics</b>	N	Statistic	477	477	477	477
	Mean	Statistic	0	-0.93	-1.06	-0.31
		Std. Error	0.05	0.06	0.07	0.06
	Std. Deviation	Statistic	1	1.32	1.45	1.26
	Variance	Statistic	1	1.74	2.11	1.59
	Skewness	Statistic	-0.12	1.23	1.06	2.73
		Std. Error	0.11	0.11	0.11	0.11
	Kurtosis	Statistic	0.35	7.73	5.36	27.24
		Std. Error	0.22	0.22	0.22	0.22

The findings affirm that MUAC presents low values in all the depictive statistics from standard deviation, skewness and kurtosis. The researcher was therefore satisfied that MUAC presented a more reliable and consistent measure of malnutrition in comparison to the other measures.

#### **4.3.5.2.1 Using correlation coefficients to determine the suitable child malnutrition measure**

The researcher also generated correlation coefficients for the respective measures on child malnutrition in the primary and secondary data to determine a reliable measure. The findings are presented in table 4.7 below.

**Table 4.7: Correlation coefficient run for primary data against secondary data on respective measures**

<b>Measure</b>	<b>Correlation coefficient</b>
Mid Upper Arm Circumference	0.13
Weight-for-height	-0.11
Height-for-age	-0.01
Weight-for-age	-0.16

The Mid Upper Arm Circumference (MUAC) measure from the primary and secondary data when correlated generate a positive correlation while the weight-for-height, height-for-age and



weight-for-age all generate negative correlations when the primary data is correlated against the secondary data. MUAC can therefore be said to be more reliable compared to the other measures.

Previous studies as already handled in the literature review have also verified the effectiveness of MUAC in determining the health of children between the ages of six and 59 months. Goossens et al., (2012) concluded that MUAC was feasible criterion when admitting and discharging children in this age range in hospitals. Ralston and Myatt, (2016) also arrived at the conclusion that MUAC was an accurate measure especially in middle income countries when compared to other weight estimation tools. Tadesse et al., (2017) determined that WHZ and MUAC were appropriate tools when diagnosing severe wasting in kids between 6 and 59 months. These were findings also revealed by Mwangome et al., (2017). Mogendi et al., (2015) also concluded that MUAC as a tool was an appropriate measure used in monitoring the recovery trends and for discharging children admitted in nutritional programs. MUAC measures therefore remain a reliable measuring tool for child malnutrition to facilitate the appropriate remedies.

#### **4.4 Objective Two: Factors associated with child malnutrition in the study area**

The study also sought to assess some of the factors that were associated with child malnutrition in the study area. The findings are presented in Table 4.8.

##### **4.4.1 Education level of Household head**

From the findings presented in table 4.8 below on the 11 percent of children are malnourished with children for household's that household head's (HHH) education level is no schooling and primary incomplete contributing to two percent of it. Most children who were malnourished came from households whose heads had completed primary (33%), 32% had completed secondary and those that had not completed primary were 16%. This may bring us to one conclusion that a household head may have got education to but in the slums the environmental situations for everyone is the same, and with no control group to compare the same levels out of informal settlements not much can be concluded.

**Table 4.8: Education level of HHH and child malnutrition**

MUAC_2 * Education level of HHH Crosstabulation			MUAC_2		Total	MUAC_2		Total
			Normal	Malnourished		Normal	Malnourished	
	Education level of HHH	No schooling		99	16	115	2.7%	3.7%
Primary incomplete			576	58	634	16%	13.4%	16%
Primary complete			1159	157	1316	32%	36%	33%
Secondary incomplete			448	40	488	12%	9%	12%
Secondary complete			1158	141	1299	32%	33%	32%
College and above			172	21	193	4.8%	4.8%	5%
<b>Total</b>			3612	433	4045	89%	11%	100%

#### 4.4.2 Food security

The findings on the effects of food security are presented in Table 4.9. The results indicate that higher percentage children who were malnourished came from households with little hunger scores (73 percent) followed by moderately malnourished at 22 percent household hunger scores. From the findings a household may have food but not the right nutritional food for the members, as you find that food may constitute balck tea and mandazi (also known as kangumu in the street language) which does not have sufficient nutrients for a child's growth.

**Table 4.9: Food security in survey areas**

MUAC_2 * HHS_final Crosstabulation			MUAC_2		Total	MUAC_2		Total
			Normal	Malnourished		Normal	Malnourished	
	HHS_final	Little		2719	318	3037	75%	73%
Moderate			726	96	822	20%	22%	20%
Severe			167	19	186	5%	4.4%	5%
<b>Total</b>			3612	433	4045	89%	11%	100%

#### 4.4.3 Sex of Household head

The findings on the gender of the household heads and child malnutrition levels is presented in Table 4.10 below. Most households headed by males exhibited higher chances of getting

malnourished when compared to those that were headed by females at 84% and 16% respectively. From these findings, being in a female-headed household made children less vulnerable to malnutrition.

**Table 4.10: Sex of household heads and malnutrition in children**

MUAC_2 * Sex of HHH Crosstabulation			MUAC_2		Total	MUAC_2		Total
			Normal	Malnourished		Normal	Malnourished	
	Gender	Male	2879	364	3243	80%	84%	80%
Female		733	69	802	20%	16%	20%	
Total		3612	433	4045	89%	11%	100%	

It is noted from the findings that most malnourished children came from households which are male headed unlike the female headed households. Looking deeper into the information may give a conclusion that women who are single take full charge of their children whereas those who are married most of the time hire a caretaker for the children as they run other errands and this is the major cause of malnutrition in the households.

#### 4.4.4 Marital status of Household head

From the findings presented in figure 4.11 below, children in households having both parents showed higher cases of malnutrition at 72% compared to those from single-headed households who were at 28%. The findings show that a household head may be single and single handedly taking care of the child's welfare whereas one who has both parents are having another person hired to take care of the child thus infection to diseases and malnutrition.

**Table 4.11: Marital status of Household head and malnutrition in children**

MUAC_2 * Marital Status of HHH Crosstabulation			MUAC_2		Total	MUAC_2		Total
			Normal	Malnourished		Normal	Malnourished	
	Marital Status of HHH	No	2572	310	2882	71%	72%	71%
Yes		1040	123	1163	29%	28%	29%	
Total		3612	433	4045	89%	11%	100%	

#### 4.4.4 Child's sickness status

From the findings presented in Table 4.12 above, children who were sick two weeks before data collection were determined to be more malnourished compared to those who did not have any kind of illness in a similar period at 58% and 42% respectively. The implication is that having an illness can result in malnourished.

**Table 4.12: Childs sickness and malnutrition in children**

MUAC_2 * Child's sickness Crosstabulation			MUAC_2		Total	MUAC_2		Total
			Normal	Malnourished		Normal	Malnourished	
	Child's sickness	No	2142	184	2326	59%	42%	58%
	Yes	1470	249	1719	41%	58%	42%	
	Total	3612	433	4045	89%	11%	100%	

#### 4.4.5 Sex of Child

From the findings presented on table 4.13 above, girls were more malnourished compared to boys at 60% to 40% respectively. This implies that the girl child is more vulnerable to malnutrition compared to male children. The sex of the child can, therefore, be a factor on malnutrition.

**Table 4.13 Sex of Child and impact on malnutrition**

MUAC_2 * Sex of Child Crosstabulation			MUAC_2		Total	MUAC_2		Total
			Normal	Malnourished		Normal	Malnourished	
	Child Gender	Male	1775	173	1948	49%	40%	48%
	Female	1837	260	2097	51%	60%	52%	
	Total	3612	433	4045	89%	10.7%	100%	

#### 4.4.6 Descriptive analysis of factors associated with child malnutrition in the study sites

**Table 4.14: Descriptive analysis of factors associated with child malnutrition in the study sites**

<b>Variable of Interest</b>	<b>Value Label</b>	<b>Frequency</b>	<b>Percentage</b>	
<b>Dependent Variable</b>		<b>n =4,045</b>		
MUAC (As Binomial)	Normal	3612	89.30%	
	Malnourished	433	10.70%	
<b>Independent Variables</b>				
Slum name	Korogocho	1252	30.95%	
	Mukuru	1293	31.97%	
	Viwandani	566	13.99%	
	Kibera	650	16.07%	
	Moroto	284	7.02%	
Education level of HHH	No Schooling	115	2.84%	
	Primary Incomplete	634	15.67%	
	Primary Complete	1316	32.53%	
	Secondary Incomplete	488	12.06%	
	Secondary Complete	1299	32.11%	
	College and Above	193	4.77%	
Household Hunger Score	Little	3037	75.08%	
	Moderate	822	20.32%	
	Severe	186	4.60%	
Sex of Household Head	Male	3243	80.17%	
	Female	802	19.83%	
Marital Status of HHH	Married	2882	71.25%	
	Single	1163	28.75%	
Health status of the child	Sick			
	Not Sick			
<b>IV of scale measure</b>	<b>Mean</b>	<b>Std. Dev</b>	<b>Minimum</b>	<b>Maximum</b>
Household Size	4.35	1.55	1	13
Age of Child (in Months)	29.52	14.88	6	59
Age of Household Head (in Years)	33.65	11.58	11	96

There was a total of 4,045 households' data that have been used in the analysis from five informal settlements four in Nairobi and one in Mombasa over a three-year period. Data have been picked in every quarter from 2014 to 2016. Korogocho data represents 31% of the data, Mukuru 32%, Viwandani 14%, Kibera 16% and Moroto 7%.

The number of children who are severely malnourished are at 0.3%, Moderately Malnourished at 1.6%, who are At Risk are 8.9% and the rest are normal. When all children who are malnourished are combined and coded as either malnourished or not (normal), the malnourished are at 11% and normal at 89%.

The percentage of Household Heads that are did not attend schooling in the study area is 2.8%, those who attended schooling but did not complete primary is 15.7%, those who attended and completed primary are 32.5%, secondary incomplete is 12.1%, secondary complete at 32.1% and those who have college certificates or university at 4.8%.

Food security in the informal settlement is key to malnutrition and looking at the household hunger score, 4.6% of households are at severe, 20.3% at moderate and 75.1% at little hunger score. Out of all data collected in all the five informal settlements, 19.8% of the households are female headed while 80.2% are male headed. Single headed households occupy 28.8% of all the household's data collection was conducted

Mean household size is 4 people per households with a standard deviation of 1.5, where the minimum household size is 1 and maximum of 13 people in a household. Mean age of the children is 29 months and standard deviation of 14.9. The children data was collected on children between the age of 6 to 59 months. The mean age of household heads of the houses is 33 years and standard deviation of 11.8, where there are households with heads aged 11 years as the minimum and 96 years as the maximum.

#### **4.5 Multivariate Analysis and Model Specification**

The researcher then did a logistic regression analysis on the data to assess the effect of the various factors of malnutrition on MUAC. The findings are presented in below.

#### 4.5.1 Linear Regression of the malnutrition factors

**Table 4.15: Linear Regression Output**

<b>Coefficients</b>					
Model	Unstandardized		Standardized	T	Sig.
	Coefficients		Coefficients		
	B	Std. Error	Beta		
	(Constant)	3.75	.046	81.974	.00
	Slum name	-.001	.005	-.003	.85
	HH_SIZE	-.004	.004	-.02	.36
	HHH_AGE	-3.010E-005	.001	-.001	.96
	Gender	.027	.02	.03	.14
1	Marital Status of HHH	-.02	.02	-.02	.34
	Education level of HHH	.005	.005	.015	.36
	CHILD_AGE	.007	.00	.26	.00
	Child Gender	-.041	.012	-.051	.001
	Child's sickness	-.062	.012	-.077	.00
	HHS_final	-.015	.011	-.02	.2

a. Dependent Variable: MUAC

From the findings, the child's age, child's gender and sickness in the last two weeks prior to data collection had some significance to the MUAC measures on children.

#### 4.5.2 Logistic Regression Results for Factors Influencing child malnutrition in each slum area

Table 4.17 shows results for factors influencing child malnutrition in each of the slum areas under the study, for all background factors. Age of the child is the only significant factors in determining child malnutrition in the four study sites. Status of a child's health was found to be a

significant factor in determining child malnutrition in Korogocho, Mukuru, Viwandani and Kibera. Sex and marital status of the household head were found to be a factor in Viwandani. Household hunger score were found to be a factor in Kibera and Moroto. In Kibera, a child with a moderate HHS is 0.096 times less likely to be malnourished compared with little HHS. In Mukuru, a child from a household with severe HHS was 0.056 times less likely to suffer malnourishment.

**Table 4.16: Logistic Regression Output**

	Korogocho		Mukuru		Viwandani		Kibera		Moroto	
	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.
Little		0.68		0.16		0.93		0.01		0.03
Moderate(1)	0.72	0.42	3.97	0.07	0.74	0.76	0.10	0.00	3.68	0.23
Severe (2)	0.81	0.62	4.37	0.06	0.82	0.86	0.14	0.02	9.77	0.04
Age of the Child	0.93	0	0.93	0	0.90	0	0.94	0	0.93	0
No Schooling		0.88		0.22		0.32		0.95		0.14
Primary Incomplete (1)	1.02	0.98	0	1.00	0	1	0	1.00	1.76	0.67
Primary Complete (2)	1.17	0.82	2.04	0.21	0.64	0.55	0.76	0.72	0.35	0.44
Secondary Incomplete (3)	0.95	0.93	2.03	0.14	1.14	0.80	1.31	0.65	0.58	0.67
Secondary Complete (4)	1.42	0.62	1.07	0.9	0.39	0.2	0.88	0.86	0.18	0.29
College And Above (5)	1.05	0.94	1.40	0.48	0.58	0.32	1.15	0.80	0.79	0.86
SINGLE(1)	0.92	0.77	0.97	0.89	0.01	0.01	0.5	0.02	1.01	0.98
HHH_SEX(1)	0.79	0.41	1.80	0.20	548.05	0.00	1.81	0.22	0.79	0.63
HH_SIZE	1.02	0.79	1.18	0.06	1.31	0.07	0.95	0.67	0.92	0.59
HHH_AGE	0.99	0.56	1.02	0.28	0.96	0.09	1.00	0.83	1.00	0.95
CHILD_SICK(1)	0.65	0.04	0.59	0.00	0.49	0.02	0.51	0.03	1.56	0.30
Constant	1.32	0.74	0.04	0.00	0.91	0.95	7	0.09	0.31	0.51



## **CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS**

### **5.1 Introduction**

This research set out to evaluate factors associated with child malnutrition and assessing utility of mid upper arm circumference in the urban informal settlement of Nairobi. The study was guided by two objectives that set out to determine the appropriate measure to provide quick and reliable information on the extent of child malnutrition in study sites and the identification of factors associated with child malnutrition in the study site. This chapter presents a summary of the findings and the conclusions derived.

### **5.2 Summary of findings and conclusion**

#### **5.2.1 Objective One: Effective measure in determining child malnutrition levels**

The study then reviewed the various techniques used in the determination of the malnutrition levels in children between the ages of 6 and 59 months. The methods considered for this study included the Mid Upper Arm Circumference (MUAC) which states that a child having measurement of 115mm or below are said to be severely acutely malnourished, while those in the range greater than 115 but less than 125mm are moderately acutely malnourished, Height-for-age (stunting) where it is stated that children whose height-for-age Z-score is below minus two standard deviations (-2 SD) are considered short for their age (stunted) and are chronically malnourished. Children who are below minus three standard deviations (-3 SD) are considered severely stunted, Weight-for-height (wasting) where children whose weight-for-height is below minus three standard deviations (-3 SD) are considered severely wasted, and Weight-for-age (underweight) which stated that children whose weight-for-age is less than standard deviation of negative three (-3 SD) are concluded as severely underweight. With the Mid Upper Arm Circumference (MUAC), majority of children had normal nutritional health with only 0.4 percent having severe cases of malnutrition as presented in figure 4.4. The researcher also established that there was no significant statistical difference in MUAC measurements for the primary and secondary data used in the study.

The study revealed higher proportions of normal height-for-age measures of malnutrition both for primary and secondary data as presented in Figure 4.5. The stunting or height-for-age measures in the study area were also determined to be lower than the national levels of 26 percent. The study also revealed a significant statistical difference in the height-for-age measures of malnutrition in the primary and secondary data used in the study as revealed in the findings of Table 4.3. The measures of correlation coefficient on primary and secondary data also confirmed the reliability of MUAC as a measure of malnourishment in children.

The weight-for-height index was also assessed by the researcher. It was established that majority of the children did not suffer wasting problems with 9% showing cases of severe wasting as presented in Figure 4.6. The researcher also having carried out comparisons on the significant statistical difference in the wasting measure for the primary and secondary data concludes that there was no significant statistical difference in the measure provided by the primary and secondary data.

On the weight-for-height measure, the study established that most children had normal measures as presented in Figure 4.7. The secondary data however revealed a higher proportion of weight-for-age measure compared to the national levels. With this measure, the researcher also concluded that there was a significant statistical difference between the weight-for-age measures provided by the primary and the secondary data.

### **5.5.2 Objective Two: Factors associated with child malnutrition in the study area**

The study determined that education levels was not a factor on child malnutrition given that most of the malnourished children came from families where the household heads had some education compared to those that had no education as presented in Table 4.8. With all factors held constant in the informal settlements all households experience the same environmental challenges leading to child malnutrition, educated parents also take their time out looking for work leaving their children in the hands of caregivers who may not conduct it rightfully unlike the less educated household heads who do not work or washes clothes in the neighborhood carrying their children with them and taking good care of them. It was also established that food security did not guarantee that a child would not suffer malnutrition since most cases of malnutrition in children was experienced in children from households that were food secure as presented in Table 4.9.

Food according to the households is anything that fills the belly not putting into consideration the nutritional contents in it, thus a child may be full because they have eaten black tea and mandazi. The sex of the household head was determined to have an impact on malnutrition in children. This is because children from families headed by males were more vulnerable to malnutrition as presented in Table 4.10. On the other hand, children hailing from homes headed by female are less vulnerable. The study did not dig deeper to find out if the male headed households all have spouses to take care of their children or they do it alone. The female heading their households most of the time work close to their children (tag them along) or also leave them in the hands of caretakers. The findings from Table 4.11 also revealed that the marital status of a household did not expose a child to malnutrition. Children from single parents showed low cases of malnutrition, compared to those from married-parent families. Child sickness was also established to have an effect on child malnutrition as presented on Table 4.12, when a child suffers from any illness they are prone to be malnourished if proper care and good feeding program is not in place. The sex of a child being female predisposed a child to malnutrition as presented on Table 4.13.

### **5.3 Conclusion**

The following conclusions can be made based on the summary of the findings from this study.

- i. MUAC is a more appropriate measure in the provision of quick and reliable information on the extent of child malnutrition.
- ii. The factors that are associated with child malnutrition and that may predispose them include sex of the child, education levels of the parents, sex of the household head being male and child sickness.

### **5.4 Recommendations for Monitoring and Evaluation**

Based on the findings of this study, the following recommendations are made.

- i. Health practitioners in slum areas need to be encouraged to use MUAC as a measure of nutritional health in children for its reliability.
- ii. There is need to boost food security in order to avoid instances of severe cases of malnutrition in children.

## **5.5 Recommendations for further research**

- i. Further studies to be carried out on the other possible factor that affect nutritional health of children living in slum areas.
- ii. Studies should be conducted to find out how best nutritional health can be improved in children to avoid cases of poor nutritional health.

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**APPENDIX I: WORK BREAKDOWN STRUCTURE**

<b>Activities</b>	<b>January</b>	<b>February</b>	<b>March</b>	<b>April</b>	<b>May</b>	<b>June</b>	<b>July</b>	<b>August</b>	<b>September</b>	<b>October</b>	<b>November</b>	<b>December</b>
Concept Writing												
Proposal Writing												
Proposal Presentation/Editing												
Authorization Request												
Study of Secondary Data												
Primary Data Collection												
Data Analysis												
Report Writing												
Project defense												
Project editing												
Project printing & binding												
Project Handover												

Source: Author 2017

**APPENDIX II: TABLE STUDY BUDGET**

<b>Item Description</b>	<b>Unit Cost (Ksh.)</b>	<b>No. Of Units</b>	<b>Total Cost (Ksh.)</b>
Internet Subscription	5,000	1	5,000
Data Collection	10,000	3	30,000
Hiring of android phones for data collection	3,000	3	9,000
Hiring of weighing scale and height board	3,000	3	9,000
Data analysis fee	40,000	1	40,000
Transport and lunch	1,000	3*4	12,000
Printing, Photocopy and binding	2,000	7	14,000
<b>Grand Total</b>	<b>64,000</b>	<b>30</b>	<b>119,000</b>

### APPENDIX III : QUESTIONNAIRE

#### Malnutrition study Questionnaire

Date and Time

What round of data collection are you doing?

Study Household ID

Informed Consent? [0=No, 1=Yes, 2=willing but unable to sign, 3=Accepted interview but refused to sign

My name is {enumerator}. I am here today to conduct a malnutrition household survey in your area. Your household has been randomly selected to participate in the study. Your participation will help us better understand the nature of malnutrition children undergo in urban areas. Participation is voluntary and any information you provide will be kept confidential and used for the intended purpose only. We are using this mobile device to help us to collect information. It does not record your voice neither does it take your photograph. It will store your information very safely and help us to make decisions about my study. Are you willing to participate in this interview?

No 00                      Yes 01

Do you have children between the ages of 6 to 59 months?                      No 00                      Yes 01

*[If No thank the respondent and leave, if yes go to next question]*

What is the gender of <child>?                      Male 01                      Female 02



