TREATMENT OF MODERATE ACUTE MALNUTRITION USING PLUMPY SUP AMONG CHILDREN AGED 6 TO 59 MONTHS IN TURKANA COUNTY, KENYA

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DECLARATION

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DEDICATION

This work is dedicated to the children of Turkana county, the late Fridah Awiti, my dad Melkizadek Majwa, my siblings Ezekiel Otieno Majwa, Joshua Odhiambo Majwa, Loice Auma Majwa, Nathan Ouma Majwa, and Nashon Oluoch Majwa. To Annete Fridah, Kyndya Mercy, Albert Kamudala, Stella Nameje, and Jane Kipembeu Katitia for all the support and encouragement during the study. And to Jackline Akoth Otieno, Justus oguna, David Oburu, and Charles Otieno Ameso for the nudge to finish the study.

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OPERATIONAL DEFINITION OF TERMS

Acceptability: the children's overall liking of the ready to use supplementary food as reported by the caregiver/mother on assessing the child's response to consuming the intervention product (Kiio, 2016).

Acute malnutrition: a type of growth retardation that occurs due to recent dramatic weight loss or inability to acquire weight (WFP 2018). The weight-for-height index is used to classify malnutrition as acute, mild or moderate (Karakochuk, 2010; WFP, 2018).

Community-based management of acute malnutrition: a community-based strategy for malnutrition control that entails detecting undernutrition in the population by employing simple screening techniques and providing ready-to-use food for treatments in kids who do not have medical issues (Field Exchange, 2019; Karakochuk 2010; UNICEF, 2009).

Coverage rate: a program performance indicator defined as the number of individuals receiving treatment as a proportion of people who need treatment (SPHERE, 2018).

Death rate: a benchmark used to track and assess supplementary feeding programmes. It is defined as the proportion of children who die while participating in the programme (Karakochuk, 2010).

Default rate: A quality measure for supplementary feeding initiatives used to track and evaluate the initiatives; defined as the proportion of kids lost to follow-up or missing for two visits (Karakochuk, 2010).

Disaster: a significant breakdown of a community's or society's operation, resulting in extensive humanitarian, material, financial, or ecological losses and damages that surpass the afflicted community's or society's ability to manage to utilise its resources (United Nations Office for Disaster risk reduction, 2017).

Effectiveness: the ability of supplementary feeding programmes to meet the SPHERE standards on the management of moderate acute malnutrition (SPHERE, 2018)

Oedema: The enlargement of the bodily tissues induced by the buildup of fluid may be classified as mild, affecting only the ankles and feet; moderate, affecting both feet, including the lower legs, lower arms and hands; or serious, affecting both feet, legs, arms, face and hands (Lenters et al., 2016; World Health Organisation, 2012).

Plumpy sup: a lipid-based ready-to-use supplement designed to treat moderate acute malnutrition at six months of age (Plumpy'Sup™ | Nutriset-fr).

Global acute malnutrition : population-wide intermediate malnourishment and acute malnutrition (Mutoro, 2018; World Health Organisation, 2000).

Morbidity: the occurrence of diarrhoea, severe respiratory infections, as well as fever as determined by self-reported data from a two-week recall (Kiio, 2016).

Moderate acute malnutrition: Refers to " weight-for-height z-score (WHZ) between −2 and −3 or mid-upper arm circumference (MUAC) between 115 millimetres and <125 millimetres"(World Health Organisation, 2012).

Preparedness: the skillset established by authorities, professional recovery groups, organisations, or individuals to successfully anticipate, react to and recuperate from the effects of anticipated, impending, or existing risks or conditions (Gary, 2018; United Nations Office for Disaster risk reduction, 2017).

Prevalence: a measure of a phenomenon's recurrence or frequency expressed as a percentage of a unit of tim**e** or other bechmarks (American Heritage Dictionary, 2016).

Severe acute malnutrition: is defined as WHZ < −3 or MUAC < 115 millimetres, or existence of either or both bilateral pitting oedema (Black et al., 2016; World Health Organisation, 2013).

Stunting: the percentage of children under the age of five who are below two standard deviations (severe and moderate) or below three standard deviations (severe) from the median height-for-age of the reference demographic (Black et al., 2016; World Health Organisation, 2013).

Transfer rate: an evaluation metric for supplementary feeding initiatives used in tracking and assessing such initiatives; defined as the proportion of kids whose nutritional condition degrades more while enrolled in the programme, necessitating relocation to therapeutic intervention or an inpatient care programme (Karakochuk, 2010).

Recovery rate: an evaluation metric for supplementary feeding initiatives used in tracking and assessing such initiatives; defined as the proportion of kids that recovered from the programme by recording MUAC measurement above 125 millimetres and WFH z score of above -2 SD for a period of two consecutive weighs (Karakochuk 2010; Government of Kenya, 2009).

Resilience: the capacity of a system, group, or civilisation exposed to risks to withstand, absorb, assimilate, and rebound quickly and efficiently from the consequences of a disaster, especially through the restoration and preservation of its key basic functions and structures (United Nations Office for Disaster risk reduction, 2017).

Response: the urgent action carried out before, during, or soon following a crisis in order to preserve lives, minimise health implications, guarantee public protection, and provide the basic subsistence necessities of those impacted (United Nations Office for Disaster risk reduction, 2017).

Risk: the possibility that a system, civilization, or society would suffer casualties, injury, or damaged assets during a specified timeframe due to risk, vulnerability, exposure, and capability. (United Nations Office for Disaster risk reduction, 2017).

Vulnerability: the circumstances created by social, physical, economic and ecological elements, or mechanisms that raise an individual's, society's, asset's, or system's vulnerability to risks' impacts (United Nations Office for Disaster risk reduction, 2017).

Wasting: the low weight-for-height manifestation among children indicating severe weight loss because of inadequate nutrition over a shorter period (Caulfield et al., 2019)

ABBREVIATIONS AND ACRONYMS

ANOVA	Analysis of Variance
AIDS	Acquired Immunodeficiency syndrome
ARI	Acute Respiratory Infections
CHW	Community Health Worker
CHV	Community Health Volunteer
CI	Confidence Interval
CSB	Corn Soy Blend
CSB++	Corn Soy Blend plus plus
DALY	Disability Adjusted Life Year
DNA	Deoxyribonucleic Acid
FBF	Fortified Blended Food
GAM	Global Acute Malnutrition
HIV	Human Immunodeficiency Virus
IMAM	Integrated Management of Acute Malnutrition
IYCF	Infant and Young Child Feeding
KEMSA	Kenya Medical Supply Authority
KDHS	Kenya Demographic Health Survey
KG	Kilograms
KNBS	Kenya National Bureau of Statistics
Ksh	Kenyan Shillings
MAM	Moderate Acute Malnutrition
MDD	Minimum Dietary Diversity

Mg	Milligrams
μg	Micrograms
MUAC	Mid upper arm circumference
MMF	Minimum Meal Frequency
RNA	Ribonucleic Acid
RUTF	Ready to Use Therapeutic Food
RUSF	Ready to Use Supplementary Food
RDA	Recommended Daily Allowance
SAM	Severe Acute Malnutrition
SD	Standard Deviation
UNICEF	United Nations Children Emergency Fund
USAID	United States Agency for International Development
USD	United State Dollars
WAZ	Weight for Age Z score
WHZ	Weight for Height Z score
WHO	World Health Organization

ABSTRACT

In Kenya, 26% of children are moderately stunted, 11.4% severely stunted, 6.7% moderately underweight, 2.6% severely underweight, and 13.0% moderately wasted, with 2.5% severely. In Turkana County, 25.6% of children are moderately stunted, and 17.4% are moderately wasted. Plumpy Sup is used to treat moderate acute malnutrition through the supplementary feeding programme. With the increased reports of relapse and overstay of children aged 6 to 59 months in the supplementary feeding programme, there is limited documentation of the effectiveness of plumpy sup in a community-based programme in Turkana county. This prospective cohort study assessed the effectiveness of Plumpy sup in the management of moderate acute malnutrition among 300 children aged 6 to 59 months in Turkana central sub-county. The study employed stratified and multistage sampling, with data collected via desk review, key informant interviews, focused group discussions, and household interviews. Data on child morbidity status was collected using a two -week-day recall period, while a 24-hour dietary recall was used to collect data on the type and amount of food that the child consumed. Nutrient analysis was done using the Nutri-surv software in conjunction with the Kenya Food Consumption Table. Descriptive and inferential statistics were used to analyze the variables of interest. Survival analysis and log-rank test were used to establish the recovery rate of the children. At the 90^{th} day, the mean energy intake, 556.1±56.9 kcal per day, of children aged six to 11months was below the recommended daily allowance of 675 to 806 kcal; Protein intake for children aged 6 to 11 months was 11.3±3.9 g per day; while Carbohydrate intake was 74.3±5.7 g per day, all below the recommended daily allowance. Morbidity prevalence was high (76.3% at baseline) at with 39.3% suffering from malaria, 21.7% from diarrhoea, and 7.7% from an eye infection.. Access to water and sanitation services from baseline to day 90 was statistically significant except for treatment with traditional herbs. The median day to recovery was 84 days for females and 70 days for males. The difference observed in recovery rate between males and females was not statistically significant. There was a significant relationship between caregivers' socioeconomic status and the recovery rate of children on day one and day 42. There was no statistically significant difference in caregivers' attitude on IYCF and recovery rate for all the days. There was no statistically significant association, all $p>0.05$, between the effectiveness of Plumpy sup and the morbidity status of the child. On factors affecting the effectiveness of Plumpy sup, a full model containing all predictors was statistically significant, $\chi 2$ (8, N=300) = 17.847, p=0.022; the model could distinguish between children who recovered and those who did not recover.

CHAPTER ONE: INTRODUCTION

1.1 Background to the study

Nearly 144 million (21.3 per cent) kids under five years old are underdeveloped, 47 million (6.9 per cent) are wasted, while 38 million (5.6 per cent) are obese worldwide (Global Nutrition Report, 2020; UNICEF et al., 2020). There are also children suffering from multiple forms of malnutrition, with 16 million (3.6%) of kids below five years old being stunted and wasted and 8 million (1.87%) being stunted and overweight (Global Nutrition Report, 2018). In Eastern Africa, 23 million (34.5%) children under five years old are stunted, 3.6 million (5.3%) are wasted, and 2.5 million are overweight (Global Nutrition Report, 2020; UNICEF et al., 2020). In South Asia and Africa, moderate acute malnutrition — also dubbed as moderate wasting — affects 45 million children of the under-five-year-old population (Gera et al., 2017). In Africa, even though stunting prevalence is decreasing, there has been a stead increment in the number of stunted children to 58.7 million in 2017 from 50.6 million in 2000 (Global Nutrition Report, 2020), indicating that feeding habits among children under the age of five remain inadequate (Amegovu et al., 2013; Global Nutrition Report, 2020; UNICEF et al., 2020). Malnutrition stunts a child's growth, resulting in nutritional deficits leading to illness, death, and delayed mental and physical development (Kimiywe & Chege. 2017; Steenkamp et al., 2015).

The World Health Organization (2006) defines stunting in 0 to 59 months old children as children who are less than minus two standard deviations (SD) from the WHO Child Growth Standards median height-for-age. A child is regarded short for their age or stunted if their z-score in terms of height-for-age is less than minus two SD from the reference population median, and

severely stunted if their z-score is less than minus three SD from the base population median (Kenya National Bureau of Statistics, 2018).

Wasting in 0 to 59 months old children refers to children under less than two SD from the WHO Child Growth Standards median weight-for-height. A child has a z-score of more than minus three SD below the reference population is considered severely wasted (WHO, 2006). Wasting impairs immune system function, increasing the severity, duration, and susceptibility to infectious infections and the likelihood of death (WHO, 2006). A child is considered underweight or moderately wasted if their z-score is less than two SD below the reference population's median (Kenya National Bureau of Statistics, 2018). Children aged 0 to 59 months who differ by more than 2 SD from the WHO Child Growth Standards' median weight-for-height will be considered overweight (WHO, 2006). Underweight (low weight for age) is a combination of weight for height and height for age. Its proportion reflects acute chronic malnutrition and the severity of nutritional issues (WHO, 2006).

According to the 2018 Kenya Integrated Budget Survey Report, 29.9% of children in Kenya were moderately stunted, 11.4% were severely stunted, 6.7% were moderately underweight, 2.6% were severely underweight, and 13.0% were moderately wasted, 2.5% severely wasted (Kenya National Bureau of Statistics, 2018). Turkana county had a moderate wasting rate of 27.4%, a severe wasting rate of 15.9%, a stunting rate of 25.3%, and a severe stunting rate of 7.8% (Kenya National Bureau of Statistics, 2018). Approximately 25.5% of children in Turkana County were underweight, with 4.7% severely underweight (Kenya National Bureau of Statistics, 2018).

The national food poverty headcount rate (the proportion of food insecure people) in Kenya was reported to have decreased significantly from 44.4% in 2005 and 2006 to 32.0% in 2015 and 2016 (World Bank, 2018). This means that the incidence of food poverty has decreased by more than 13 % points in the last ten years from households' inability to earn a sustainable income to improve their food purchasing power (World Bank, 2018), raising the risk of malnutrition among children due to poor socioeconomic conditions as well as early exposure to negative conditions like improper feeding practices and illness (20th International Congress of nutrition, 2013; Kenya National Bureau of Statistics, 2018).

Supplementary foods, such as lipid-based nutrient supplements, have been used to treat acute malnutrition in community settings to promote rapid weight gain in children (Gera et al., 2017). Ready-to-use therapeutic foods provide all of the energy needed from foods other than breastmilk, making them an excellent supplement for food intake during malnutrition treatment (20th International Congress of nutrition, 2013; Osendarp et al., 2015). Although ready-to-use supplementary foods are taken in lower quantities than ready-to-use therapeutic foods, they provide a complete set of micronutrients, microminerals, and essential fatty acids (20th International Congress of nutrition, 2013; Osendarp et al., 2015).

Plumpy sup is one such ready-to-use supplementary food utilized to treat moderate acute in Turkana central sub-county (Nutriset, 2018). Its effectiveness in such settings is determined by demonstrating its ability to improve the recovery rate among children treated for moderate acute malnutrition (SPHERE, 2018). It is measured by the percentage of children suffering from moderate acute malnutrition who record, in two consecutive measurements, a weight-for-height

Z score greater than minus two standard deviations (20th International Congress of nutrition, 2013; SPHERE, 2018). The default rate is the proportion of children lost to follow-up or missed more than two visits during the 90-day treatment period, whereas the death rate is the proportion of children passing on during the treatment period (SPHERE, 2018). The percentage of children not recovering from malnutrition within 90 days is the non-response rate (SPHERE, 2018). Despite their widespread use, the clinical significance of these treatments has yet to be determined in terms of their contribution to increasing recovery rates, lowering default rates or lowering death rates among children under five years old (SPHERE, 2018).

The average distance to a healthcare facility in Turkana County is approximately 50 kilometres due to its vast geographical coverage (Kimani et al., 2019). This creates significant gaps in the human resources required to provide essential services in the county (Kimani et al., 2019), thus limiting local populations' ability to access healthcare services that are critical for a child being treated for moderate acute malnutrition (Kimani et al., 2019). According to the author, Turkana county has a doctor-to-population ratio of about one doctor for every 70,000 people, whereas the ratio of nurse-to-population is about one nurse for every 52,000 people, which has a direct impact on the quality of healthcare services in the county, including the management of moderate acute malnutrition. The major causes of child morbidity in Turkana, according to the 2019 SMART survey, are increased acute respiratory infections/cough, fever-like malaria, watery diarrhoea, and inadequate access to sanitation facilities and safe drinking water (Borg et al., 2019; Osendarp et al., 2015).

Cultural and intrahousehold practices, such as the sharing of ready-to-use supplementary food within families, were shown to impact the effectiveness of supplementary food in treating childhood malnutrition (Nackers et al., 2010; Ickes et al., 2019). Supplementary food or its components desirability, child age, mothers' involvement in child feeding, social and behavioural change communication strategies effectiveness, social norms, food insecurity and household composition may influence the degree to which the supplement is shared or diverted (Osendarp et al., 2015).

1.2 Statement of the problem

In Kenya, 2.5% of children are severely wasted, and 13.0% are moderately wasted (Kenya National Bureau of Statistics, 2018), with the Kenyan government and its partners implementing programs to address this, primarily through blanket supplementary feeding and targeted supplementary feeding using Plumpy sup (Kenya National Bureau of Statistics, 2018; Nutriset, 2018). However, studies show that Turkana County continues to have high global acute malnutrition rates (25.6%), indicating that these Plumpy sup is failing to address childhood malnutrition (SMART survey, 2019) with increased reports of children aged 6 – 59 months relapse and overstay in supplementary programmes (Lambebo et al., 2021; Lelijveld et al., 2021; Stobaugh et al., 2018). There is limited understanding of the contribution of morbidities and barriers to basic services access on the effectiveness of plumpy sup (Fikrie et al., 2019; Gizaw et al., 2018; Hoq et al., 2019; Wondie et al., 2022). Despite its use to treat moderate acute malnutrition, little is known regarding Plumpy sup's effectiveness and acceptability among children aged 6-59 months in Turkana Central sub-county (Borg et al., 2018). The high cost of administering ready-to-use supplementary food, like Plumpy sup, and the product/commodity

focus (Annan et al., 2014), have raised concerns about the long-term viability of ready-to-use supplementary food, including Plumpy sup, in terms of humanitarian agencies and government support (Nackers et al., 2010).

1.3 Justification

Despite research in Turkana County, the current literature has not determined the effectiveness of Plumpy sup as a treatment for moderate acute malnutrition in 6 to 59 months old children (Navarro-Colorado, 2007). This research gives evidence of the effectiveness of Plumpy sup in moderate acute malnutrition treatment in children in response to the World Health Organization's recommendation for more evidence on food supplements used for treating moderate acute malnutrition in children (World Health Organisation, 2012). The study's findings will help improve the design of a targeted supplementary feeding program. This is an important strategy for combating moderate malnutrition in Turkana County and other Kenyan arid and semi-arid areas.

1.4 Research questions

1. What are the caregivers' attitudes toward infant and young child feeding among children aged 6 to 59 months receiving Plumpy sup to treat moderate acute malnutrition in Turkana county, Kenya?
2. What are the nutrient intakes for children aged 6 to 59 months receiving Plumpy sup to treat moderate acute malnutrition in Turkana county, Kenya?
3. What is the morbidity status of 6 to 59 months old children in Turkana county, Kenya, receiving Plumpy sup to treat moderate acute malnutrition?

4. What is the recovery rate of using Plumpy sup among children aged 6 to 59 months to treat moderate acute malnutrition in Turkana county, Kenya?
5. What factors influence Plumpy sup's effectiveness as a treatment for moderate acute malnutrition for 6 to 59 months old children in Turkana county?

1.5 Research Hypotheses

Ho1: There is no significant relationship between caregivers' attitudes toward IYCF and the effectiveness (weight gain) of Plumpy sup in children aged 6 to 59 months receiving treatment for moderate acute malnutrition in Turkana county Kenya.

Ho2: There is no significant relationship between the effectiveness of Plumpy sup (weight gain) and the morbidity status of children aged 6 to 59 months being treated for moderate acute malnutrition in Turkana county, Kenya.

1.6 Study Objectives

1.6.1 Broad objective

To assess the effectiveness of Plumpy sup in the management of moderate acute malnutrition among children aged 6 to 59 months in Turkana county, Kenya.

1.6.2 Specific objectives

1. To determine caregivers' attitudes towards infant and young child feeding among children aged 6 to 59 months who are receiving Plumpy sup to treat moderate acute malnutrition in Turkana county, Kenya.

2. To establish the nutrient intake for children aged 6 to 59 months receiving Plumpy sup to treat moderate acute malnutrition in Turkana county, Kenya.
3. To determine the morbidity status of children aged 6 to 59 months in Turkana county, Kenya, receiving Plumpy sup to treat moderate acute malnutrition.
4. To determine the recovery rate of using Plumpy sup among children aged 6 to 59 months to treat moderate acute malnutrition in Turkana county, Kenya.
5. To determine the factors that influence Plumpy sup's effectiveness as a treatment for moderate acute malnutrition for 6 to 59 months old children in Turkana county.

1.7 Study Delimitations and Limitations

The study's design presupposed that moderate acute malnutrition and climatic conditions such as drought are exogenous to households and that households with strong coping capacities are more likely to manage moderate acute malnutrition in 6 to 59 months old children. There were also similarities in exposure to hazards and factors that contribute to moderate acute malnutrition in children. As the inclusion criteria within the population, the study focus was on moderately acute malnourished children aged 6 to 59 months with a weight for age Z score of less than minus two SD to greater than or equal to minus three SD and a MUAC greater than or equal to 11.5 and less than 12.5 cm in Turkana central sub-county; hence, these results can only be generalized under similar conditions. The caregiver's recall of the child's dietary intake and morbidity status was used, so there is a possibility of bias when sharing this information.

1.8 Conceptual framework

Figure 1.1 shows the study conceptual study framework adapted from the UNICEF 2013 nutrition framework, emphasising the interdependence of malnutrition and public health

indicators at the household level. The framework categorizes factors and their effects on a child's nutritional status as basic, underlying and immediate malnutrition causes. Child feeding patterns; biological and behavioural influences, like measles vaccinations; infectious diseases (respiratory infections and diarrhoea); and food consumption (supplementation and micronutrient status) are all immediate causes. Basic causes include basic influences such as residence location, access to sanitation and clean water and economic and social factors, e.g. maternal education. The conceptual framework also includes the World Health Organization's 1978 primary health care model, which recognized the multifaceted nature of health problems by promoting, among other things, maternal and child health care, which includes immunization against major infectious diseases and family planning, basic sanitation and adequate amount of safe water, proper nutrition and food supply (World Health Organisation, 1978). The Africa Union Nutrition Strategy 2015 to 2025 recognizes the multifaceted nature of malnutrition by emphasizing adequate primary health care, including water and environmental sanitation. This would eventually lead to household nutrition security, which would focus on access to supplementary food to treat moderate acute malnutrition and overall nutrition security (African Union, 2015). Thus, in addition to food access, nutrition security focuses on community members' access to water, sanitation, health services, knowledge, and skills in ensuring all household members have a healthy life.

As a result, the study investigated the effects of socio-demographic and socioeconomic factors, access to health services, water, sanitation and hygiene practices, access to humanitarian assistance, and nutrition policy adoption on community-based treatment regimes uptake for moderate acute malnutrition using ready-to-use supplementary nutrition. Furthermore, the study

investigated how the treated child would not relapse into another episode of moderate acute malnutrition through household-level sustainability measures.

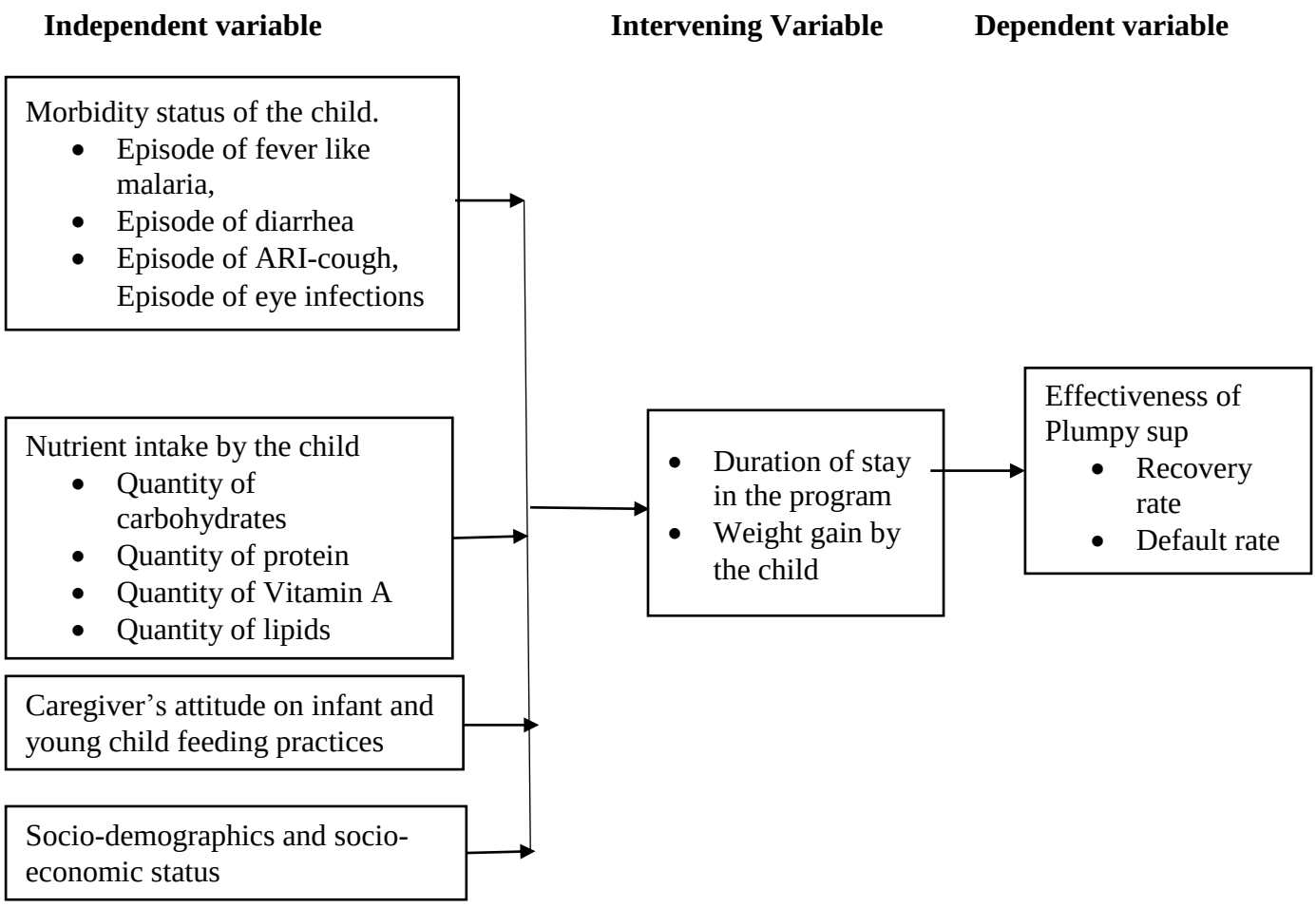

Figure 1.1: The conceptual framework for the study as adapted from the Government of Kenya 2009 guidelines for the management of acute malnutrition.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Wasting is a public health concern in Kenya, where 13.0% of children under five years old suffer from moderate wasting, and 2.5% suffer from severe wasting. Plumpy sup is a popular supplementary food used to treat the condition in Kenya, particularly in arid and semi-arid areas like Turkana County. This section examines the evidence for using ready-to-use supplementary food, such as Plumpy sup, for treating moderate acute malnutrition. It identifies the documentation's strengths and weaknesses regarding the efficacy of ready-to-use supplementary food in a community-based supplementary feeding program.

2.2 Defining Moderate Acute Malnutrition

Malnutrition is a two-word phrase that combines "mal" and "nutrition." Merriam Webster's medical dictionary defines the prefix "mal" as "ill, bad, opposite of, abnormal, inadequate, or inadequately". On the other hand, nutrition refers to the utilization, absorption, and intake of food for the body's dietary needs (WHO, 2016). Thus, malnutrition is defined as a condition characterized by poor quality and quantity of food intake, absorption, utilisation, nutrient deficiencies or excesses, a nutrient imbalance, or impaired nutrient utilization (WHO, 2016). Malnutrition is classified as overnutrition — overweight and obesity — and undernutrition, which includes stunting or chronic malnutrition — shown as low height for age — and wasting (WHO, 2016). Stunting is frequently linked to cognitive impairments like impaired brain function and delayed motor development, leading to poor academic performance (Global nutrition report, 2020). Acute malnutrition or wasting (shown as low weight for height) in children as young as five years old is characterized by a constant decline in nutrient intake in a short duration and frequently leads to death (Style et al., 2017).

Wasting and stunting are associated with an increased risk of death, which rises directly to the severity of the nutritional nutrient deficit (Briend et al., 2015). When wasting and stunting occur simultaneously, the risk of death rises (Briend et al., 2015). Severely wasted children have an 11.6 times likelihood of dying, while moderately wasted children are 3.4 times more probable to die (Briend et al., 2015). Similarly, severely stunted children have 5.5 times more likelihood of dying than moderately stunted children, who are 2.3 times more likely to die (Lopez et al., 2020; Briend et al.,2015). Children who suffered moderate acute malnutrition episodes had a 0.4% fatality rate within six months and 1.1% over an 18-month study period in India (Prost et al., 2019). The cut-off point for the various classifications of acute malnutrition is displayed in

Table 2.1: Summary of definitions of acute malnutrition

Classification of Acute malnutrition	Z- score	oedema	*MUAC (millimeter)
Normal	≥-2	No	≥135
Severe	<-3	Yes or No	<115
	>-3	Yes	≥115 to <125
Moderate	<-2 to ≥-3	No	≥115 to <125
Global	<-2	Yes or No	

*MUAC: Mid upper arm circumference

Globally, nearly 34 million children under five years old suffer from moderate acute malnutrition (Sheila et al., 2019). According to the Turkana county SMART survey conducted in 2019, acute malnutrition levels among children under the age of five were higher than the WHO classification (WHO, 2006) in the four sub-counties reported for global acute malnutrition, namely Turkana Central (20.2%), Turkana North (30.2%), Turkana South (30.8%), and

Turkana West (23%) (SMART survey, 2019). The global underweight rate in Turkana central sub-county was 32.1%, with severe underweight accounting for 9.6%, and the global stunting rate was 18.2%, with severe stunting accounting for 6.1%, according to the same report (SMART survey 2019). Table 2.2 provides additional information on the malnutrition prevalence in Turkana County over the last eight years.

Table 2.2: Prevalence of malnutrition in Turkana County between 2011 and 2019

Year (n)	Global acute malnutrition: ≤ 2 z-score and/or edema % (95% CI)	Severe acute malnutiroon: < -3 z-score and /or oedema % (95% CI)	Moderate acute malnutrition: <-2 z-score and ≥-3 z-score, no oedema % (95% CI)
2019 (362)	20.2 (15.1 – 26.4)	2.8 (1.3 – 5.7)	17.4 (11.5 – 26.9)
2018 (557)	17.5 (14.1 – 21.5)	4.7 (3.1 – 7.0)	12.6 (9.0 – 19.9)
2017 (657)	31.4 (27.5 – 35.6)	8.0 (5.8 – 10.8)	23.4 (21.4 – 31.6)
2016 (640)	24.5 (20.2 – 29.4I)	5.6 (4.2 – 7.5)	18.9 (14.0 – 24.7)
2015 (774)	20.9 (17.9 – 24.4)	4.8 (3.4 – 6.6)	Data not available
2014 (666)	28.7 (24.5 – 33.2)	6.8 (4.7 – 9.7)	Data not available
2013	17.2 (13.2 – 21.9)	3.9 (2.5 – 6.1)	Data not available
2011 (749)	24.4 (20.3 – 29.1, 95% C.I)	4.5 (3.1 – 6.7)	19.9 (16.4 – 19.9)

Source: Adapted from (Kenya Ministry of Health, 2011; WHO, 2006; Turkana County government 2019; 2018; 2017; 2016).

2.3 Nutrient intakes for children aged 6 to 59 months treat moderate acute malnutrition

2.3.1 Micronutrient deficiency

Micronutrient deficiency contributes to the vicious cycle of malnutrition, and it is difficult to diagnose, particularly in emergency and low-resource settings such as Turkana county (SPHERE, 2018). Current approaches to addressing micronutrient deficiency include supplementation, which provides micronutrients in a highly absorbable form, such as vitamin A supplementation; fortification, which fortifies food products with micronutrients such as iodized salts, fortified vegetable oil, fortified maize flour, and so on; and food-based approaches, which

provide the nutrients required through food (SPHERE, 2018). According to WHO 2020, the provision of vitamins for children aged 6 to 59 months, deworming children aged 12 to 59 months, the addition of iodized salt and other fortified ingredients like Vitamin A and D fortified vegetable oil, and providing iron-containing multiple micronutrients, including daily supplementation where necessary are some ways to address micronutrient deficiencies (WHO, 2020). Table 2.3 summarizes the recommended dosage for various micronutrient deficiencies.

Table 2.3: Preferred dosage for various micronutrient deficiencies

Product name	When administered	Age of administration	Prescription/dosage	Dose
Vitamin A	At admission	Less than 6 months	50,000 IU	Single dose on admission
		6 months to less than 12 months	100,000 IU	
		More than 12 months	200,000 IU	
Albendazole	At admission	Less than 12 months	Do not give	
		1 year and above	400 mg	1 tab on admission
Mebendazole	At admission	Less than 12 months	Do not give	
		12 months and above	500 mg	Single dose on admission
Iron folate	At admission	6 to 24 months (with low birth weight and infants	12.5mg iron/50μg folic acid	Daily dose from 6 to 12 months of age
		24 months to 60 months	20-30 mg	Daily dose

Source: Government of Kenya Guidelines on Acute Malnutrition Management (2009).

2.3.2 Nutritional requirements for a moderately malnourished child

The dietary needs of children suffering from moderate acute malnutrition (MAM) are relied on making the best utilization of locally available foods for improvement of nutritional status and prevention of severe acute malnutrition (SAM) (Annan et al., 2014; CMAM Forum Technical Brief, 2014). Supplementary foods have been used in treating children with MAM when there is food scarcity, or certain nutrients are insufficiently available through local foods (Annan et al., 2014; CMAM Forum Technical Brief, 2014). Children suffering from moderate wasting should consume 10 to 15% of their energy as protein and at least 30% as fat (CMAM Forum Technical Brief, 2014). They should contain at least 4.5 % n-6 polyunsaturated fatty acids and 0.5 % n-3 polyunsaturated fatty acids in their total energy content (CMAM Forum Technical Brief, 2014). The linoleic and alpha-linolenic acid ratios should be between 5 and 15. (Annan et al., 2014). The nutritional composition of supplementary food (Table 2.4).

Table 2.4: Proposed Nutrient Composition of Supplementary Foods for Use in the Management of Moderate Acute Malnutrition in Children

Nutrient per 1000 kcal	**Unit**	**Maximum**
Protein	G	26
Minerals		
Sodium (Na)	Mg	550
Potassium (K)	Mg	1600
Magnesium (Mg)	Mg	300
Phosphorous (P)	Mg	900
Zinc (Zn)	Mg	20
Calcium (Ca)	Mg	840
Copper (Cu)	Mg	890
Iron (Fe)	Mg	18
Iodine (I)	µg	200
Selenium (Se)	µg	55
Manganese (Mn)	Mg	1.2
Chromium	Mg	11
Molybdenum	Mg	0
Vitamins, water-soluble		
Thiamin (B_1)	Mg	1000

Riboflavin (B_2)	Mg	1800
Pyridoxine (B_6)	Mg	1800
Cobalamine (B_{12})	µg	2600
Folate (dietary folate equivalent	Mg	350
Niacin	Mg	18
Ascorbate (vitamin C)	Mg	100
Pantothenic acid	Mg	3
Biotin	µg	13
Vitamins, fat soluble		
Retinol (vitamin A)	µg	1900
Cholecalciferol (vitamin D)	Mg	11
Vitamin E (DL-α-tocopherol acetate)	Mg	22
Phytomenadione (vitamin K)	Mg	40
Fatty acids		
N-6 fatty acid	G	5
N-3 fatty acid	G	0.85
Others		
Choline	Mg	223
Histidine	Mg	430
Isoleucine	Mg	575
Leucine	Mg	1245
Lysine	Mg	1190
Methionine + cystine	Mg	575
Phenylalanine +tyrosine	Mg	1125
Threonine	Mg	655
Tryptophan	Mg	175
Valine	Mg	776

Source: Adapted from Annan et al. (2014) and WHO (2012).

2.3.3 Ready to Use Supplementary Food (RUSF)

Over the last six decades, the management of moderate acute malnutrition with RUSF has evolved significantly, with corn-soy and wheat-soy blend formulations being used and scientific evidence on their effectiveness documented (CMAM Forum Technical Brief, 2014; Annan et al., 2014). RUSF is food fortified with micronutrients as a malnutrition remedy that can be consumed without cooking or the addition of water and thus can be safely used at home or in a primary health facility without refrigeration or prior preparation (Varshney et al., 2017; Wagh & Deore, 2015; WHO 2015). The evolution of RUSF is depicted in Table 2.5

Table 2.5: Chronology of the development of supplementary food

Timeframe	Supplementary food product
1964	Cereal-plant-protein (Ceplapro) prototype fortified blended food (FBF) developed for USAID food for peace programme
1966 – 1970s	Corn- Soy milk, Corn-Soy Blend, UNIMIX
1980s	High-Energy Biscuits (HEBs)
1990s	Ready-to-use Therapeutic used in Moderate acute malnutrition programming
2000s	Ready-to-use Supplementary Food Lipid-Based Nutrient Supplements Other fortified-soy flours
2010s	Enhanced variants of Corn-Soy Blend and Wheat-Soy blend (Super cereals with new micronutrients formulations), new FBFs made of alternative grains and pulses, emergency survival bars/pastes, reformulated high-energy biscuits

Source: Adapted from (Osendarp et al., 2015; Samnani and Azim, 2020; Wagh and Deore, 2015).

In Turkana Central, supplementary feeding is based on the provision of specially formulated supplementary foods as part of interventions of emergency food aid, which are often implemented by humanitarian organizations and the Kenyan government to prevent nutritional deterioration or treat moderately acute malnourishment in children aged 6 to 59 months (CMAM Forum Technical Brief, 2014; Government of Kenya, 2009). Children with disabilities are 1.6 to 2.9 times more vulnerable to malnutrition than their able-bodied counterparts, according to Kuper et al. (2015), highlighting critical vulnerabilities and equity issues that must be addressed while addressing malnutrition in Turkana Central sub-county (Kuper et al., 2015). Mbogori (2016) recently concluded that malnutrition is strongly linked to infectious diseases, low maternal nutrition knowledge, poor dietary intake and high food insecurity in Turkana county (Mbogori 2016). Various wheat-soy and corn-soy blend formulations have been used for the past

five decades, evolving with scientific evidence advances in their impact and nutritional value (Annan et al., 2014; CMAM Forum Technical Brief, 2014).

2.3.3.1 Corn-soy blend

Corn-soy is a fortified blend of corn (maize) and soya beans or pulses distributed as flour and then used to make porridge for moderate acute malnutrition treatment in children under the age of five (Patel et al., 2005). Corn-soy blends are marketed as super cereal or super cereal plus and are primarily distributed by humanitarian organizations like the World Food Programme (Regald et al., 2014). Amegovu et al. (2013) discovered the following nutrients in every 100 mg of corn-soy blend nutrient composition: iron (16.67mg), calcium (891.6mg), magnesium (71.83 mg), sodium (27.50 mg), manganese (0.73mg), zinc (4.15mg), phosphorous (485mg), and potassium (485mg) (626mg). Vitamin A, beta-carotene, and fatty acids are among the vitamins found in the corn-soy blend (Amegovu et al., 2013).

Initially, the distribution of corn-soy blend supplementary foods was employed in treating MAM (Amegovu et al., 2013). This method has been used in addressing moderate acute malnutrition when prevalence rates go beyond 20 % or more than 15 % in exacerbating factors contexts like epidemics (Annan et al., 2014; CMAM Forum Technical Brief, 2014). Including corn-soy blends in food, rations reduce excess mortality among households with at-risk children aged 6 to 59 months by providing food rations and micronutrient supplements to vulnerable groups (Annan et al., 2014; CMAM Forum Technical Brief, 2014). In these situations, Corn-soy blends have been less efficient in promoting rapid weight addition in the target child groups (Hanson et al., 2015; Manary & Chang, 2012).

A super cereal (or Corn-Soy Blend Plus) was developed to improve the effectiveness of traditional corn-soy blends (Reginald et al., 2014; UNICEF, 2020). The super cereal comprises 64% corn, 24% whole soybeans, 10% sugar, vegetable oil, and vitamins for children over 24 months old (Reginald et al., 2014; UNICEF, 2020). Wheat (52%), vitamin/mineral premix, vegetable oil (0.2%), sugar (9%), dried skimmed milk powder (8%), dehulled soya beans (25%), and dicalcium phosphate anhydrous (1%) are among the other ingredients in the super cereal (Annan et al., 2014; CMAM Forum Technical Brief, 2014; UNICEF, 2016). Potassium, Calcium, Iron, Zinc, Folic acid, Pantothenic acid, Niacin, Riboflavin, Thiamin and vitamins A, C, B12, D, E, K, B6 are among the micronutrients in the product (Annan et al., 2014; CMAM Forum Technical Brief, 2014; WHO, 2012). Super cereal plus is intended to supplement breastfeeding in children aged 6 to 59 months (Annan et al., 2014; CMAM Forum Technical Brief, 2014; WHO, 2012).

2.3.3.2 Peanut-based ready-to-use supplementary food

Before introducing ready-to-use supplementary food, the World Health Organization 2007 approved ready-to-use therapeutic food (RUTF) in treating uncomplicated severe acute malnutrition cases allowing children to receive adequate treatment and recover (Bazzano et al., 2017). Several nutritionists created ready-to-use therapeutic food products, eventually combined with peanut butter by the Institute de Recherche pour le Development (IRD). As a result, a high-protein, high-energy, long-lasting therapeutic food with 543 kcal/100 g (five times the energy density of F-100) and nutrients/100 kcal equivalent to F-100 was created (Bazzano et al., 2017). The result is logistically appealing in emergencies where high numbers of people must be fed due to a lack of local food or strained healthcare resources and requires no more resources from the end-user (Bazzano et al., 2017).

More ready-to-use products were developed following the widespread success of ready-to-use therapeutic foods, particularly Plumpy Nut (Bazzano et al., 2017; Nutriset, 2018), and new industries emerged, producing RUSF for uses other than therapeutic feeding for acute malnutrition (Bazzano et al., 2017). Nutriset, using the slogan "from treatment to prevention," came up with numerous new product groups based on the original formula and the standard brand PlumpyNut. PlumpyDoz (micronutrient enriched supplementary food), PlumpyMum (supplementary food for lactating and pregnant women) and PlumpySup (supplementary food for stunted children) are some of the products they produced (Bazzano et al., 2017). According to a study conducted in Malawi, recovery rates among severely malnourished Malawian children using RUTF was 78 %, compared to 46 % using the WHO standard protocol of corn-soy blend (Annan et al., 2014; CMAM Forum Technical Brief, 2014).

Plumpy Sup is a RUSF made of cocoa, sugar, maltodextrins, whey, soy protein isolates, vegetable fat, peanut paste and a variety of micronutrients that are currently used in Turkana Central Sub County's targeted supplementation feeding program (Annan et al., 2014; CMAM Forum Technical Brief, 2014; Lacey et al., 2012). It can be consumed directly from the package and is intended to be consumed in low amounts as a supplement to a regular diet (Reginald et al., 2014). The product comes in 100 g sachets and provides 537 Kcal of energy to a child suffering from moderate acute malnutrition. Additional nutrients in plumpy sup include: protein (12.1 g), lipids (35 g), calcium (630 mg), phosphorous (600 mg), potassium (1000 mg), magnesium (170 mg), zinc (12 mg); copper (1.4 mg); iron (11.2 mg), iodine (140 g), selenium (20 g), manganese (1.4 mg), sodium (180 mg), Vitamin A (750 g), Vitamin D (15 g), Vitamin C, Vitamin E (16.7 mg) (Nutriset, 2020).

PlumpyDoz is intended for children ages 6 to 36 months who have completed their exclusive breastfeeding period (Dewy et al., 2012). Plumpy doz has 270 Kcal of energy in each 50-gram sachet. In addition to energy, the following nutrients are present: Calcium (17.5 g), lipids (17.5 g), and protein (6.1 g) (315mg), phosphorous (300 mg), magnesium (85mg), zinc (6mg), copper (0.7mg), iron (5.6mg), iodine (70g), selenium (10g), manganese (0.7mg), sodium (90mg), vitamin A (375 g), vitamin D (7.5 g), and vitamin E (Nutriset, 2020).

Dewey and Arimond (2012) conducted an interventional study in Chad in which Plumpy'Doz 46 g/day was added to a monthly household food rations package for four months and targeted children aged 6-36 months (n=1038) (Dewey & Arimond, 2012). This intervention had no discernible effect on waste rate; however, the product resulted in greater height growth, lower anaemia prevalence, and less morbidity (a 29% reduction in diarrhoea and a 23% fever reduction) than the control group (Dewey & Arimond, 2012).

Rapid gaining of weight in the early years has been linked to RUSF in high-resource settings, resulting in metabolic syndrome, excess adiposity and increased risk of obesity in adulthood among children; however, research in low-resource settings has been lacking (Bazzano et al.,2017). In Ethiopia, Karakochuk et al. discovered that treating moderate acute malnutrition with RUSF resulted in higher recovery rates (73 %) in children than in corn-soy blend, which recorded a 67% recovery rate (Karakochuk et al., 2010). Ackatia et al.(2015) documented in Mali that RUSF was more effective but more expensive than corn-soy blend plus and opined that the RUSF usage is based on product cost and availability.

Fabiansen et al.(2017) discovered in Burkina Faso that giving lipid-based nutrient supplements to 1,967 children with moderate acute malnutrition increased fat-free mass index accretion by 0.083 kg/m^2. Compared to other food supplements, the increase in weight-for-height z score, MUAC, triceps skinfold, and rate of nutritional recovery in children who used a lipid-based nutrient supplement was attributed to higher growth nutrients' bioavailability link phosphorus and zinc (Fabiansen et al., 2017). The study also discovered that Burkinabe children treated with lipid-based supplements for moderate acute malnutrition recovered faster than children treated with corn-soy blend supplements (Fabiansen et al., 2017).

2.3.3.3 Supply chain for ready to use supplementary food

The first commercially produced RUTF, Plumpy Nut, was patented with IRD by the French manufacturer Nutriset (Bazzano et al., 2017). Nutriset's patent on the process and method for producing ready-to-use therapeutic food initially hampered local production in low-income areas where it was most needed (Bazzano et al., 2017; Segre et al., 2016). Nutriset, on the other hand, founded PlumpyField in 2005 (Bazzano et al., 2017). InnoFaso in Burkina Faso, Hilina-enriched food processing in Ethiopia, Nutriguinee in Guinea, Meds and Foods for Kids in Haiti, Nutrivita foods in India, Societe de transformation Alimentaire in Niger, Dansa foods limited and Nutrik in Nigeria, Tanjaka food in Madagascar, Samil industrial in Sudan, and Edesia in the United States are among the manufacturers (Nutriset, 2018). Diva in South Africa, Mana Nutritive in the USA, compact in India, Tabatchnick in the United States, Project peanut butter in Sierra Leone, Vita set in the Dominican Republic, and Insta Products in Kenya are among the other manufacturers (Segre et al., 2016).

When Nutriset made its patent available online, and an accompanying usage agreement allowing independent producers to make peanut-based RUTF, which is now available in over 25 African countries, its production in developing countries increased (Bazzano et al., 2017; Marie-Pierre, 2014). There are numerous potential benefits to producing RUTF in countries where the product is needed and used (Bazzano et al., 2017; Marie-Pierre, 2014). Locally manufactured RUTF made from locally acquired ingredients ought to perform like imported RUTFs (e.g., Plumpy Nut) provided they meet World Health Organization composition specifications and follow strict quality control measures in avoiding unprocessed peanuts' aflatoxin contamination (Bazzano et al., 2017).

Quality control in the manufacture of ready-to-eat peanut-based supplementary foods is critical for reducing the risk of aflatoxin contamination (Amy, 2012; Grellety et al., 2012). These compounds, classified as B1, B2, G, and G2, are produced by *Aspergillus* (Amy, 2012). Aflatoxins are mutagenic, carcinogenic, hepatotoxic, and immunosuppressive agents that interfere with DNA repair, RNA synthesis, and protein synthesis (Amy, 2012).

To meet the demand for ready-to-use therapeutic food in Turkana County, elaborate procurement systems have been put in place, funded by development partners such as the World Bank, United Nations Children Emergency Fund and World Food Programme, through competitive bidding from RUSF manufacturers in Kenya through Kenya medical supplies authority (World Bank, 2011).

2.4 Attitudes of caregivers toward infant and young child feeding among children aged 6 to 59 months

2.4.1 Caregiver knowledge and malnutrition

Maternal knowledge of feeding practices for infants and young children is a critical component of supplementary feeding programs and moderate acute malnutrition management (Kajjura et al., 2019). As observed in a knowledge, attitudes, beliefs, and practice assessment conducted in Turkana, knowledge of complementary feeding and the benefits of exclusive breastfeeding to the child in improving nutritional status is critical to supplementary response (Akinrimade et al., 2019; Ochola, 2017). Despite studies showing increased maternal nutrition knowledge (Kajjura et al., 2019; Ochola, 2017), there are still barriers to understanding how supplementary feeding programs contribute to this knowledge (Kajjura et al., 2019; Ochola, 2017). Improving the quality of supplementary programs and adhering to nutrition counselling have been shown to increase the effectiveness of products used for supplementary feeding in food insecure settings such as Turkana (Binns et al., 2019). Mbogori discovered that targeted nutrition education for caregivers could improve nutrition knowledge. However, the education must be accompanied by food provision to protect the gained nutrition knowledge (Mbogori & Murimi, 2019).

2.4.2 Community management of moderate acute malnutrition

Community management of acute malnutrition is a continuum of prevention that focuses on preventing acute malnutrition through community outreach, preventing severe acute malnutrition through moderate acute malnutrition management, and reducing inpatient treatment by strengthening outpatient and inpatient treatment to prevent death (UNICEF, 2013; WFP, 2020; WHO, 2012). Because the community-based management program is operated in or near communities, community outreach maximizes coverage and access (Park et al., 2012).

According to a 2013 UNICEF study, the recovery rate for children on community management of moderate acute malnutrition ranged from 80.5 % in Kenya to 85.3 % in Pakistan, both of which were higher than the 75 per cent sphere recovery threshold (UNICEF, 2013; SPHERE, 2018). Community-based acute malnutrition management programming enables the active participation of community volunteers (Wagle, 2017; UNICEF, 2013), a critical component in ensuring the sustainability of the programme. According to Tekeste and others, community-based acute malnutrition management is more than twice as cost-effective as inpatient therapeutic feeding centres in Ethiopia, with 145 USD and 320 USD costs per recovered case, respectively (Tekeste et al., 2007). In another study, Ashworth and Khanum (1997) discovered that community management was five times more cost-effective than inpatient treatment for moderate acute malnutrition in Bangladesh, at 29 USD per recovered case versus 156 USD for inpatient care (Ashworth & Khanum, 1997). In Zambia, community management of acute malnutrition was found to cost an average of 203 USD per child, resulting in a savings of 1760 USD per life saved and a savings of 53 USD per disability-adjusted life year (DALY) avoided (Chloe et al., 2013; Briony, 2017; Bachmann, 2009). In Malawi, the incremental cost-efficiency of incorporating community-based acute malnutrition management into existing health services was 42 USD per DALY avoided, and 1,365 USD per life saved (Chloe et al., 2013; Wilford et al., 2011).

2.5 Morbidity status of children aged 6 to 59 months treated for moderate acute malnutrition

2.5.1 Acute respiratory tract infections

The leading cause of death and morbidity in children under five is respiratory infections (Rodriguez et al., 2011). A respiratory tract infection is characterized by fever, cough, tachypnea, respiratory distress, and findings of decreased breath sounds and crackles on auscultation (Ngari et al., 2018; Rodriguez et al., 2011). These infections may either aggravate an existing nutritional deficiency or cause malnutrition (Rodrigues et al., 2011). Respiratory infections, such as pneumonia, are most common in children aged 24 to 36 months because their immune systems are weakened, and they are first exposed to pathogens, resulting in metabolically derived anabolic energy and poor nutritional status (Ngari et al., 2018; Rodriguez et al., 2011). Malnourished children are more probable to develop respiratory infections because their mucosal epithelial barriers and mucosal immune response are compromised (Rodriguez et al., 2011). Furthermore, serum C3 levels are lower in severely malnourished children than normal children (Rodriguez et al., 2011). Children with lower respiratory tract infections had 1.6 times the odds of dying in a South African study compared to those who did not have the infections (Gavhi et al., 2020). Thus, the presence of lower respiratory tract infections not only prolongs a child's recovery from moderate acute malnutrition but also strains the household's financial resources to address medical supplies for comorbid infections (Gavhi et al., 2020).

2.5.2 Fever-like malaria

Childhood malnutrition and malaria have a complicated and poorly understood relationship, with fever serving as the universal screening tool for clinical malaria (Das et al., 2018; Mutanda et al., 2014). Malaria caused up to 67% of deaths in children under five years old worldwide in 2019

(World Malaria Report, 2019), a significant factor in a child's recovery rate from moderate acute malnutrition (World Malaria Report, 2019). Das et al. (2018) discovered studies in their systematic review that documented an increment in *Plasmodium falciparum* malaria risk in children with wasting (Das et al., 2018). The likelihood of having Ethiopian malaria study involving 428 children under five years old was three times more in severely malnourished children (Das et al., 2018). A similar observation was made in Ghana with 2,905 children aged 6 to 108 months (Das et al., 2018). However, wasting was found to reduce the risk of concurrent malaria and high-density malaria in research done in Kenya (Das et al., 2018; Ngari et al., 2018). Stunting significantly increased the risk of malaria infection in a prospective cohort study of 487 children under five in the rural Gambia (Das et al., 2018; Lopez et al., 2020). There was no link found between a low height-for-age Z score and subsequent malaria attacks in two longitudinal malaria surveillance studies, one in Burkina Faso with 685 children aged 6 to 30 months and the another in Senegal involving 874 children aged 12 months to 5 years (Das et al., 2018). Stunted children had a higher malaria incidence than non-stunted children in the rural Gambia and Uganda (Shikur et al., 2016), while in Nigeria, a link between severe acute malnutrition and malaria was observed (Shikur et al., 2016), indicating that malaria increases the risk of moderate acute malnutrition treatment regime effectiveness.

2.5.3 Diarrheal diseases

Gastroenteritis is a stomach and intestine inflammation caused by the immune system's response to a bacterial or viral infection (Hoyle, 2008). Gastric or intestinal upset, vomiting, and the production of watery feces, also known as diarrhea, are all symptoms of gastroenteritis (Hoyle, 2008). *Escherichia coli, Salmonella, Shigella,* and *Vibro cholerae* are the most common bacteria that cause gastroenteritis and are commonly associated with contaminated water and food

(Hoyle, 2008). Due to villus atrophy and mucosal barrier damage, which lessens nutrient adsorption in malnourished children, weight and height gains are impaired by gastrointestinal infections and cognitive and physical development (Rodriguez et al., 2011). Malnutrition can also cause an increase in the number of macrophages and lymphocytes in the lamina propria and the production of proinflammatory cytokines in the intestinal mucosa, altering intestinal barrier function and increasing the risk of diarrhea (Rodriguez et al., 2011; Schilling et al., 2017).

Diarrhea could be a lipid-based nutrient supplements' side effect or a sign of increased gastrointestinal infection risk (Gera et al., 2017). Children living in deprived areas with contaminated drinking water, inadequate hygiene and poor sanitation have a higher severity of diarrheal illnesses and risk of morbidity and are more vulnerable to enteric pathogens (Ferdous et al., 2013; van Cooten et al., 2019). Poor sanitation and hygiene practices, a lack of safe drinking water, and poor environmental conditions have all been identified as primary diarrhea causes in children under five years old (van Cooten et al., 2019; Tettle et al., 2015), hence reducing malnourished children's recovery rates. According to Borg et al. (2019), the prevalence of diarrhea among children receiving RUSF for malnutrition did not improve due to poor nutrient absorption (Borg et al. 2019). Given the established roles of micronutrients, particularly zinc, in diarrhea prevention and treatment, the enhanced micronutrient profile of ready-to-use supplements may make them more efficient in preventing and treating diarrhea in children under five (Puett et al., 2013). However, because of the high distribution costs and management and logistics, programs having such a cost structure struggle to attain cost-effectiveness results (Puette et al., 2013).

2.6 Recovery rate of using Plumpy sup among children aged 6 to 59 months treated for moderate acute malnutrition

2.6.1 Measures of effectiveness for ready to use supplementary food

The recovery rate is the percentage of children who maintained appropriate weight gain without nutrition-related oedema over the program intervention, typically 90 days (SPHERE, 2018). This entails calculating the mean weight gain for children with and without nutrition oedema separately (SPHERE, 2018), and such children are thus considered cured (Akparibo et al., 2017; Fabiansen et al., 2017). Gera et al. did a systematic review and discovered that RUSF contributes differently to a malnourished child's recovery (Gera et al., 2017). The study found a few children who did not recover from moderate acute malnutrition (RR 0.70, 95 % Cl 0.58 to 0.85) in seven randomized control trials with 8364 participants (Gera et al., 2017). Researchers discovered that the risk of developing severe acute malnutrition was lower in children with MAM who had lipid-based nutrient supplements than those who received specially formulated foods in six trials (7,124 participants) (Gera et al., 2017). In two studies, children had a 20% chance of relapsing (Gera et al., 2017). Children who received lipid-based nutrient supplements gained much weight (5040 study participants; mean weight gain is 0.62 gm/kg/day; 95 % confidence interval: 0.18 to 1.06). In terms of morbidity, Era et al. (2017) found a slightly higher risk of diarrhoea (RR 1.10, 95 % CL 0.98, 1.24) and a risk of vomiting (RR 1.37, 95 % CL 1.09, 1.72) (Era et al., 2017; Gera et al., 2017).

The death rate is the percentage of children who die while participating in a RUSF program to treat moderate acute malnutrition (SPHERE, 2018). In the context of RUSF effectiveness, the population death rate should be less than 3 % (Akparibo et al., 2017; SPHERE, 2018). The

default rate is the proportion of children who miss two consecutive moderate acute malnutrition treatments (Akparibo et al., 2017; SPHERE, 2018).

2.7 Factors influencing the recovery rate of ready to use supplementary food

In Kenya, treatment for moderate acute malnutrition is guided by IMAM guidelines and SPHERE standards indicators (Government of Kenya, 2010; SPHERE, 2018). As a result, the ability of moderate acute malnutrition therapy, ready-to-use supplementary food, to improve nutrition indices from admission to discharge is used to assess its effectiveness. A child with moderate acute malnutrition has a weight-for-height of less than two to greater than minus three standard deviations (SD) and a MUAC of 115 mm to 125 mm without nutritional oedema at admission. At discharge, the child should have had a weight-for-height z-score of more than minus two SD and MUAC of 125 mm for two consecutive weigh-ins or measurements without nutritional oedema (Government of Kenya, 2009). SPHERE standards performance indicators recommend that an effective program have a death rate of less than 3%, a default rate of less than 15 % and a recovery rate of greater than 75 % (SPHERE, 2018). In 2012, UNICEF used the same indicators to document the performance of its moderate acute malnutrition program in Kenya, documenting an 80.5 % recovery rate, a 14.5 % default rate and a 0.4 % death rate (SPHERE, 2018; UNICEF, 2012).

Malnutrition in a specific population indicates failings in critical community sectors that contribute to population health (Akparibo et al., 2017; SPHERE, 2018). The UNICEF nutritional conceptual framework is a good tool to show the connection between the exploitation of locally available resources and improving a child's nutritional status to understand the underlying malnutrition causes (UNICEF, 1991). Poor community governance; insufficient access to

education by caregivers; insufficient access to health services; poor child caregiving practices; household food insecurity; disease incidences; and the child's ability to process food for use in the body are among the identified factors that contribute to low rates of malnutrition (van Cooten et al., 2019).

In Ethiopia, the magnitude of co-morbidity with moderate acute malnutrition has influenced the recovery rate of malnutrition-treated children (Derseh et al., 2018). In their study, Derseh et al. (2018) discovered that 55.9 % of children treated for severe acute malnutrition recovered, 5.8 % died, and 16.3 % did not receive treatment. A child with coexisting factors such as edematous malnutrition and pneumonia was unlikely to recover from malnutrition (Derseh et al., 2018). Studies in Turkana County have revealed a link between child morbidity and malnutrition (Turkana county government, 2019). For example, according to the 2019 SMART survey (Turkana county government, 2019), 41.4 % of the 693 children surveyed had been sick in the previous two weeks, with 49.5 % suffering from acute respiratory infections – cough, 37 % suffering from fever-like malaria, and 17.9 % suffering from watery diarrhoea (Turkana county government, 2019). According to Malawian studies, only 51 % of children treated for moderate acute malnutrition recovered after treatment, with some experiencing fever, cough, malaria, and diarrhoea that hampered their recovery (Stobaugh & Manaryet, 2018). In Burkina Faso, incomplete vaccination increased the risk of relapse among children receiving treatment for moderate acute malnutrition, lowering the effectiveness of RUSF (Fabiansen et al., 2017).

2.7.1 Health facility accessibility

Treatment or protocols proposed for moderate acute malnutrition management should take into account both the health component (including access to health services) and the nutrition

component, which includes access to and the efficacy of nutritional products given to a child (Annan et al., 2014; CMAM Forum Technical Brief, 2014; Manary & Callaghan-Gillespie, 2018). Long distances may be travelled by children referred for primary health care services to receive treatment, increasing the likelihood of them going unnoticed (Annan et al., 2014; CMAM Forum Technical Brief, 2014). In the long run, a lack of critical attendant care may jeopardize the efficacy of RUSF used to treat moderate acute malnutrition (Annan et al., 2014). Universal access to health-care services, determined by factors such as how far the health facility is, significantly reduces health services and is a critical factor in reducing child mortality and promoting child health (Schoeps et al., 2011). A malnourished child is less able to fight infections, resulting in more severe and longer-lasting illnesses (Schilling et al., 2017). In Ethiopia, Shaw et al. (2015) discovered that caregivers perceived the child's illness as not serious enough to warrant a visit to the health facility; perceptions that the health facility was not open, lack of drugs, and the health facility located too far from a caregiver's household to access; poor service by health extension workers or at the health facility; and preference of the health facility to attend. Furthermore, because RUSF was typically distributed at the catchment health facility, caregivers may not have visited the health facility regularly to receive supplies (Icke et al., 2012).

According to a study conducted in western Kenya, distance decay significantly impacted attendance at health facilities by caregivers of sick children (Feikin et al., 2009). This distance effect is more pronounced in men than in women, implying that individual health-seeking behaviour, social and reproductive activities, and economic activities all affect (Müller et al., 1998). According to studies, every 3.5 km travelled reduces potential health facility attendance

by 50 % in Papua New Guinea; every 3.2 km travelled reduces attendance by 50 % in Uganda; and every 3.4 km travelled reduces attendance by 50 % in Northern Nigeria (Müller et al., 1998). According to data from Burkina Faso, the child's mortality risk increases as the distance from the health facility increases (Anja et al., 2011). In South Sudan, it was observed that therapeutic feeding centres were affected by heavy rains, forcing mothers to walk for four hours with food and children, resulting in default among children treated for moderate acute malnutrition as well as their recovery from moderate acute malnutrition (Akparibo et al., 2017).

2.7.2 Ready-to-use supplementary food leakage, misuse at the health facility level

Because of their perceived economic value, several organizations that distribute RUSF have documented cases of its losses, leakage, and misuse (Jurgen, 2013). In Ethiopia, it was discovered that 13% of RUSF was lost due to leakage, with most of the leakage caused by a shortage of RUSF delivered to the health facility (Jurgen, 2013). Outpatient program health workers give caregivers less RUSF than was recorded in the health facility register; administrative errors; and, in some cases, theft caused by a lapse in the implementation of basic logistic control such as bin cards, stock registers, and regular inventories are some of the strategies that contributed to the shortage of RUSF (Jurgen, 2013).

2.7.3 Sharing of peanut-based ready to use supplementary food at the household level

Sharing supplementary foods is a cultural norm across African cultural settings, according to existing literature and common experience (Osendarp et al., 2015). Supplementary food desirability or its components, child age, involvement of mothers in child feeding, behavioural and social change communication strategies' effectiveness, food insecurity and household composition

can all have an impact on the extent to which the supplementary food is shared or diverted (Osendarp et al., 2015). Since 2010, the Kenyan Ministry of Public Health and Sanitation has registered RUSF as food (Government of Kenya, 2018).

According to a Niger study, because of the nature of the ready-to-use supplementary food, it is given local names, and thus RUSF is not regarded as a treatment regime (Marquer et al., 2020). The RUSF is referred to as "biskit," and it is believed that giving the child "biskit" protects them from illnesses such as diarrhoea, vomiting, and fever (Marquer et al., 2020). As a result, it was discovered that sharing RUSF with a child receiving treatment for moderate acute malnutrition could be harmful to a child receiving treatment for moderate acute malnutrition (Marquer et al., 2020) because of the risk of defaulting on treatment. However, the researchers of the Niger study did note that sharing of ready-to-use supplementary food was mostly done among children from the same household (Marquer et al., 2020). Solidarity with friends, neighbours, and close and immediate family members has also been documented as a socially innate and desirable cultural practice that significantly influences the sharing of nutritional supplements (Marquer et al., 2020). According to Ackatia-Armah et al. (2015), in Mali, the supplement was mostly taken by the child being treated for moderate acute malnutrition and shared with other children in the household (Ackatia-Armah et al., 2015). In other studies, caregivers of children being treated for moderate acute malnutrition in Burkina Faso gave siblings some of the RUSF, citing that sharing food is culturally acceptable (Luel-Brockdorf et al., 2016). According to Phuka et al. (2011), there was some sharing of RUSF given to children receiving treatment for moderate acute malnutrition in Malawi, where sharing occurred with a neighbour's child, sibling, or adults (Phuka et al., 2011). Furthermore, Karakochuk et al. (2010) discovered that RUSF sharing

accounted for 30 to 60% of food ration in take-home food distribution programs (Karakochuk et al., 2010). According to Nackers et al. (2010), unlike corn-soy blends or locally made food supplements, ready-to-use supplementary foods were perceived as therapeutic products and were less likely to be shared within households due to their specialized packaging (Nackers et al., 2010).

2.7.4 Acceptability and tolerance of peanut-based ready-to-use supplementary food

Taste, and the belief that ready-to-use supplementary food was assisting the child, resulted in increased energy and weight gain, thus a quick recovery (Beckett et al., 2016). In Uganda, Ickes et al. (2012) discovered that RUSF was widely accepted, with differing perceptions of factory produced RUSF versus locally made food supplements (Ickes et al., 2012).

The ease with which the ready-to-use supplement could be mixed into the regular child feeding routines was observed to improve the child's appetite and thus consume ready-to-use supplementary food (Ickes et al., 2012).

2.7.5 Socio-economic status of caregiver and moderate acute malnutrition

A wealth of research shows a link between the socioeconomic status of households and caregivers and the malnutrition risk in children under five (Ferdous et al., 2013; Singh et al., 2019; Tettle et al., 2015). Household and income expenditure are the most utilized measures of socioeconomic status in low-income countries, and they frequently serve as a marker for malnutrition (Ferdous et al., 2013). Singh et al. (2019) conducted research in India that discovered a link between economic status, mother literacy, and childhood malnutrition (Singh et al., 2019). They found that household equivalent income and maternal employment status were not significantly related to child overweight, but marginally (Singh et al., 2019). According to

evidence from Ghana, family income is a factor connected to higher odds of malnutrition (Tettle et al., 2015) and an increment in severe diarrheal disease likelihood among malnourished children from poorer families which have low monthly income ($100 US) (Ferdous et al., 2013). They discovered that increasing household income through preventive distribution of supplementary food and cash transfers was more effective (Tettle et al., 2015). Another researcher observed that household wealth status, health insurance, access to antenatal care, and mother's education all contribute significantly to child malnutrition (Novignon et al., 2015). Pramod et al. (2009) found similar findings in a study of 443 children in Nepal, where they discovered that child malnutrition was heavily dependent on the mother's educational status (Pramod et al., 2009).

The income approach has been used over time, and poverty reduction approaches continue to assess poverty based on how much an individual earns in a day in terms of dollars (Watete et al., 2016). According to Reach et al. (2015), poverty is a condition of multiple deprivations for vulnerable communities, households and individuals that varies in time and space (Reach et al., 2015). A person's daily income defines income poverty and thus purchasing power parity, whereas consumption poverty is defined by an individual's ability to meet basic needs (clothing, food, energy, shelter, and so on) (Reach et al., 2015). According to the 2018 Kenya integrated household and budget survey, Turkana has the lowest expenditure per poor person as a share of its development and recurrent expenditures, with all having income per person of less than 15,000 Kenya shillings (Vidhya et al., 2018). However, the income approach to poverty ignores structural factors that contribute to poverty, assumes no-market resource flows and fails to account for differences in the living cost between rural and urban areas (Watete et al., 2016).

2.8 Summary of literature review

Wasting affects 13.0 % of children under five in Kenya, with Turkana central sub-county having 20.2% global wasting and 2.8% severe acute malnutrition in 2019. Micronutrient deficiency is a concern among this group, with measures proposed to control the problem primarily through vitamin A supplementation via vaccination and fortification of food such as vitamin A and D fortified vegetable oil and iodized salt. Supplementary feeding programs should be able to meet malnourished children's nutritional needs. The supplement should provide 26g of protein, 18 mg of iron, 1900 g of vitamin A, and 5.85g of fatty acids per 1000 kcal, among other nutrients. Maternal knowledge of nutrition practices is a critical component in addressing childhood malnutrition. Some documented contributors to reduced malnutrition rates among children under five include a good understanding of when to initiate complementary feeding, start breastfeeding, understanding minimum dietary diversity, and diseases caused by micronutrient deficiency. Community-based malnutrition management, including supplementary feeding, is used to control moderate acute malnutrition in Turkana central sub-county, with Plumpy sup being the preferred treatment product. However, the effectiveness of Plumpy sup has not been adequately documented, particularly in resource-limited settings such as the Turkana Central sub-county. The effectiveness of any RUSF, including Plumpy sup, is based on SPHERE standards guidelines and Kenya integrated management of acute malnutrition guidelines, focusing on non-response recovery, default, and death rates. Proper hygiene practices, access to good sanitation, safe water, and access to health facilities for prompt treatment of sickness in the child have all been documented to affect the recovery rate of children undergoing treatment with RUSF. Because of the influence on the caregiver's purchasing power, the caregiver's socioeconomic status is a critical factor in sustaining the child's recovery. Sharing RUSF meant for the child

being treated for moderate acute malnutrition is a critical factor at the household level because it reduces the recommended dosage for the child.

CHAPTER THREE: MATERIALS AND METHODOLOGY

3.1 Introduction

This section outlines the methodology employed to assess the effectiveness of Plumpy sup in treating moderate acute malnutrition among 6 to 59 months old children in Turkana central sub-county, Kenya. It describes the study's research design, sampling techniques, description of intervention, techniques for data collection, and methods for data analysis.

3.2 Study Design

A prospective cohort study was conducted in Turkana Central Sub County to evaluate the effectiveness of Plumpy sup as a treatment for moderate acute malnutrition in 6 to 59 months old children. The study was integrated with the ministry of health's community-based supplementary feeding program in Turkana's central sub-county, which humanitarian stakeholders supported.

3.3 Variables

The effectiveness of Plumpy sup in treating 6 to 59 months old children for moderate acute malnourished was the dependent variable in this study. The duration of stay in the supplementary program, the child's weight gain, and the default rate in accordance with SPHERE standards were used as indicators of effectiveness (SPHERE, 2018). The independent variables were socioeconomic characteristics, the child's nutrient intake, caregivers' attitudes toward infant and young feeding practices, and the child's morbidity status. Table 3.1 lists the variables studied, and the indicators used to assess them.

Table 3.1: Study variables

Dependent Variable	Indicator
• Effectiveness of Plumpy sup	• Duration of stay in the program • Weight gain by the child
Independent Variable	Indicator
• Morbidity status of the child in the last 14 days	• Episode of fever like malaria, • Episode of diarrhea • Episode of ARI-cough, • Episode of eye infections
• Nutrient intake by the child	• Quantity of carbohydrates, proteins, lipids, vitamin A, and iron. • Minimum meal frequency • Dietary diversity
• Caregiver's attitude on feeding practices for infant and young child	• When to initiate breastfeeding • What causes kwashiokor • What causes Marasmus. • Impact of mirconutrient deficiency in children. • When to breastfed a child. • When to introduce semi-solids, solids and soft food to the child.
• Socio-demographics and Socio-economic characteristics	• Child's age • Child's sex • Caregiver's education level • Caregiver's occupation • Caregiver's monthly income • Caregiver's expenditure level • Caregiver's socio economic status (wealth index)

3.4 Location of the Study

The study was done in Turkana Central Sub County, one of Turkana County's seven sub-counties, as shown in Appendix 1. The county has a total area of 68,680.3 Km^2 and is located between Longitudes 340 30' and 360 40' East and Latitudes 10 30' and 50 30' North (Turkana County Annual Development Plan, 2015).Turkana Central County has a global acute malnutrition rate of 20.2 %, a severe acute malnutrition rate of 2.8 %, and a moderate acute

malnutrition rate of 6.8 % (SMART 2019). Children in Turkana central sub-county have a high morbidity rate (39.8 %), with the most common illnesses being acute respiratory infection/cough (40.5 %), fever-like malaria (37.0 %), and watery diarrhoea (17.9 %), affecting water, sanitation and hygiene projects in the county (SMART, 2019).

3.5 Study Population

The children in the study ranged in age from 6 to 59 months and were enrolled in supplementary feeding programs that used Plumpy sup as a treatment for moderate acute malnutrition. The researcher went to the health facilities that provided supplementary feeding, randomly selected children who fulfilled the inclusion criteria and enrolled them. The researcher concentrated on children enrolled for the first time in a treatment program for moderate acute malnutrition. The nutritionist at the hospital assisted the researcher in selecting the children. Following identification and confirmation that the child met the inclusion criteria, the researcher explained the research purpose, objective, and how their data will be used to inform the research to the caregivers and their 6 to 59 months old children. The caregiver and their children were then enrolled by signing the consent form (See Appendix 2) or thumb printing for those who were illiterate. This signing confirmed their participation in the study, and the researcher assigned each child a unique identifier. The screening, enrolment, and discharge processes are summarized in Table 3.2.

Table 3.2: Definition of child exit indicators from the study

Category	Description of indicators
Recovery	• The child is discharged after WHZ score of greater than minus two standard deviation (-2 SD) or MUAC greater than 125mm on two successive visits • Absence of edema for at least seven days before the visit. • Absence of acute medical condition • Adequate appetite for food consumption • Updated immunization status and Vitamin A supplementation
Default	• The child could not be traced for two successive bi-weekly visits.
Non-response	• The child remained in the programme without meeting the recovery criteria of MUAC above 125mm or weight-for-height Z score greater than minus three standard deviation and less than minus two standard deviations.
Death	• The child died while he or she was enrolled in the programme.

Source: Adapted from Karakochuk (2016).

3.5.1 Inclusion Criteria

The researcher enrolled 6 to 59 months old children with weight-for-height Z scores greater than or equal to minus three (-3) but less than two (-2z). This was confirmed through the MUAC reading of greater than or equal to 115 millimetres and less than 125 millimetres without oedema, as per World Health Organisation guidelines (2006). The caregiver must have consented for their child to be treated for moderate acute malnutrition treatment with Plumpy sup. The researcher confirmed with the caregiver that the child was not enrolled in any other supplementary feeding program and sought moderate acute malnutrition treatment for the first time.

3.5.2 Exclusion criteria

The researcher did not include severely malnourished children who had weight-for-height z scores of less than minus three (-3), had bilateral oedema, or had a medical condition that prevented them from feeding normally. Children who were discharged from an inpatient or stabilization therapeutic centre directly into a supplementary feeding program were also excluded from the study. The researcher also did not enrol children whose caregivers refused to participate in the study.

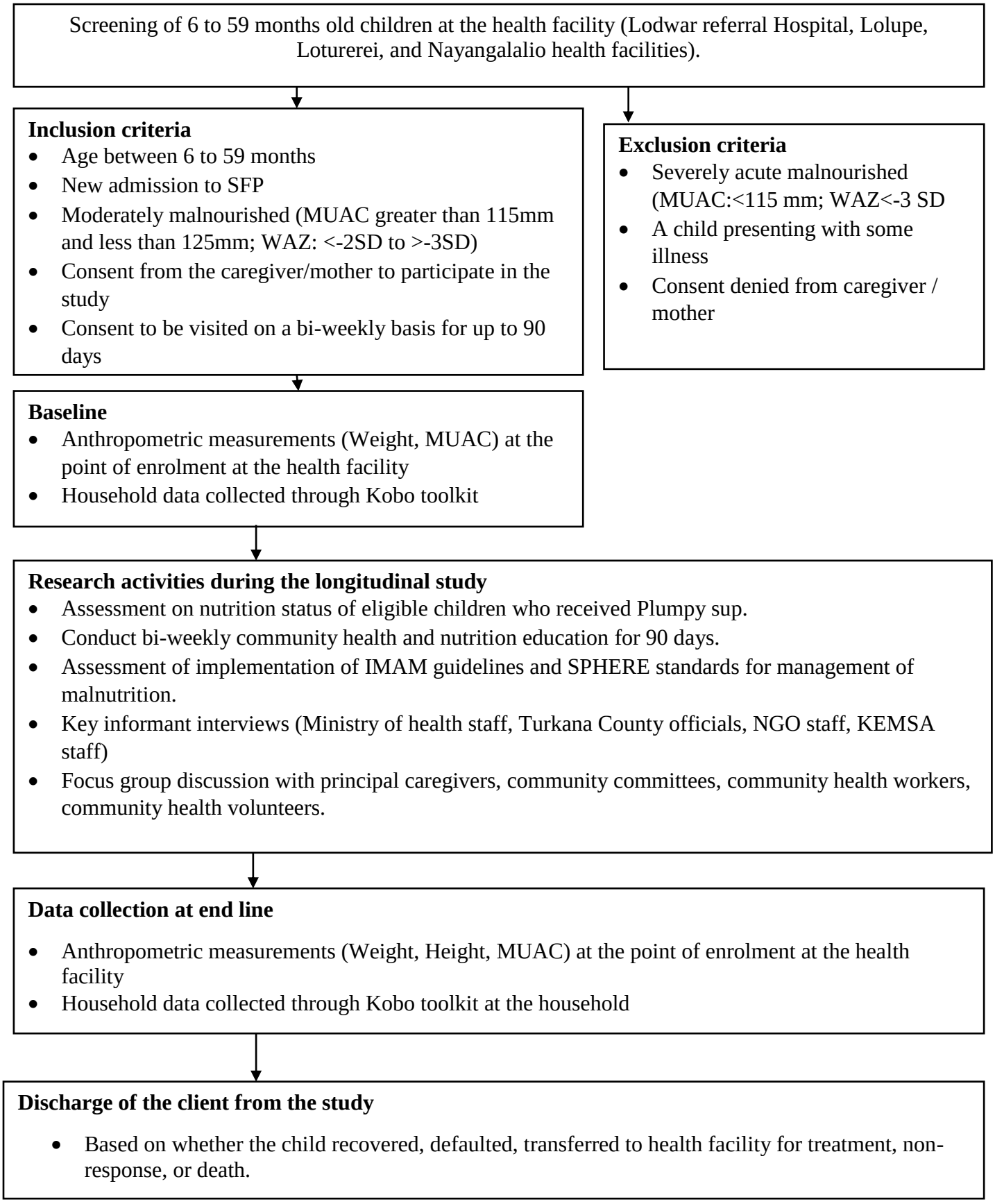

Figure 3.1: Schematic diagram of the study enrolment process

3.6 Sample size and sampling techniques

3.6.1 Sample size determination

The Fisher et al. (1998) formula was used to calculate the sample size:

$N=Z^2 PqD/d^2$

Where:

n= the desired sample size for children.

Z=normal standard deviation at 95% confidence interval, which is 1.96

P= Recovery rate amongst beneficiaries using ready to use supplementary food. The recovery rate (83.9%) for ready to use supplementary food was used (UNICEF, 2014).

d =margin of error(0.05)

D=design effect (1)

$N= 1.96^2 *0.839*0.161/0.05^2$

= 207.56 approximately 208

Taking into consideration that the population of children aged 6-59 months suffering from moderate acute malnutrition in January 2018 was 4707, the desired sample size Nf was calculated for a population of less than 10,000.

Nf=n/1+n/N

= 208/1+208/4707

=208/1.044

=199

To account for the non-response rate, an additional 51% was added, resulting in a total sample size of 300.

3.6.2 Sampling techniques

The researcher used a multistage sampling technique to enrol the study participants and purposefully sampled Turkana central sub-county due to the high malnutrition rate (19.7 %) in the sub-county as captured in the SMART survey conducted in January 2018. Compared to the other six Turkana County sub-counties, Turkana Central Subcounty was also easily accessible. From the 13 Turkana's central sub-county locations, four were chosen at random. In these four locations, there were 63 health facilities, which were all rolled up in a paper, and four health facilities were chosen for the study. The study included Lodwar referral hospital, Nayanaeang ikalalio, Loturerei, and Lolupe health facilities. The sample size for the sampled health facility was determined by the number of children (6 to 59 months old) suffering from moderate acute malnutrition, as projected by county demographic data provided by the Turkana central sub-county information office and health facility register.

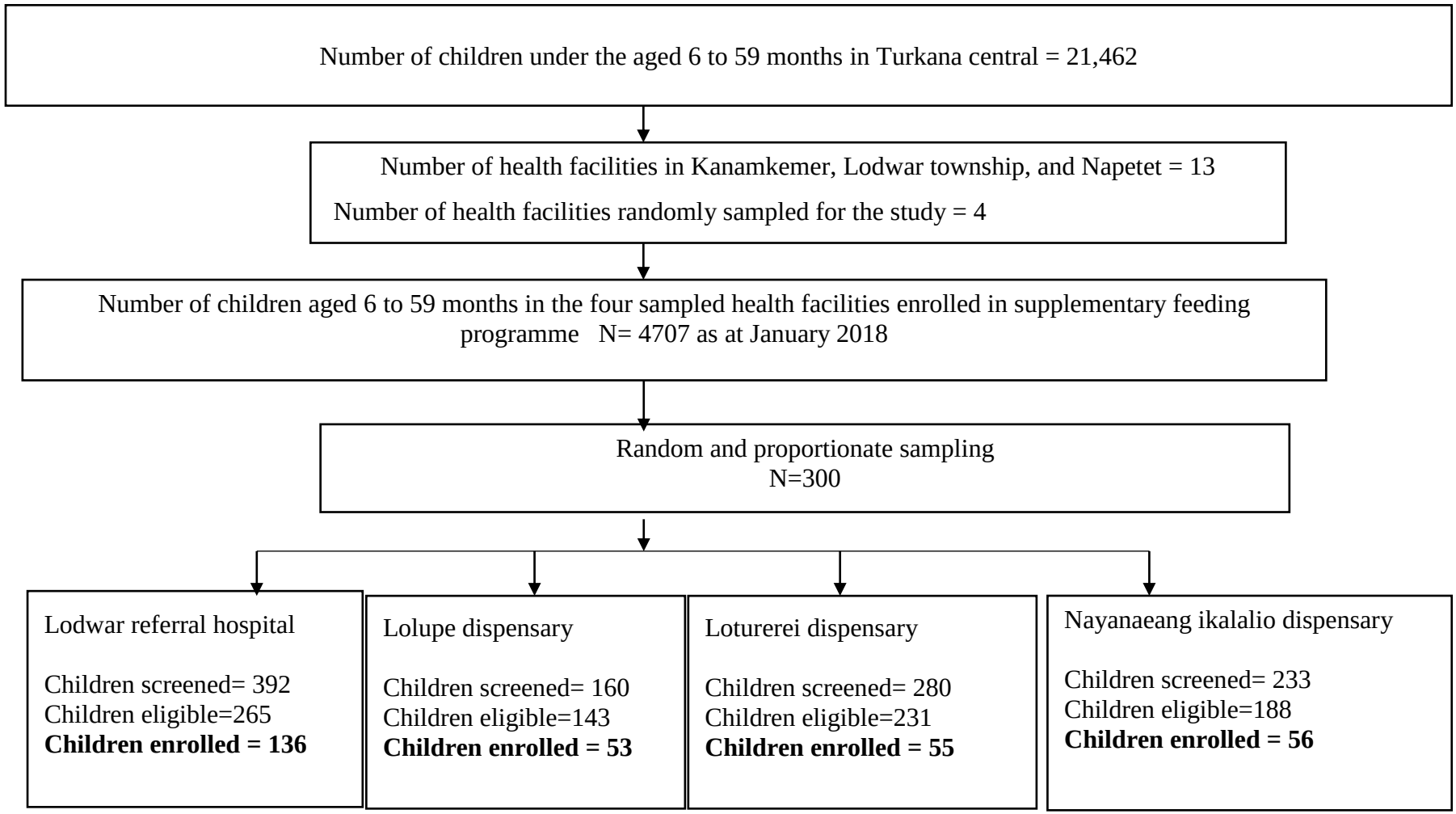

Figure 3.2: *Schematic representation of the sampling procedure*

3.10 Data collection tools and techniques

3.10.1 Information from facility health records

The researcher examined health facility records on moderate acute malnutrition treatment in children from the health facility's catchment area. Among the documents reviewed by the researcher were administrative data from health facilities, morbidity trends, and demographic information on children who attended health facilities.

3.10.2 Household questionnaire

The researcher used Kobo collect, a mobile data collection platform, to distribute the household questionnaire (See Appendix 3). The platform included a semi-structured questionnaire which had closed-ended open-ended questions. These questions were administered on the first day of enrollment and the ninetieth day of the program. The household questionnaire was deployed to gather data on socio-demographics, caregiver socioeconomic status, access to hygiene services, sanitation, water, and nutrition practices, caregiver attitude on child feeding practices, child feeding practices, access to health services, morbidity status of the child, and access to other forms of food aid from the government and non-governmental organizations. The researcher used a separate questionnaire to record the child's anthropometric measurements, MUAC, height, and weight (See Appendix 4). The bi-weekly form was used to collect information on Plumpy sup consumption trends such as the child's appetite and sharing of the Plumpy sup, morbidity in the previous 14 days, weight, and MUAC measurements.

3.10.3 Key informant interviews

These were conducted with the county nutrition coordinator, eight health officers at the respective health facilities, and 15 representatives from non-governmental organizations working in Turkana central sub-county. The researcher also interviewed one ministry of water employee, two health employees, one ministry of agriculture employee, and one ministry of labour and social protection employee

3.10.4 Focus group discussions

At the community level, the researcher held eight focus group discussions (See Appendix 5) with community health volunteers, community health workers, and caregivers involved in social mobilization for the supplementary feeding program's uptake. In the first week of the study, eight focus group discussions were held with 29 caregivers and 32 community health workers and committee volunteers who were chosen at random attending. These two rounds were conducted with the same caregivers for consistency and reliability. Six community committee volunteers and two community health volunteers from each health facility were among the other groups with whom the researcher held focus group discussions. The local research assistants assisted with the local translation for the focus group discussion participants who did not understand Swahili or English.

3.10.5 Observations

The researcher used observation (See Appendix 7) to collect data primarily on the child's eating habits and caregivers' water, sanitation, and hygiene practices in the community from which the child enrolled in the program came. This entailed observing and recording the behaviour of the children and the caregivers participating in the research. The researcher and community health

workers made these observations during impromptu visits to the household of children being treated for moderate acute malnutrition as part of their routine community mobilization work.

3.10.6 Information on Adverse effects of plumpy sup

During the bi-weekly visits, the researcher gathered information from the caregiver on any unexpected changes in the child's health that could be linked to the use of Plumpy sup. The researcher looked into whether there was vomiting, an allergic reaction, a loss of appetite, or diarrhoea. The researcher documented the responses and analyzed the same.

3.10.7 Anthropometric measurements

The researcher and nutritionists took the child's anthropometric measurements as part of the regular data collection for the supplementary feeding program procedure during the screening process. During the screening process, the researcher and nutritionists took the child's anthropometric measurements, namely MUAC, weight, height, and age. The child's weight was measured in triplicate using an electric scale calibrated in 0.100 kilograms, with the average of the three measurements recorded. When a child was too weak or small to use the weighing scale, the weight of both the caregiver and the child was taken, followed by the weight of the caregiver alone. The researcher calculated the child's weight by subtracting the caregiver's weight from the total weight of the caregiver and the child. The data was then recorded on the researcher data collection tool, child's health card, and entered into the health facility register. The researcher measured the child's height by letting the child lie on the board with their head against the head support, as UNICEF and the Ministry of Health recommended. The foot was then adjusted until the lower board touched the child's feet. Measurements were taken in triplicate to the nearest 0.1 cm, and the average of the three was recorded on the child's health card and in the heal register. The nutritionist assessed the child's health and asked the caregiver to share the child's illness

history, including food consumption habits. The researcher then put the child through an appetite test by giving him a sachet of Plumpy sup to see if he could consume the product. The researcher used a standard insertion tape to measure the child's upper arm circumference to the nearest 0.1 centimetres with the help of a nutritionist. This was accomplished by locating the tip of the child's shoulder and bending the hand at an angle to locate the mid-arm point. After locating the mid-point, a MUAC tape was wrapped around the arm, and a centimetre reading was taken. The procedure was repeated a second time, and an average was calculated and entered into the child health card and health registry.

3.10.8 Questionnaire on 24-hour dietary recall

The researcher used a 24-hour recall questionnaire embedded within the bi-weekly questionnaire to assess the child's dietary intake (See Appendix 4 and 9). This was deployed in gathering data on all the foods and beverages that the child consumed to their satisfaction from when they woke up in the morning until when they went to bed at night. The researcher recorded the child's consumption frequency as well as the portion consumed in the previous 24 hours. The researcher asked the caregiver to identify which utensils they used to feed the child and estimate the quantity.

3.11 Description of treatment of moderately malnourished using Plumpy sup

The study's goal was to see how effective Plumpy sup was as a treatment for moderate acute malnutrition in 6 to 59 months old children in Turkana central sub-county. The Kenya medical supplies authority procured Plumpy sup during the study period and distributed it to the sampled health facilities via the county commodity supply chain structures. The caregiver was taken through the dosage of Plumpy sup by the nutritionist after the researcher enrolled her in the

study. The researcher documented the nutritionist's instruction process and carefully observed whether the caregiver was paying attention. The caregiver was then taken through nutrition education by community health workers, who were tasked with raising awareness and providing education about factors that contribute to reducing childhood malnutrition. The integrated management of acute malnutrition at the community level included access to water and sanitation, infant and young child feeding practices, environmental protection, access to safety net programs, and timely treatment of sick children.

The nutritionist at the facility asked the caregiver if the child had an allergy to lipids, which are the main ingredients in the Plumpy sup. To determine whether the child would accept the Plumpy sup, an appetite test was performed following the protocol developed by the Government of Kenya for the acute malnutrition integrated management (Government of Kenya ,2009). At the health facility, the nutritionist instructed the caregiver to wash their hands, the hands of the child, and the child's face with water and soap. The child was then placed on the caregiver's lap, and sachets of the Plumpy sup were sliced open so that the caregiver could reach the content with their fingers. The caregiver then scooped the sachet contents with her finger and placed them in the child's mouth. In cases where the child was crying, the caregiver had to calm the child down and encourage the child to consume the contents of the sachet. The child was then given water to drink from a bottle or a cup, depending on the type of feeding equipment used by the caregiver. The proportion of sachets eaten by the child was used to determine if the child passed the appetite test (Table 3.3). Those children who failed the test were referred to a nutritionist for further medical evaluation and treatment. The nutritionist provided a 14-day supply of Plumpy sup based on a one-sachet-per-day prescription for two weeks until the next visit to the health facility for those children who passed the test.

Table 3.3: Minimum amount of ready to use supplementary food per kg of body weight required to pass the appetite test

Bodyweight (kg)	Sachets
Less than 4	1/8 to ¼
4 to 6.9	1/4 to 1/3
7 to 9.9	1/3 to ½
10 to 14.9	1/2 to ¾
15 to 29	3/4 to 1
Over 30 kg	More than one sachet

Source: Adapted from Kenya integrated guidelines for acute malnutrition management (Government of Kenya, 2009)

After giving the caregiver the recommended sachets for the child, the nutritionist and researcher instructed the caregiver on using Plumpy sup, emphasizing that Plumpy sup was not meant to replace the child's regular diet. The researcher and nutritionist advised the caregiver at home to always wash their hands with soap and water before giving the child the Plumpy sup. Immediately after taking the product, the caregiver was also advised to keep track of the child's appetite and any adverse reactions to Plumpy sup, such as diarrhea or vomiting. The administration frequency was based on meal times, as long as the child did not exceed the nutritionist's recommendation of one sachet per day. The researcher and nutritionist advised the caregiver not to share the Plumpy sup with the child's siblings or anyone else in the household. The researcher and nutritionist advised the caregiver not to sell the Plumpy sup.

3.11.1 Treatment for common illness

Due to the outpatient nature of the supplementary feeding program, the child admitted to the study had no medical complications and thus did not require admission for treatment. However, the researcher and nutritionist advised the caregiver that if the child developed complications while undergoing treatment, they should seek medical attention at the nearest health facility. The child was also given vitamin A in addition to the Plumpy sup. In cases where the child's

nutritional status deteriorated, the caregiver was advised to seek inpatient treatment for the condition.

3.12 Pre-testing of data collection tools

The researcher recruited research assistants in collaboration with the Turkana county health officer, as the assistants were embedded in supplementary feeding programming managed by county health facilities. The researcher created selection criteria and terms of reference for the research assistants and advertised the positions on local bulletin boards. The research assistants needed a college diploma in public health or nutrition and previous experience working as a research assistant. This resulted in hiring four research assistants, each of whom was assigned to one of the study's locations. Following recruitment, the researcher held a three-day training session in Lodwar township, where the research assistants were instructed on the research protocol and research tools. Demonstrations, role plays, and lecture techniques were used to train on data collection methods.

The researcher led a one-week pre-testing of data collection tools in Kakwanyang village, Turkana central sub-county, with 10 % of the sample size to ensure that the developed tools and research protocol were accurate and reliable. The pre-testing study’ primary goal was to ascertain whether the tools developed were simple to use and would capture the key indicators, providing a measurement for the study's variables. Following the pre-testing, the researcher revised the tools by removing vague questions and adjusting questions that sounded repetitive.

3.13 Validity

Kenyatta University and the Turkana County Ministry of Health community development and nutrition professionals reviewed the data collection tools. The study's supervisors also reviewed and provided feedback on the data collection instruments. The researcher revised the instruments in response to the feedback. The researcher ensured that the study's questions were consistent with the peer-reviewed questions used in Turkana County's SMART survey.

3.14 Reliability

The researcher used a test and retest method to determine the questionnaires' reliability. The questionnaires were given to the same respondents within three days to obtain the same results. The Cronbach correlation formula (Cronbach & Shavelson, 2004) was used to obtain a coefficient of 0.83 at a 95 % confidence interval.

3.15 Data analysis

Quantitative data from the kobo toolkit were downloaded to Excel 2010, and each entry was cross-checked for accuracy against the questionnaire before being uploaded to R studio for analysis. Descriptive statistics (frequency, means, medians, and standard deviations) were deployed in describing demographic and socioeconomic characteristics, weight-for-height z scores, weight-for-age z scores, morbidity status, caregiver nutrition knowledge, distance to water sources, sachets of Plumpy sup distributed, caregiver hygiene practice, amount of cash distributed through social protection, et cetera. Running frequencies and cross-tabulating variables were used to ensure consistency.

The data from the 24-hour recall of the child's dietary intake was analyzed based on the recommended daily allowance using Nutri-survey software and the Kenya nutrition database.

The analysis was aligned with WHO 2008 recommendations for complementary feeding of children who are breastfed and non-breastfed. The indicators for analysis were energy, carbohydrates, protein, fat, iron, and vitamin A. The minimum dietary diversity score for 6 to 23 months old children was calculated using seven food groups recommended by WHO guidelines (WHO, 2008): 1) grains, roots, and tubers, 2) legumes and nuts, 3) dairy products (milk, yoghurt, cheese), 4) flesh foods (meat, fish, poultry, and liver/organ meats), 5) eggs, 6) vitamin A-rich fruits and vegetables, and 7) other fruits and vegetables. The dietary diversity score for children aged 24 to 59 was calculated using nine food groups: 1) starchy staples (a combination of cereals and white roots and tubers), 2) dark green leafy vegetables, 3) other vitamins. a variety of fruits and vegetables, 4) additional fruits and vegetables, 5) Organ meat; 6) meat and fish; 7) eggs; 8) legumes, nuts, and seeds; and 9) milk and milk products (Kennedy et al., 2011).

The minimum meal frequency was determined using an adapted formula for breastfed and non-breastfed 6 to 23 months old. The rate was calculated by dividing the proportion of children who received soft foods, semi-solid or solid, by the proportion of children who received milk feed from breastfed children (WHO, 2008b). The minimum number of times they could breastfeed was two times if they were 6 to 8 months old and three times if they were 9 to 23 months old. According to the WHO 2008 part 2 guidelines, the minimum amount for non-breastfed 6 to 59 months old children was four times.

The anthropometric indices (weight-for-height z score, height-for-age z score and weight-for-age z score) were computed according to the WHO 2006 child growth standards. These were analysed with the anthro package installed in R programming via R studio. The weight gained (g/kg/day) relative to the enrolment weight was calculated and presented as a percentage for

children enrolled in the study. The number of children documented in health facility records needing MAM treatment following SPHERE standards was used to calculate the Plumpy sup coverage rate and presented as a percentage of those who received Plumpy sup. The default rate was determined by the number of enrolled children who consented to the study but could not be located at their home address for two consecutive visits. A log-rank test was utilized to determine statistical significance. A Kaplan Meier survival analysis assessed the recovery rate from moderate acute malnutrition relative to the time from admission initiation. The researcher also used clinical equivalence to examine the recovery rate with a 10 % change regardless of a statistically significant difference (Karakochuk, 2016; Christy, 1999).

A principal component analysis was deployed in understanding the relationship between the socioeconomic status of the households and the effectiveness (weight gain) of the child from moderate after being given Plumpy sup, with asset ownership, caregiver occupation, education status, and income level, and consumption expenditure being used.

Pearson's chi-square was used to establish associations between effectiveness (weight gain) and the independent variables, including gender, education status, caregiver occupation, and access to sanitation and hygiene services. The independent t-test was used to test for differences in continuous variables with normal distribution, such as weight-for-height z score and MUAC, at the beginning and end of the program evaluation. Statistical significance was determined at 5%, with p values less than 0.05 indicating statistical significance.

To determine which factors influence the effectiveness of Plumpy sup, variables with p values less than 0.2 when tested against weight-for-height z scores, such as household expenditure, type of water source, handwashing, morbidity in the previous 14 days, breastfeeding, and several

sachets of Plumpy sup, were subjected to multivariate logistic regression analysis. The odds ratio was used to identify predictors of Plumpy sup effectiveness in the study population.

Data from key informant interviews and focus group discussions were recorded, coded, and analyzed by organizing them into themes. The main topic of discussion during the focus group discussion was opinions on enrolling the child for treatment of moderate acute malnutrition, factors influencing the child's uptake of Plumpy sup, access to the health facility, water, sanitation, and hygiene practice at the community level. The themes of the key informant interviews were factors that hampered or facilitated the adoption of policies to address moderate acute malnutrition, household ability to sustain moderate malnutrition management, and strategies put in place to continue moderate acute malnutrition treatment after the supplementary feeding program expired.

Table 3.3: Summary of data analysis

Variable	**Data analysis**
• Demographics and socio-economic characteristics of caregivers (Sex, education, occupation, caregivers' monthly income)	Descriptive statistics, Chi-square, Independent T-test, principal component analysis, Analysis of Variance
• Caregivers' attitude on infant and young child feeding practices	Descriptive statistics, F-Test, Analysis of Variance
• Children nutrient intake	Descriptive statistics, nutri survey analysis tool
• Morbidity status of the children	Descriptive statistics, Analysis of Variance
• Effectiveness of Plumpy sup (recovery rate, default rate)	Descriptive statistics, Chi-square
• Recovery rate of the child from moderate acute malnutrition	Descriptive statistics, Chi-Square, Kaplan Meier survival analysis
• Anthropometric indices (Weight, Height, MUAC)	Descriptive test, T-Test
• Factors influencing effectiveness of Plumpy sup	Multiple logistic regression

3.16 Logistical and Ethical consideration

Kenyatta University Ethics and Research Committee and Kenyatta University Graduate School (See Appendix 10) granted the authority and ethical approval for the study. The researcher sought a research permit from the NACOSTI (See Appendix 11). Approval letters were also obtained from Turkana County Commissioners (See Appendix 12) and the Turkana County Ministry of Health (See Appendix 13). The children in the study ranged in age from 6 to 59 months, and their caregivers agreed to their participation by signing a consent form approved by Kenyatta University's Ethics and Research Committee. The researcher protected the confidentiality of the data by assigning each questionnaire respondent a unique code. The consent forms containing children's information were only accessible to the researcher. Data on the Kobo toolkit was password-protected and only known to the researcher. Before taking part in the study, focus group discussions, and key informant interviews, participants signed a written consent form.

CHAPTER FOUR: RESULTS

4.1 Introduction

The findings of a study assessing the effectiveness of Plumpy sup in the management of moderate acute malnutrition among children aged 6 to 59 months from Turkana central sub-county, Kenya, are presented in this chapter. The findings are based on data gathered on the first day of enrolment, biweekly visits for 90 days, and an end-of-program household questionnaire for children enrolled in the study.

4.2 Distribution of Plumpy sup to 6- 59 months old children being treated for moderate acute malnutrition

Plumpy Sup sachets were distributed by the Ministry of Public Health and Sanitation. This was utilized in treating 827 children who had moderate acute malnutrition, resulting in a coverage rate of 60.1 % based on the total number of children who had moderate acute malnutrition, as shown in Table 4.1 below. Lodwar referral received 63.5 % coverage, Lolupe dispensary 51.6 %, Loturerei dispensary 61.9 %, and Nayanaenga ikalalio 60.6 %.

Table 4.1: Summary of the distribution of Plumpy sup in Turkana central during the study period

Description of variable	Lodwar referral hospital	Lolupe dispensary	Loturerei Dispensary	Nayanaeang ikalalio dispensary	Total
Total number of children suffering from MAM	417	277	373	310	1,377
Number of children in supplementary feeding programme	265	143	231	188	827
Number of Plumpy sup distributed (sachets)	8,214	4,220	5,148	4,498	22,080
Children who received Plumpy sup (%)	63.5	51.6	61.9	60.6	60.1

The nutritional value presented by the manufacturer was used to calculate the Plumpy sup's nutrient analysis (Nutriset, 2020). Each 100-gram sachet of Plumpy contained 537 kcal of energy, 12.1 grams of protein, 11.2 milligrams of iron, and 750 mg of vitamin A. Each child enrolled in the study group was given 14 sachets of Plumpy sup based on their weight for 14 days at the health facility.

4.3 Background information of the study population

4.3.1 Children enrolled for the study

One thousand and sixty-five children (6 to 59 months old) were screened for enrolment at the respective health facilities. The 1,065 children were proportionately assigned to the randomly selected four target health facilities: Lodwar referral hospital (392), Lolupe dispensary (160), Loturerei dispensary (280), and Nayanaeang ikalalio dispensary (233). Eight hundred twenty-seven children met the study inclusion criteria of having a MUAC between 115 millimetres and 125 millimetres and a weight-for-height z score (WHZ) between minus two (-2) and minus three (-3) without oedema. A total of 300 caregivers agreed to take part, and baseline data were collected from them via a household questionnaire. Although 226 children completed the study, 57 were lost to follow-up (Table 4.2). A total of 17 caregivers withdrew their consent for the study, primarily due to differences in incentive and motivation for participation. Some caregivers felt that too much information was being collected from their households and that the time required to collect the data was too long for them due to competing household responsibilities.

Table 4.2: Presentation of recruitment of study participants

Health Facility	**Number enrolled n**	**Lost to follow up n (%)**	**Consent withdrawn n (%)**	**Completed study n (%)**	**Analyzed n (%)**
Lodwar referral hospital	136	25 (18.4)	2 (1.5)	109 (80.1)	106 (77.9)
Lolupe dispensary	53	15 (28.3)	6 (11.3)	32 (60.4)	32 (60.4)
Loturerei dispensary	55	9 (16.4)	1 (1.8)	45 (81.8)	45 (81.8)
Nayanaeanga- ikalalio dispensary	56	8 (14.3)	8 (14.3)	40 (71.4)	40 (71.4)
TOTAL	**300**	**57 (19.0)**	**17 (5.6)**	**226 (75.3)**	**223 (74.3)**

4.3.2 Caregivers and children's socio-demographics and socio-economic status

There were more males (62 %) than females (38 %), with an interquartile range of 19 months and a median age of 18 months, among the total number of children who participated in the study. Almost all caregivers in this study, approximately 99 %, were female. More than three-quarters (83.3 %) did not complete primary school, with only 2.7 % having a college education. Caregivers' median and interquartile ages were 32 and 9 years, respectively (Table 4.4).

Table 4.3: Children and caregiver/mothers' demographic characteristics

Variables	N	% (%)
Children characteristics		
Children sex		
Male	185	61.67
Female	115	38.33
	Median	IQR*
Child age	18	19
Caregivers' characteristics	N	%
Caregivers' sex		
Male	4	1.3
Female	296	98.7
Level of education		
Did not complete primary	250	83.3
Primary education	42	14
College education	8	2.7
	Median	IQR
Caregivers' age	32	9

*IQR = Interquartile range

Fewer caregivers owned livestock at baseline (34 %) than at day 90 (43.9 %), and most of them (40 %) were petty traders at day 90 compared to baseline (38 %). Similarly, at day 90, there were 35 % more daily waged casual labourers as a source of income than at baseline (34 %). More caregivers (5.8 %) were salaried from permanent employment at day 90 than at baseline (5.7 %). Additionally, 5.7 % and 5.8 % of those who owned livestock sold them as a source of income, while 5.3 % and 4.9 % sold their products at baseline and day 90, respectively. At baseline and day 90, the caregivers' average fortnight income was Ksh. 2,142.4 and Ksh. 2004.9, respectively. Average food expenditure increased from Ksh. 1,281.3 at baseline to Ksh. 1,497 at day 90, followed by average clothing expenditure, which increased from Ksh. 344.4 to Ksh. 377.1, with the least expenditure on the water at both baseline and day 90. Only the differences in the number of respondents at baseline and day 90 of those who owned livestock versus those who sold crops were significant statistically, with all p-value < 0.05, indicating that more caregivers owned livestock on day 90 than at baseline. Furthermore, the findings indicated that more caregivers sold crops at the start of the study than at the end.

Finally, no statistically significant differences in caregiver income and expenditure in the previous 14 days were found using an independent T-test, with all p-values > 0.05. The differences observed may be due to other factors not captured in the study (Table 4.5).

Table 4.4: Socioeconomic characteristics of the households with the child enrolled in the study at baseline

Variable	Baseline (n=300)		Day 90 (n=223)			
	n	%	N	%	Chi-sq	*p*-value
Livestock Ownership						
Yes	102	34	98	43.9	5.3581	0.0z21*
No	198	66	125	56.1		
Main source of income						
Sale of livestock						
Yes	17	5.7	13	5.8	0.0063	0.937
No	283	94.3	210	94.2		
Sale of livestock product						
Yes	16	5.3	11	4.9	0.0419	0.838
No	284	94.7	212	95.1		
Sale of crops						
Yes	43	14.3	19	8.5	4.1367	0.042*
No	257	85.7	204	91.5		
Petty trading						
Yes	110	36.7	89	39.9	0.5709	0.45
No	190	63.3	134	60.1		
Daily waged casual labor						
Yes	102	34	78	35	0.0542	0.816
No	198	66	145	65		
Salary from permanent employment						
Yes	17	5.7	13	5.8	0.0019	0.965
No	283	94.3	220	94.2		
	M	SD	M	SD	T-value	*p*-value
Caregiver Income in last 14 days (Ksh)	2,142.40	1760.8	2004.9	1407.1	2159	0.08
Caregiver expenditure in last 14 days (Ksh)						
Food	1281.3	963.8	1497	969.7	-1.3	0.18
Water	12.5	52.9	13.9	53.9	-0.16	0.88
Health	51.4	199.3	58.3	206.1	-0.21	0.84
Rent	55.6	471.4	111.1	661.9	-0.58	0.56
Clothing	344.4	501.4	377.1	516	-0.38	0.7
Savings	62.5	166.7	83.3	237.5	-0.61	0.54

* Significant at 95% CI; M= Mean; SD = Standard Deviation; Ksh= Kenya Shillings

The principal component analysis revealed that most (90.3 %) of the caregivers were poor during the period they were enrolled in the study. Only 0.7 % of caregivers were classified as wealthy. The socioeconomic status of the caregivers is shown in table 4.6.

Table 4.5: Socio-economic status of the caregivers

Wealth index quintile	Baseline N=300 n (%)	Day 90 N=223 n (%)	Fisher exact test	*p* value
Lowest (poorest)	271 (90.3)	188(84.3)		
Second	22 (7.3)	27(12.1)		
Middle	5(1.7)	6(2.7)		
Highest (wealthiest)	2(0.7)	2(0.9)	4.36	0.22

*Significant at 5% level

4.4 Specific objective 1: To determine attitudes of caregivers toward infant and young feeding practices among children aged 6 to 59 months receiving Plumpy sup as a treatment for moderate acute malnutrition in Turkana County, Kenya

A four-point Likert scale measuring caregivers' attitudes toward child and infant feeding practices among 6 to 59 months old children receiving Plumpy sup was converted into scores by multiplying strongly disagree by 1 point, disagree by 2 points, agreed by 3 points and strongly agreed by 4 points. The mean and standard deviation for each item of attitude scores were then calculated, as shown in table 4.7. The caregivers agreed that breastfeeding of a newborn ought to be done within one hour of birth (3.1 ± 0.6), exclusively breastfeeding should be done for a minimum of six months (3.6 ± 0.5), that a child should be breastfed whenever they need to be breastfed (3.2 ± 0.8), and that introduction of other foods should be done at least at the age of 6 months (3.2 ± 0.9).

Table 4.6 Caregivers' attitude on Infant and young child feeding practices

Variables	N=300	N=223		
	Day 1 M(SD)	Day 90 M(SD)	F value	*p*-value
Breastfeeding of a newborn ought to be done within one hour after birth.	3.1(0.6)	2.9(1.7)	2.38	0.01*
Protein deficiency in a child causes Kwashiorkor.	2.1(0.7)	1.9(1.4)	18.23	0.06
A child will suffer from marasmus if they are not eating enough protein, calories, carbohydrates, and other nutrients needed for a child growth.	1.7(0.7)	2.3(1.5)	9.81	0.03*
Micronutrients like Iodine, Vitamin D, Vitamin A, iron, zinc, and folate are important for a child's wellbeing.	1.6(0.5)	1.4(0.9)	2.03	0.01*
Plumpy sup improves the nutritional status of children who have moderate acute malnutrition.	3.0(0.9)	2.6(1.6)	2.93	0.01*
When giving Plumpy sup to the child you are supposed to wash your hands, squeeze the paste out of the sachet and give the whole content to the child being treated for moderate acute malnutrition.	3.2(0.7)	2.9(1.7)	3.58	0.01*
A child should be breastfed whenever he / she feel like breastfeeding.	3.2(0.8)	2.7(1.7)	6.83	0.02*
Colostrum should be the first food for a newborn because it builds the baby's immune system.	3.5(0.6)	2.9(1.7)	7.10	0.02*
A child ought to be exclusively breastfed for a minimum of six months.	3.6(0.5)	2.8(1.7)	12.15	0.04*
A child should be introduced to other food (semi-solids, solids, soft food) at least at the age of six months.	3.2(0.9)	2.9(1.7)	1.35	<0.01*

*Significant at 95% CI, M= Mean, SD= Standard Deviation

Average scores of attitudes on feeding for children among caregivers across the study period had statistically significant differences, with all p-values less than 0.05, except for understanding causes of Kwashiorkor in children, with a p-value of 0.06. The findings indicated that caregivers' attitudes toward the causes of Kwashiorkor in children did not differ (Table 4.7).

4.5 Specific objective 2: To establish the nutrient intakes for children aged 6 to 59 months who are receiving Plumpy sup to treat moderate acute malnutrition in Turkana county, Kenya

4.5.1 Infant and young child feeding practices

At the start of the study, 21.0 % of the children in the study group consumed vitamin A-rich vegetables and fruits, 17.7 % consumed tubers, roots and grains, 14.8 % consumed legumes, nuts, and seeds, and 12.8 % consumed flesh meat. At the end of the program, 25.3 % consumed tubers, roots and grains, 17.9 % consumed eggs, 17.4 % consumed vitamin A-rich vegetables and fruits, and 15.3 % ate flesh meat (Table 4.8).

At the focus group discussion, caregivers shared that wild fruits, meat, kales, and edible herbs were some of the food types they prepare for children. However, during the dry season, gathering wild fruits and reliance on flesh meat is the preferred food. *“During the dry season, we gather wild dried nuts and drink goat blood,” Care giver in Nayaangalia kalialio.*

Table 4.7: Analysis of children dietary diversity within the study period who confirmed receiving the food type in the past 24 hours

	Baseline n=243	Day 14 n=221	Day28 n=183	Day42 n=197	Day56 n=227	Day70 n=202	Day84 n=203	Day90 n=190
Grains, roots, and tubers	43(17.7)	36(16.3)	40(21.9)	38(19.3)	47(20.7)	44(21.8)	49(24.1)	48(25.3)
Vitamin A rich fruits and vegetable	51(21.0)	42(19.0)	37(20.2)	43(21.8)	40(17.6)	38(18.8)	44(21.7)	33(17.4)
legumes, nuts, and seeds	36(14.8)	15(6.8)	12(6.6)	10(5.1)	11(4.8)	8(4.0)	10(4.9)	8(4.2)
Other fruits and vegetables	24(9.9)	23(10.4)	18(9.8)	28(14.2)	32(14.1)	29(14.4)	27(13.3)	20(10.5)
Flesh meat	31(12.8)	41(18.6)	26(14.2)	20(10.2)	24(10.6)	26(12.6)	30(14.8)	29(15.3)
Eggs	37(15.2)	46(20.8)	34(18.6)	43(21.8)	56(24.7)	38(18.8)	22(10.8)	34(17.9)
Dairy products	21(8.6)	18(8.1)	16(8.7)	15(7.6)	17(7.5)	19(9.4)	21(10.3)	18(9.5)

4.5.2 Minimum acceptable diet for the children

The analysis was based on the WHO's recommendation for meal frequency for breast-fed and non-breast-fed children within the previous 24 hours. In a day, breastfed infants aged 6 to 8 months were expected to eat at least twice; 9 to 23 months old, breastfed children were expected to eat three times; and 6 to 23 months old non-breastfed children were expected to eat four times a day. The 6 to 23 months age group was used as a proxy indicator for the 24 to 59 months age group, and data was analyzed based on four or more consumptions for either breastfed or non-breastfed children. Yes (6 to 23) for the minimum acceptable diet was calculated based on the consumption of at least 4 of the seven recommended food groups (WHO ,2008), and Yes (24 to 59) for the MDD was calculated depending on the consumption of five of the nine recommended

food groups (WHO,2008; FAO, 2011). At the start of the study, 53.7 % of the children in the study group were breastfeeding, but by the end of the program, this had dropped to 35 %. A further 2.2 % of non-breastfed children had fewer than two meals per day at baseline, and this remained nearly unchanged at 2.1 % by the end of the program. Children aged 9 to 23 months had the highest proportion, 31.7 %, of children eating more than three times a day at the program's start, but this decreased to 17.2 % by the end of the program. Up to 10.8 % of children aged 24 to 36 months had more than four meals per day at the program's start, rising to 15.2 % by the end. The same trend was observed for children aged 37 to 59 months, where 5.8 % had more than five meals per day at the program's start and increased to 9.0 % by the end. At the start of the program, 9.3 % of the 6 to 8 months old, breastfed children had more than two meals per day; by the end, this had dropped to 6.4 % (Table 4.9 and Table 4.10).

Table 4.8: Infant and young child feeding practices for non-breastfed children

	Baseline (n=300) n (%)	Day 14 (n=286) n (%)	Day 28 (n=275) n (%)	Day 42 (n=267) n (%)	Day 56 (n=252) n (%)	Day 70 (n=243) n (%)	Day 84 (n=235) n (%)	Day 90 (n=223) n (%)
Breastfeeding								
Yes	161(53.7)	114(39.9)	111(40.4)	107(40.1)	97(38.5)	97(39.9)	84(35.7)	78(35.0)
No	139(46.3)	172(60.1)	164(59.6)	160(59.9)	155(61.5)	146(60.1)	151(64.3)	145(65.0)
Meal frequency								
Not breastfeeding								
6 to 8 months								
< 2 times a day	3(2.2)	4(2.3)	4 (2.4)	4 (2.5)	3 (1.9)	3(2.1)	3 (2.0)	3 (2.1)
≥ 2 times a day	1(0.7)	2(1.2)	2(1.2)	1(0.6)	1(0.6)	2(1.4)	2(1.3)	2(1.4)
9 to 23 months								
< 3 times a day	27 (19.4)	47(27.3)	43(26.2)	42(26.3)	39(25.2)	38(26.0)	39(25.8)	33(22.8)
≥ 3 times a day	44(31.7)	36(20.9)	26(15.9)	30(18.8)	25(16.1)	34(23.3)	27(17.9)	25(17.2)
24 to 36 months								
<4 times a day	26(18.7)	38(22.1)	34(20.7)	36(22.5)	34(21.9)	32(21.9)	31(20.5)	30(20.7)
≥ 4 times a day	15(10.8)	5(2.9)	20(12.2)	17(10.6)	24(15.5)	13(8.9)	19(12.6)	22(15.2)
37 to 59 months								
<5 times a day	15(10.8)	22(12.8)	21(12.8)	20(12.5)	19(12.3)	19(13.0)	18(11.9)	17(11.7)
≥ 5 times a day	8(5.8)	18(10.5)	14(8.5)	10(6.3)	10(6.5)	5(3.4)	12(7.9)	13(9.0)

Table 4.9: Infant and young child feeding practices for breastfed children

	Baseline (n=300) n (%)	Day 14 (n=286) n (%)	Day 28 (n=275) n (%)	Day 42 (n=267) n (%)	Day 56 (n=252) n (%)	Day 70 (n=243) n (%)	Day 84 (n=235) n (%)	Day 90 (n=223) n (%)
Breastfeeding								
6 to 8 months								
<2 times a day	10(6.2)	10(8.8)	9(8.1)	9(8.4)	8(8.2)	8(8.2)	8(9.5)	7(9.0)
≥ 2 times a day	15(9.3)	7(6.1)	6(5.4)	7(6.5)	5(5.2)	5(5.2)	5(6.0)	5(6.4)
9 to 23 months								
<3 times a day	41(25.5)	33(28.9)	41(36.9)	40(37.4)	38(39.2)	36(37.1)	32(38.1)	28(35.9)
≥ 3 times a day	39(24.2)	26(22.8)	35(31.5)	29(27.1)	29(29.9)	31(32.0)	27(32.1)	26(33.3)
24 to 36 months								
<4 times a day	18(11.2)	10(8.8)	9(8.1)	9(8.4)	8(8.2)	8(8.2)	8 (9.5)	7 (9.0)
≥ 4 times a day	10(6.2)	13(11.4)	5(4.5)	7(6.5)	4(4.1)	6(6.2)	0 (0.0)	0(0.0)
37 to 59 months								
<5 times a day	16(9.9)	13(11.4)	4(3.6)	4(3.7)	3(3.1)	2(2.1)	2(2.4)	1(1.3)
≥ 5 times a day	12(7.5)	2(1.8)	2(1.8)	2(1.9)	2(2.1)	1(1.0)	2(2.4)	4(5.1)
Minimum acceptable diet (Yes)								
6 to 8 months	6 (2.0)	7 (2.4)	8(2.9)	8(3.0)	7(2.8)	7(2.9)	7(3.0)	7(3.1)
9 to 23 months	79 (26.3)	73(25.5)	61(22.2)	49(18.4)	77(30.6)	65(26.7)	66(28.1)	59(26.5)
24 to 36 months	25(8.3)	18(6.3)	25(9.1)	23(8.6)	28(11.1)	26(10.7)	19(8.1)	22(9.9)
37 to 59 months	14(4.7)	31(10.8)	28(10.2)	14(5.2)	13(5.2)	6(2.5)	14(6.0)	17(7.6)

4.5.3 Nutrient intakes for the non-breastfed children

The data on nutrient intake for the different age groups were collected using the 24-hour dietary recall provided by the primary caregivers. For non-breastfeeding children aged 6 to 11 months, the energy intake increased from 466.1±99.8kcal per day to 556.1±56.9kcal per day at the end of the programme. At the end of the programme, protein intake increased from 18.1±6.1g per day at baseline to 23.3±3.9g per day. A similar trend was observed for fat, 12.6±8.0 to 13.3±2.6mg per day, Vitamin A, 366.2±187.5μg per day to 455.6±173.7μg per day and iron 2.91±0.7mg per day to 3.3±0.8 mg per day.

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Table 4.10: Nutrient intake for non-breastfed children aged 6 to 11 months

Age group 6 to 11 months	Energy (mean±SD) kcal/day	Protein (mean±SD) g/day	Carbohydrates (mean±SD) g/day	Fat (mean±SD) mg/day	Vitamin A (Mean±SD) µg/day	Iron (mean±SD) mg/day
Recommended daily allowance/1,000 kcal	675-806	11-14	130 - 135	30 - 31	1280	11 - 14
Baseline (N=300) n=22	566.1±99.8	8.1±6.1	68.8±3.3	12.6±8.0	366.2±187.5	8.91±0.7
Day 14 (n=286) n=21	501.9±60.5	8.4±5.6	74.1±2.0	17.7±5.6	374.5±80.3	9.2±0.3
Day 28 (N=275) n=21	504.7+81.6	9.5±6.6	73.5±3.8	14.6±6.2	307.3±41.8	8.7±0.6
Day 42 (N=267) n=19	567±76.9	9.9±5.9	82.5±7.2	16.4±4.6	331±218.1	9.6±1.2
Day 56 (N=252) n=17	558.5±74.0	8.6±4.2	79.2±5.3	16.5±4.3	334.3±88.3	10.7±0.5
Day 70 (N=243) n=15	565.6±83.0	8.2±4.5	83.7±4.6	16.6±5.4	373.3±99.8	8.8±0.6
Day 84 (N=235) n=15	540.8±65.1	10.4±3.0	74.1±2.0	17.6±5.5	374.5±80.3	9.2±0.3
Day 90 (N=223) n=15	556.1±56.9	11.3±3.9	74.3±5.7	13.3±2.6	455.6±173.7	9.3±0.8

For children aged 12 to 17 months, a gradual increase in the energy intake from 508.8±30.1kcal per day at baseline to 543.2±74 kcal per day was observed. However, there was a decrease in energy consumption on day 28, 478.1±25.6kcal per day, on day 42, 486.6±18.9kcal per day, and day 70, 479.5±28.3kcal per day. Protein intake doubled from 13.7±0.98g per day at baseline to 25.9±7.1g per day at the end of the programme (Table 4.12).

Table 4.11: Nutrient intake for non-breastfed children aged 12 to 17 months

Age group 12 to 17 months	Energy (mean±SD) kcal/day	Protein (mean±SD) g/day	Carbohydrates (mean±SD) g/day	Fat (mean±SD) mg/day	Vitamin A (Mean±SD) µg/day	Iron (mean±SD) mg/day
Recommended daily allowance/1,000 kcal	844 – 894	38 – 50	105 - 112	33 - 50	1820	12 - 40
Baseline (N=300) n=32)	508.8±30.1	13.7±0.98	67.5±5.6	20.1±2.8	496.4±67.8	12.1±0.2
Day 14 (N=286) n=31	521.2±28.9	14.7±1.1	66.14±5.8	21.7±0.6	458.4±79.1	12.5±0.5
Day 28 (N=275) n=30	478.1±25.6	13.72±2.2	67.7±1.6	26.5±1.2	504.5±34.3	12.8±0.1
Day 42 (N=267) n=28	486.6±18.9	12.2±4.2	61.7±4.3	18.2±2.1	480.9±32.2	12.9±0.3
Day 56 (N=252) n=27	508.3±27.4	13.5±0.8	61.46±2.3	21.12±2.1	488.8±42.4	13.3±0.2
Day 70 (N=243) n=24	479.5±28.3	12.3±2.5	63.7±3.9	19.5±2.7	562.4±15.9	13.7±0.8
Day 84 (N=235) n=24	491.5±34.2	11.5±2.2	68.6±2.4	24±1.8	503.4±87.9	13.4±0.4
Day 90 (N=223) n=24	543.2±74	15.9±7.1	71.9±4.9	20.2±3.3	565.8±86.0	13.8±0.5

There is a rise in energy and carbohydrate consumption by non-breastfed children aged 18 to 23 months. At the baseline, energy intake was observed to be 705.9±53.1kcal per day, which increased to 723.4±32.8kcal per day at the end of the programme. At the end of the programme, the intake of carbohydrates increased from 87.2±6.5g per day at baseline to 95.5±3.7g per day. The intake of protein decreased from 33.4±6.1g per day to 25.5±3.1g per day, while the intake of vitamin A decreased from 686.8±42.2μg per day to 658.2±27.6μg per day at the end of the programme as captured in table 4.13.

Table 4.12: Nutrient intake for non-breastfed children aged 18 to 23 months

Age group18 to 23 months	Energy (mean±SD) kcal/day	Protein (mean±SD) g/day	Carbohydrates (mean±SD) g/day	Fat (mean±SD) mg/day	Vitamin A (Mean±SD) μg/day	Iron (mean±SD) mg/day
Recommended daily allowance/1,000 kcal	844 – 894	38 – 50	105 - 112	33 - 50	1820	12 - 40
Baseline (N=300) n=47	705.9±53.1	23.4±6.1	87.2±6.5	24.0±1.6	686.8±42.2	24.6±0.4
Day 14 (N=286) n=45)	695.2±6.5	27.3±1.9	86.16±3.6	26.2±1.8	531.5±117	24.3±0.8
Day 28 (N=275) n=45	685.0±83.0	25.2±4.8	94.3±10.7	23.9±7.2	583.8±80.9	23.8±0.5
Day 42 (N=267) n=45	727.8±33.2	28.2±1.1	93.9±5.4	25.9±1.0	530.9±63.1	24.2±0.3
Day 56 (N=252) n=43	749.7±31.4	28.6±2.7	97.3±1.6	26.6±1.7	636.4±83.9	24.8±0.3
Day 70 (N=243) n=43	773.4±24.6	29.5±2.1	97.28±2.4	28.4±1.6	658.8±82.1	24.9±0.4
Day 84 (N=235) n=41	692.9±76.1	25.2±3.4	94.9±6.6	27.4±4.4	680.3±79.5	25.2±1.1
Day 90 (N=223) n=38	723.4±32.8	25.5±3.2	95.5±3.7	25.7±2.9	658.2±27.6	24.6±0.4

For children aged 24 – 36 months who were not breastfed, it was observed that energy intake increased from 730.5±23.3kcal per day at baseline to 830.7±55.5 kcal per day at the end of the programme. The opposite trend was observed for protein intake, which decreased from 25.0±1.6g per day at baseline to 38.5±4.16g per day. At the end of the programme, the intake of carbohydrates remained constant at 98.9±2.7g per day at baseline and 97.4±6.3g per day. Vitamin A intake increment increased from 787.7±96.7μg per day at baseline to 1277.1±19.8μg per day at the end of the programme (Table 4.14).

Table 4.13: Nutrient intake for non-breastfed children aged 24 to 36 months

Age group 24 to 36 months	Energy (mean±SD) kcal/day	Protein (mean±SD) g/day	Carbohydrates (mean±SD) g/day	Fat (mean±SD) mg/day	Vitamin A (Mean±SD) μg/day	Iron (mean±SD) mg/day
Recommended daily allowance/1,000 kcal	1242	38 – 50	105 - 112	33 - 50	2360	12 - 40
Baseline (N=300) n= (55)	730.5±23.3	29.0±1.6	98.9±2.7	25.2±2.2	687.7±96.7	25.1±0.4
Day 14 (N=286) n =53	663.6±76.9	27.1±1.9	89.2±7.2	22.1±4.6	743±99.9	24.7±0.6
Day 28 (N=275) n =51	555.1±21.7	28.4±1.5	77.9±4.2	17.3±1.2	617.1±71.3	23.9±0.3
Day 42 (N=267) n =51	650.5±78.5	28.9±2.8	87.6±11.1	22.5±2.9	642.7±109.8	24.22±0.5
Day 56 (N=252) n =48	748.1±147.8	29.5±13.4	93.9±8.5	27.0±7.7	753.7±67.2	25.3±1.3
Day 70 (N=243) n =44	726.6±179.1	21.5±14.8	96.9±3.2	26.62±9.1	806.4±90.5	26.1±1.7
Day 84 (N=235) n =42	819.6±133	29.6±10.4	97.2±4.9	31.6±5.5	927.1±58.6	27.4±1.6
Day 90 (N=223) n =42	830.7±55.5	28.5±4.1	97.4±6.3	30.9±2.1	977.1±19.8	28.2±0.5

For non-breastfed children aged 37-59 months, the energy intake increased from 671.1±90.1kcal per day at baseline to 782.4±78.1kcal per day at the end of the programme. Intake of protein was observed to be 24.9±5.5g per day at baseline and 26.9±3.2g per day at the end of the programme. Carbohydrate consumption decreased from 88.2±13.3g per day to 81.7±6.7g per day at the end of the programme. Vitamin A intake increased from 529.3±145.8µg per day to 563.1±86.1µg per day, while iron intake increased from 3.9±0.1mg per day to 4.2±0.5mg per day (Table 4.15)

Table 4.14: Nutrient intake for non-breastfed children aged 37 to 59 months

Age group 37 to 59 months	Energy (mean±SD) kcal/day	Protein (mean±SD) g/day	Carbohydrates (mean±SD) g/day	Fat (mean±SD) mg/day	Vitamin A (Mean±SD) µg/day	Iron (mean±SD) mg/day
Recommended daily allowance/1,000 kcal	1242	38 - 50	105 - 112	33 – 50	2360	12 - 40
Baseline (N=300) n=31	671.1±90.1	20.9±5.5	88.2±13.3	23.7±3.7	529.3±145.8	33.9±0.1
Day 14 (N=286) n =30	746.2±91.8	21.2±2.5	100.1±16.8	24.6±0.5	736.8±87.1	34.8±0.5
Day 28 (N=275) n =29	795.4±48.2	29.1±1.6	103.0±11.5	27.9±2.9	745.4±78.1	24.9±0.3
Day 42 (N=267) n =29	774.2±24.7	20.5±1.2	94.3±7.7	29.8±3.9	695.7±77.1	28.8±0.2
Day 56 (N=252) n =29	721.4±80.6	21.5±3.6	104.9±16.1	30.1±2.7	556.5±87.6	34.3±0.5
Day 70 (N=243) n =29	750.9±93.5	28.2±3.8	103.5±14.8	32.3±3.4	641.9±220.1	29.9±1.2
Day 84 (N=235) n =29	702.6±78.6	27.1±4.2	106.6±5.9	26.8±4.9	534.9±73.9	24.1±0.5
Day 90 (N=223) n =27	782.4±78.1	29.9±3.5	101.7±6.7	26.9±4.6	563.1±86.1	34.2±0.5

4.5.4 Nutrient intakes for the breastfed children

Energy intake for children aged 6 to 11 months decreased from 517.5±33.8kcal per day to 418.6±42.8kcal per day at the end of the programme. A similar trend was observed for protein intake, which decreased from 27.3±2.4per day to 23.2±2.2g per day. Carbohydrate intake decreased from 36.9±2.6g per day to 30.1±3.1g per day. Vitamin A intake increased from 434.2±275.9µg per day to 1021.2±119.5 µg per day. A similar trend was observed for iron intake, which increased from 2.1±1.6mg per day to 3.1±0.5mg per day (Table 4.16).

Table 4.15: Nutrient intake for breastfed children aged 6 to 11 months

Age group 6 to 11 months	Energy (mean±SD) kcal/day	Protein (mean±SD) g/day	Carbohydrates (mean±SD) g/day	Fat (mean±SD) mg/day	Vitamin A (mean±SD) µg/day	Iron (mean±SD) mg/day
Recommended daily allowance/1,000 kcal	645-817	9 -11	81 -102	30 -31	1280	11 – 14
Baseline (N=300) n= 40	517.5±33.8	10.3±2.4	36.9±2.6	27.1±2.1	334.2±275.9	5.1±1.6
Day 14 (N= 286) n =40	439.4±63.4	11.7±3.6	31.8±4.4	23.4±3.2	394.4±191.6	4.7±0.9
Day 28 (N=275) n =36	421.1±47.8	10.1±2.5	30.4±3.4	22.3±2.6	391.3±149.2	6.1±0.8
Day 42 (N=267) n =34	463.8±57.1	10.2±2.8	36.5±130.2	19.2±3.2	365.1±130.2	6.4±0.6
Day 56 (N=252) n =32	419.1±46.1	10.0±2.6	30.22±3.2	22.2±2.4	307.6±229.4	6.8±0.8
Day 70 (N=243) n =32	432.7±51.9	9.8±2.9	31.2±3.7	22.9±2.7	346.4±202.2	6.6±0.8
Day 84 (N=235) n =32	486.6±39.2	9.6±1.9	27.7±2.9	20.4±2.2	408.3±300.7	4.9±1.3
Day 90 (N=223) n =29	418.6±42.8	8.2±2.2	30.1±3.1	22.1±2.3	321.2±119.5	5.1±0.5

Energy intake for children aged 12 to 17 months increased from 539.2±37.4kcal per day at baseline to 560.3±97.5kcal per day at the end of the programme. Protein intake decreased from 23.9±2.4g per day to 21.4±6.8g per day. Carbohydrate intake increased from 63.48±4.8g per day to 77.4±6.8g per day, while Vitamin A intake decreased from 844.1±232µg per day to 537.3±68.7 µg per day. Iron intake decreased from 3.6±0.9mg per day to 3.2±0.5mg per day (Table 4.17).

Table 4.16: Nutrient intake for breastfed children aged 12 to 17 months

Age group 12 to 17 months	Energy (mean±SD) kcal/day	Protein (mean±SD) g/day	Carbohydrates (mean±SD) g/day	Fat (mean±SD) mg/day	Vitamin A (mean±SD) µg/day	Iron (mean±SD) mg/day
Recommended daily allowance/1,000 kcal	844 - 894	38 – 50	105 - 112	33-50	1820	11 - 14
Baseline (N=300) n=23)	539.2±37.4	18.9±2.4	63.48±4.8	20.26±2.4	544.1±232	8.6±0.9
Day 14 (N=286) n =20	513.7±73.8	18.8±3.2	75.6±10.3	18.4±3.1	557.6±43.5	12.6±0.2
Day 28 (N=275) n =20)	537.4±72.3	19.0±3.1	79.3±8.8	17.1±3.3	608.3±132.7	13.4±0.5
Day 42 (N=267) n =20	513.1±58.5	17.2±1.7	77.1±8.1	18.5±2.8	534.1±114.8	12.9±0.3
Day 56 (N=252) n=18	468.3±32.1	15.3±0.9	74.2±6.2	21.7±2.4	523.7±119.8	13.4±0.6
Day 70 (N=243) n =18	551.3±84.6	18.6±3.5	79.2±7.5	19.2±5.1	535.7±65.7	13.2±0.5
Day 84 (N=235) n =16	538.5±71.1	19.6±4.9	74.9±2.3	22.3±5.1	526.8±56.4	11.1±0.4
Day 90 (N=223) n =14	560.3±97.5	11.4±6.8	77.4±6.8	20.7±5.5	537.3±68.7	12.2±0.5

At the end of the programme, energy intake and breastfeeding for 18 to 23 months old children increased from 501.6±33.8kcal per day at baseline to 672.4±43.9kcal per day. Protein intake increased from 18.2±1.2g per day to 29.9±2.1g per day, while carbohydrates intake increased from 75.74±4.8g per day to 91.4±3.3g per day. Fat intake increased from 13.3±1.6mg per day to 31.4±5.4mg per day. On the other hand, vitamin A intake increased from 575.9±9.6μg per day to 699.3±102.9 μg per day (Table 4.18).

Table 4.17: Nutrient intake for breastfed children aged 18 to 23 months

Age group 18 to 23 months	Energy (mean±SD) kcal/day	Protein (mean±SD) g/day	Carbohydrates (mean±SD) g/day	Fat (mean±SD) mg/day	Vitamin A (mean±SD) μg/day	Iron (mean±SD) mg/day
Recommended daily allowance/1,000 kcal	844 - 894	38 – 50	105 – 112	33 – 50	1820	12 - 40
Baseline (N=300) n=27	501.6±33.8	28.2±1.2	75.74±4.8	23.3±1.6	575.9±9.6	23.14±0.1
Day 14 (N=286) n =25	545.9±64.2	29.9±2.4	78.9±6.2	26.1±3.7	587.9±16.4	21.3±0.2
Day 28 (N=275) n =25	559.1±58.8	20.4±2.5	77.1±1.2	28.2±4.9	535.5±424.5	25.1±0.2
Day 42 (N=267) n =24	626.1±15.5	28.4±5.2	83.1±8.4	21.7±6.9	593.9±110.5	28.5±0.8
Day 56 (N=252) n =23	657.3±24.2	21.8±5.5	86.1±8.8	23.2±7.5	646.9±119.6	26.9±0.9
Day 70 (N=243) n =23	753.6±9.3	28.9±0.3	92.8±0.6	28.98±0.6	641.5±71.8	22.9±0.3
Day 84 (N=235) n =22	753.6±9.3	20.9±1.6	92.8±0.6	28.9±0.6	641.5±71.8	24.5±0.3
Day 90 (n=223) n =20	672.4±43.9	29.9±2.1	91.4±3.3	31.4±5.4	699.3±102.9	26.7±0.3

Breastfeeding children aged 24 to 36 months, energy intake increased from 552.6±16.6kcal per day at baseline to 570.9±29.8kcal per day at the end of the programme. Protein intake increased from 21.2±0.6g per day to 22.3±1.1g per day. Carbohydrates intake increased from 81.2±2.8g per day to 82.4±4.9g per day, while fat intake increased from 15.2±0.8mg per day to 16.2±0.6mg per day (Table 4.19).

Table 4.18: Nutrient intake for breastfed children aged 24 to 36 months

Age group 24 to 36 months	Energy (mean±SD) kcal/day	Protein (mean±SD) g/day	Carbohydrates (mean±SD) g/day	Fat (mean±SD) mg/day	Vitamin A (mean±SD) μg/day	Iron (mean±SD) mg/day
Recommended daily allowance/1,000 kcal	1242	38 - 50	105 – 112	33 – 50	2360	12 – 40
Baseline (N=300) n=15)	552.6±16.6	21.2±0.6	81.2±2.8	25.2±0.8	565.9±8.3	23.3±0.1
Day 14 (N=286) n =13	545.6±26.4	20.9±0.9	79.6±4.7	21.3±0.6	550.9±24.2	30.2±0.2
Day 28 (N=275) n =12	538.7±25.7	21.1±0.7	77.8±4.7	15.3±0.6	544.9±44.1	28.3±0.2
Day 42 (N=267) n =11	526.2±20.8	20.8±0.5	75.5±4.4	19.1±0.5	551.9±49.4	27.9±1.3
Day 56 (n=252) n =10	562.2±20.9	21.9±0.9	81.54±3.2	22.8±0.7	598.9±15.3	25.3±0.2
Day 70 (N=243) n =10	462.1±20.9	21.88±0.8	81.5±3.2	18.8±0.7	598.9±21.9	29.8±0.7
Day 84 (N=235) n =9	582.8±33.3	22.7±1.2	83.1±4.6	22.3±0.6	621.5±52.4	34.8±2.5
Day 90 (N=223) n =9	570.9±29.8	22.3±1.1	82.4±4.9	26.2±0.6	589.5±78.7	31.7±1.8

For children aged 37 to 59 months, energy intake increased from 583.1±22.1kcal per day to 778.2±22.2kcal per day at baseline compared to the end of the programme. Protein intake increased from 22.5±0.6g per day to 32.2±1.1g per day, while carbohydrates intake increased from 84.5±3.8g per day to 103.9±1.9 g per day. A similar trend was observed for fat intake, which increased from 16.6±0.6mg per day to 25.3±1.3mg per day (Table 4.20).

Table 4.19: Nutrient intake for breastfed children aged 6 to 11 months

Age group 37 to 59 months	Energy (mean±SD) kcal/day	Protein (mean±SD) g/day	Carbohydrates (mean±SD) g/day	Fat (mean±SD) mg/day	Vitamin A (mean±SD) μg/day	Iron (mean±SD) mg/day
Recommended daily allowance/1,000 kcal	1242	38 - 50	105 - 112	33 - 50	2360	12 - 40
Baseline (N=300) n= (8)	583.1±22.1	22.5±0.6	94.5±3.8	26.6±0.6	561.7±63.6	23.9±1.1
Day 14 (N=286) n =8	606.8±27.8	21.1±1.1	97.3±3.8	27.3±1.2	547.9±17.6	24.0±1.3
Day 28 (N=275) n =6	634.8±18.2	22.3±2.3	99.9±2.5	28.2±1.6	565.5±16.9	26.6±0.1
Day 42 (n=267) n =6	663.9±32.6	23.9±2.1	94.8±5.4	29.3±1.8	583.1±25.9	23.5±0.2
Day 56 (n=252) n =5	663.9±32.6	20.9±2.1	93.6±5.5	31.1±1.5	583.1±25.9	27.8±0.2
Day 70 (n=243) n =5	759.5±11.2	21.3±0.6	102.5±2.1	34.2±0.6	680.1±33.1	29.5±0.2
Day 84 (n=235) n=5	767.9±15.3	21.6±0.7	109.9±2.2	34.4±0.6	687.8±33.5	28.8±0.6
Day 90 (N=223) n=5	778.2±22.2	22.2±1.1	103.9±1.9	35.3±1.3	716.8±54.9	30.4±0.3

4.6 Specific objective 3: To determine the morbidity status of children aged 6 to 59 months in Turkana county, Kenya, who are receiving Plumpy sup to treat moderate acute malnutrition

In general, there was a high prevalence of sickness (76.3 % at baseline) among children, which varied across days, and the most common disease that affected the majority of 6 to 59 months old children during the study period was malaria (39.3 % at baseline), followed by watery diarrhoea (21.7 % at baseline), with eye infection being the least prevalent (7.7 % at baseline). Table 4.21 summarizes the morbidity status of 6 to 59 months old children receiving Plumpy sup as a treatment for moderate acute malnutrition.

Caregivers shared their concerns about access to health care facilities during the focus group discussion. “Because the health facility is far away, we would treat the fever with herbs. “I only go to the health centre when the child is in critical condition,” says a caregiver at Loturerei dispensary.

Table 4.20: Morbidity status of 6 to 59 months old children receiving Plumpy sup as treatment for moderate acute malnutrition in Turkana central sub-county, Kenya

	Day							
	1	14	28	42	56	70	84	90
Variable	n=300 n (%)	n=286 n (%)	n=275 n (%)	n=267 n (%)	n=252 n (%)	n=243 n (%)	n=235 n (%)	n=223 n (%)
Sickness								
Yes	229(76.3)	214(74.8)	181(65.8)	172(64.4)	154(61.1)	205(84.4)	177(75.3)	170(76.2)
No	71(23.7)	72(25.2)	94(34.2)	95(35.6)	98(38.9)	38(15.6)	58(24.7)	53(23.8)
Malaria								
Yes	118(39.3)	83(29.0)	51(18.5)	29(10.7)	46(18.3)	87(35.8)	83(3.5)	62(27.8)
No	182(60.7)	203(71)	224(81.5)	238(89.3)	206(81.7)	156(64.2)	152(96.5)	161(72.2)
Watery diarrhea								
Yes	65(21.7)	50(17.5	47(17.1)	26(9.7)	37(14.7)	58(23.9)	43(18.3)	46(20.6)
No	235(78.3)	236(82.5)	228(82.9)	241(90.3)	215(85.3)	185(76.1)	192(81.7)	177(79.4)
Bloody diarrhea								
Yes	46(15.3)	74(25.9)	15(5.5)	19(7.1)	24(9.5)	19(7.8)	9(3.8)	11(4.7)
No	254(84.7)	212(74.1)	260(94.5)	248(92.9)	228(90.5)	224(92.2)	226(96.2)	212(95.3)
ARI cough								
Yes	65 (21.7)	35(12.2)	91(33.1)	58(21.7)	39(15.5)	52(21.4)	23(9.8)	38(16.2)
No	235(78.3)	251(87.8)	184(66.9)	209(78.3)	213(84.5)	191(78.6)	212(90.2)	185(83.8)
Eye infection								
Yes	23(7.7)	9(3.1)	19(6.9)	5(1.9)	7(2.8)	13(5.3)	10(4.3)	15(6.7)
No	277(92.3)	277(96.9)	256(93.1)	262(98.1)	245(97.2)	230(94.7)	225(95.7)	208(93.3)
Other infection								
Yes	22(7.3)	17(5.9)	8(2.9)	3(1.1)	11(4.4)	17(7.0)	14(6.0)	16(7.2)
No	278(92.7)	269(94.1)	259(97.1)	264(98.9)	241(95.6)	226(93)	221(94)	207(92.8)

As assessed by chi-square, the differences observed in the number of children affected by various diseases during the study's bi-weekly record were statistically significantly different, with all *p*-values<0.05 (Table 4.22).

Table 4.21: Comparison of baseline data and of programme data on morbidity

Variable	Day 1 n=300 n (%)	Day 90 n=223 n (%)	Fishers/χ2 value	*p*-value
Sickness				
Yes	229(76.3)	170(76.2)	53.4328	<0.01*
No	71(23.7)	53(23.8)		
Malaria				
Yes	118(39.3)	62(27.8)	96.9503	<0.01*
No	182(60.7)	161(72.2)		
Watery diarrhea				
Yes	65(21.7)	46(20.6)	24.001	0.001*
No	235(78.3)	177(79.4)		
Bloody diarrhea				
Yes	46(15.3)	11(4.7)	111.356	<0.01*
No	254(84.7)	212(95.3)		
ARI cough				
Yes	65 (21.7)	38(16.2)	62.3356	<0.01*
No	235(78.3)	185(83.8)		
Eye infection				
Yes	23(7.7)	15(6.7)	18.956	0.008
No	277(92.3)	208(93.3)		
Other infection				
Yes	22(7.3)	16(7.2)	18.6717	0.009
No	278(92.7)	207(92.8)		

*Significant at 5% level

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Based on the results, most caregivers treated their water before drinking at baseline, most caregivers boiled water before drinking at baseline, most caregivers filtered water before drinking at day 42, the majority of caregivers treated water with aqua tabs or other chemicals on the 14th day, and the majority of caregivers treated water with traditional herbs on the 56th day, more than any other day during the study period. Table 4.23 summarizes the frequency and percentages of caregivers who had access to sanitation, water and hygiene services

Table 4.22: Caregiver's access to sanitation, water, and hygiene services

Variables	Day 1 n (%)	Day 14 n (%)	Day 28 n (%)	Day 42 n (%)	Day 56 n (%)	Day 70 n (%)	Day 84 n (%)	Day 90 n (%)
Water is treated before drinking								
Yes	178(59.3)	172(60.1)	141(51.3)	150(56.2)	156(61.9)	129(53.1)	128(54.5)	119(53.4)
No	122(40.7)	114(39.9)	134(48.7)	117(43.8)	96(38.1)	114(46.9)	107(45.5)	104(46.6)
Drinking water is boiled before drinking	86(47.8)	64(36.6)	35(24.6)	69(40.6)	65(35.1)	44(29.3)	47(35.3)	45 (31.9)
Water is filtered before drinking	27(22.8)	41(23.4)	37(26.1)	56(32.9)	51(27.6)	39(26.0)	25(18.8)	37(26.2)
Water is treated using aqua tabs/other chemicals	26(15.0)	45(25.7)	31(21.8)	18(10.6)	15(8.1)	21(14.0)	20(15.0)	29(20.6)
Water is treated using traditional herbs	41(14.4)	25(14.3)	39(27.5)	27(15.9)	54(29.2)	46(30.7)	41(30.8)	30(21.3)
Response on hygiene practices								
Hands are washed before eating	71(23.7)	66(23.1)	51(18.5)	63(23.6)	72(28.6)	65(26.7)	57(24.3)	63(28.3)
Hands are washed after using toilet	84(28.0)	100(35.0)	106(38.5)	110(41.2)	118(46.8)	85(35.0)	74(31.5)	56(25.1)
Hands are washed after changing the child soiled nappies	46(15.3)	32(11.2)	29(10.5)	41(15.4)	19(7.5)	43(17.7)	49(20.9)	52(23.3)
Hands are washed before cooking foods	23(7.7)	21(7.3)	35(12.7)	26(9.7)	18(7.1)	23(9.5)	29(12.3)	36(16.1)

Participants in a focused group expressed concerns about the distance between community water facilities and the safety of the water distributed by pushcart vendors. *"There are boreholes built by non-governmental organizations, but most do not have water during the dry season. We are forced to use water from vendors who do not provide information about the water source,* " stated a caregiver at Lodwar Referral Hospital.

According to the chi-square test of independence, all the differences observed in the proportion of caregivers who had access to various services from baseline to day 90 were statistically significant, except for water treatment using traditional herbs (p-value < 0.05) (Table 4.24).

Table 4.23: Comparison of WASH data collected at baseline and the end of the programme

Variables	Day 1 n=300 n (%)	Day 90 n=223 n (%)	$\chi 2$ value	*p* value
Drinking water is treated before drinking	178(59.3)	119(53.4)	203.7	<0.01*
Water is boiled before drinking	86(47.8)	45 (31.9)	5.75	0.02*
Water is filtered before drinking	27(22.8)	37(26.2)	3.65	0.05*
Aqua tabs/other chemicals are used to treat water before drinking	26(15.0)	29(20.6)	4.32	0.03*
Traditional herbs are used to treat water before drinking	41(14.4)	30(21.3)	0.42	0.52
After using the toilet, caregivers wash their hands	84(28.0)	56(25.1)	0.02	0.88
Caregivers wash their hands before cooking food	23(7.7)	36(16.1)	235	0.05*
Caregivers wash their hands before feeding the child	71(23.7)	63(28.3)	0.01	0.91
Caregivers wash their hands after changing the diapers of the child	46 (15.3)	52(23.3)	3.01	0.08

*Significant at 5% level.

4.7 Specific objective 4: To determine the effectiveness of using Plumpy sup among children aged 6 to 59 months to treat moderate acute malnutrition in Turkana county, Kenya

The Kaplan Meier survival curves for the length of time to recovery for children treated with Plumpy sup are plotted in Figure 4 below. The differences in recovery rate observed between children's genders (boys and girls) were not statistically significant, with a Chi-square value of 0.109 and a log-rank p-value of 0.1. According to the curve, 66.3 % of children recovered from mild acute malnutrition. Females recovered in an average of 84 days, while males recovered in an average of 70 days. The average recovery time for both men and women was 84 days.

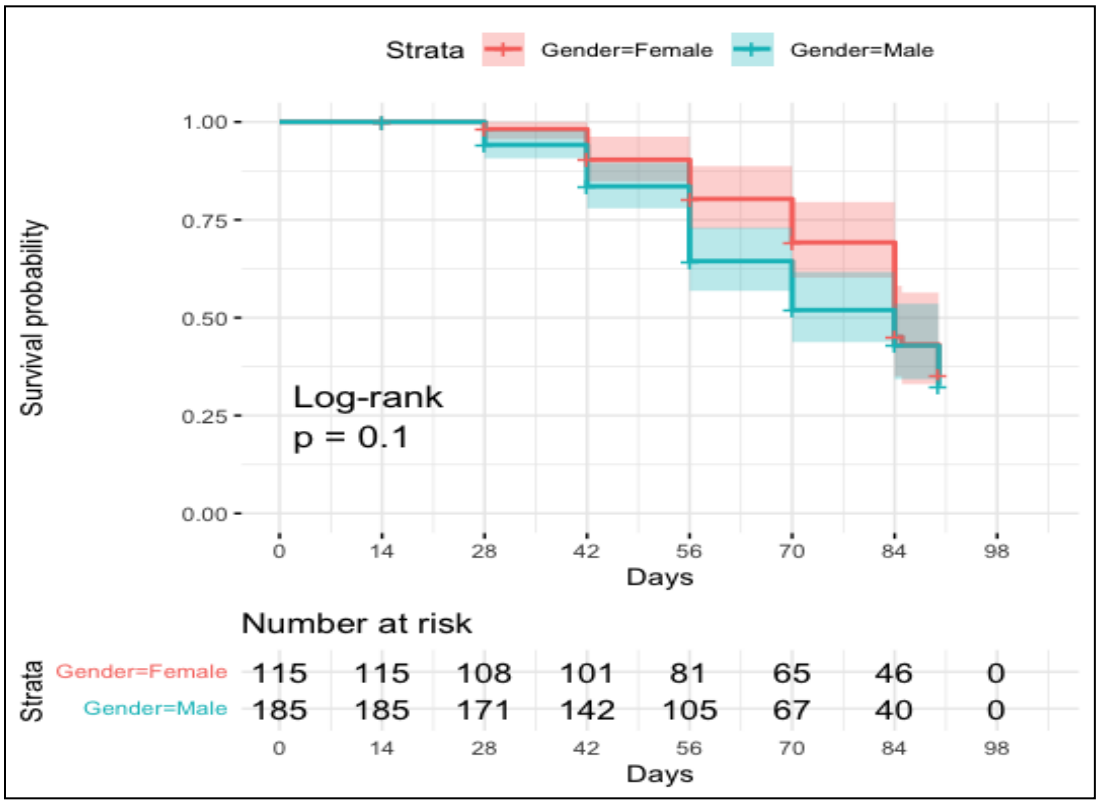

Figure 4.1.1. *Survival curve for children given Plumy sup as a treatment for moderate acute malnutrition*

As shown below, anthropometric measurements were summarized into mean and standard deviation, which varied depending on the measurement day (Table 4.25). All the differences observed were significant statistically, with all p-values < 0.05, according to an independent t-test (Table 4.26).

Table 4.24: Anthropometric indexes for children with moderate acute malnutrition treated with Plumpy sup

Variable	Day 1	Day 14	Day 28	Day 42	Day 56	Day 70	Day 84	Day 90
Mid upper arm circumference (cm)	12.0±0.3	11.6±2.4	10.5 ± 4.4	10.7 ± 4.1	12.0 ± 2.4	11.2±4.0	12.1±3.4	11.5±1.1
Height (cm)	79.8±14.1	79.8±14.1	80.6±12.6	80.6±12.6	81.0±12.4	81.0±12.4	81.1±12.2	81.6±12.3
Weight (kg)	8.8±2.7	8.9±2.6	9.0±2.6	9.2±2.8	9.4±2.7	8.5±2.7	9.6 ±2.8	9.0±3.0
Height-for-age (HAZ)	-1.6± 3.2	-1.6± 3.2	-1.5±2.6	-1.6±2.6	-1.6±2.7	-1.6±2.7	-1.6±2.6	-1.6±2.7
Weight-for-age (WAZ)	-2.9±1.4	-2.8±1.5	-2.6±1.5	-2.5±1.6	-2.3±1.6	-2.2±1.6	-2.1±1.7	-2.1±1.6
Weight-for-height (WHZ)	-2.3±0.9	-2.5±0.5	-2.5±0.3	-2.2±0.9	-2.0±1.3	-2.1±1.6	-2.0±2.1	-2.2±0.5

Table 4.25: Paired t-test analysis of anthropometric data collected at baseline and the end of the programme

Variable	Day 1 (n=300) M ± SD	Day 90 (n=223) M ± SD	T-value	*p*- value
Mid upper arm circumference (cm)	12.0±0.3	11.5±1.1	-3.3	0.001*
Height (cm)	79.8±14.1	81.6±12.3	-9.7	<0.01*
Weight (kg)	8.8±2.7	9.0±3.0	-43.6	<0.01*
Height-for-age (HAZ)	-1.6± 3.2	-1.6±2.7	-2.3	0.02*
Weight-for-age (WAZ)	-2.9±1.4	-2.1±1.6	-5.5	0.01*
Weight-for-height (WHZ)	-2.3±0.9	-2.2±0.5	-1.9	0.05*

*Significant at 5% level

4.7.1 Relationship between caregivers' socioeconomic status scores (wealth index) and effectiveness (weight gain) of Plumpy sup among 6 to 59 months old children being treated for moderate acute malnutrition in Turkana County, Kenya

The relationship between caregivers' socioeconomic status, converted into scores (wealth index), and the recovery rate of 6-59 months old children from the first to the ninetieth day of feeding on Plumpy sup was examined using a one-way ANOVA. There was only a statistically significant difference on the first and 42nd days (Table 4.27).

Table 4.26: Analysis of variance (ANOVA) on caregivers' socioeconomic status scores (wealth index) and weight gain of children aged 6-59 months

Variable	Recovery rate	Socio-economic status scores M (SD)	F-value	*p*-value
At baseline	Not recover	0.0769 (0.3224)	12.419*	<0.01*
	Recover	-0.0781 (0.198)		
	Loss to follow up	-0.0175 (0.06467)		
At 28 days	Not recover	0.0454 (0.3105)	2.275	0.105
	Recover	-0.0266 (0.2619)		
	Loss to follow up	0.0388 (0.2627)		
At 42 days	Not recover	0.0542 (0.30097)	4.136*	0.017*
	Recover	-0.0373 (0.2579)		
	Loss to follow up	0.06 (0.2913)		
At 56 day	Not recover	0.0206 (0.2573)	0.304	0.738
	Recover	-0.0099 (0.2933)		
	Loss to follow up	-0.0014 (0.267)		
At 70 days	Not recover	0.0333 (0.2887)	0.548	0.579
	Recover	-0.011 (0.2787)		
	Loss to follow up	0.0014 (267)		
At 84 days	Not recover	0.0102 (0.2965)	0.973	0.379
	Recover	0.0337 (0.2928)		
	Loss to follow up	-0.0248 (0.2769)		
At 90 days	Not recover	0.0207 (0.2739)	0.28	0.756
	Recover	0.0139 (0.2929)		
	Loss to follow up	-0.0394 (0.3018)		

*significant at 5% level

4.7.2 Relationship between caregivers' attitude on IYCF and effectiveness (weight gain) of Plumpy sup among 6 to 59 months old children being treated for moderate acute malnutrition in Turkana County, Kenya

A one-way ANOVA was utilized to examine the association between caregivers' attitudes toward IYCF, converted into scores, and the recovery rate of 6-59 months old children from the first to the ninetieth day of feeding on Plumpy sup. According to the findings, there was no statistically significant relationship between caregivers' attitudes toward IYCF and the effectiveness of plumpy sup (Table 4.28).

Table 4.27: Analysis of variance (ANOVA) on caregivers' attitude on IYCF and effectiveness (weight gain) of Plumpy sup among children aged 6-59 months

Variable	Recovery rate	Knowledge scores M (SD)	F-value	*p*-value
At baseline	Not recover	0.0002 (0.2524)	1.23	0.294
	Recover	-0.0045 (0.2186)		
	Loss to follow up	0.211 (0.1206)		
At 28 days	Not recover	-0.0032 (0.274)	0.754	0.471
	Recover	-0.0066 (0.222)		
	Loss to follow up	0.05 (0.2034)		
At 42 days	Not recover	-0.0287 (0.276)	1.034	0.357
	Recover	0.006 (0.221)		
	Loss to follow up	0.0336 (0.2064)		
At 56 day	Not recover	-0.0119 (0.248)	0.678	0.509
	Recover	-0.0077 (0.2199)		
	Loss to follow up	0.0273 (0.2536)		
At 70 days	Not recover	0.0035 (0.2591)	0.782	0.458
	Recover	-0.0135 (0.2186)		
	Loss to follow up	0.0273 (0.2536)		
At 84 days	Not recover	-0.0363 (0.1838)	1.809	0.166
	Recover	0.0302 (0.2398)		
	Loss to follow up	-0.0190 (0.2432)		
At 90 days	Not recover	0.0396 (24006)	2.354	0.097
	Recover	-0.0142 (0.2291)		
	Loss to follow up	0.0936 (0.2395)		

*Significant at 5% level

4.7.3 Relationship between effectiveness (weight gain) of Plumpy sup and the morbidity status of 6 to 59 months old children in Turkana County, Kenya

The relationship between morbidity status converted into scores and recovery rate of 6 to 59 months old children from the first to the ninetieth day of feeding on Plumpy sup was assessed using a one-way analysis of variance. Table 29 presented data showing that there was statistically significant relationship in the variables.

Table 4.28: Analysis of Variance (ANOVA) on effectiveness (weight gain) of Plumpy sup and morbidity status of 6 to 59 months old children

Variable	Recovery rate	Morbidity status scores M (SD)	F-value	*p*-value
At baseline	Not recover	0.018 (0.3059)	1.216	0.298
	Recover	-0.0215 (0.2665)		
	Loss to follow up	0.1688 (0.4607)		
At 28 days	Not recover	-0.011 (0.2607)	0.086	0.918
	Recover	0.0035 (0.2941)		
	Loss to follow up	0.0082 (0.3319)		
At 42 days	Not recover	-0.0212 (2722)	0.313	0.731
	Recover	0.0063 (0.2822)		
	Loss to follow up	0.0151 (3281)		
At 56 day	Not recover	0.0037 (0.2802)	0.865	0.422
	Recover	-0.0194 (0.269)		
	Loss to follow up	0.034 (0.3316)		
At 70 days	Not recover	0.0277 (0.3155)	1.433	0.24
	Recover	-0.0252 (0.2554)		
	Loss to follow up	0.034 (0.3316)		
At 84 days	Not recover	0.0598 (0.302)	1.136	0.323
	Recover	0.0026 (3072)		
	Loss to follow up	0.0624 (0.3075)		
At 90 days	Not recover	0.0934 (0.2939)	2.395	0.093
	Recover	0.0224 (0.3155)		
	Loss to follow up	-0.0878 (0.1958)		

*significant at 5% level

4.8 Specific objective 5: To determine the factors that influence Plumpy sup's effectiveness as a treatment for moderate acute malnutrition for 6 to 59 months old children in Turkana county, Kenya

Multiple logistic regression was utilized in evaluating factors related to the Plumpy sup efficacy as a treatment for moderate acute malnutrition in 6 to 59 months old children. The model included 21 independent variables listed in table 4.19 below. The model, which included all predictors, was significant statistically, $\chi 2$ (8, n=300) = 17.847, p-value=0.022, indicating that the model could differentiate between children who recovered and those who did not recover. The model correctly classified 77.9 % of the cases and explained between 14.1 % (Cox and Snell R squared) and 21.4 % (Nagelkerke R squared) of the variance in child recovery rate. Only petty trade and chemical treatment made a significant contribution to the model. Caregivers of children who did petty trade had a 2.6 times likelihood of recovering than those who did not. Furthermore, children from homes where chemical treatment was used for water treatment had 4.6 times more likelihood of recovering than those from households where other water treatment methods were used (Table 4.30).

Table 4.29: Factors associated with the effectiveness of Plumpy sup as a treatment for moderate acute malnutrition among 6 to 59 months old children in Turkana Central sub-county, Kenya

Variable	Child recovered		UOR (95% CI)				AOR (95% CI)			
	Yes (n=156)	No (n=67)	UOR	Lower	Upper	*p* value	AOR	Lower	Upper	*p* value
The gender of my child is										
Male	74	51	1.76	0.95	3.27	0.632	0.47	0.23	0.95	0.081
Female	82	16	1				1			
Caregiver own livestock										
Yes	69	29	1.04	0.55	1.97	0.710	1.31	0.59	2.91	0.192
No	87	38	1				1			
Caregivers engage in petty trade										
Yes	54	35	0.355	0.18	0.66	0.741	2.62	1.28	5.36*	<0.01*
No	102	32	1				1			
Caregiver is a casual laborer										
Yes	58	20	0.75	0.39	1.42	0.653	1.66	0.80	3.44	0.881
No	98	47	1				1			
Water is treated before drinking										
Yes	79	40	0.84	0.41	1.75	0.872	0.49	0.35	1.79	0.843
No	77	27	1				1			
Caregivers use traditional herbs to treat drinking water										
Yes	18	12	1.53	0.43	5.50	0.091	0.49	0.11	2.22	0.562
No	138	55	1				1			
Caregivers use chlorine-based compounds to treat water before drinking										
Yes	38	11	0.41	0.17	1.02	0.232	4.63	1.22	17.51*	0.002*
No	118	56	1				1			

Table 4.30: Factors associated with the effectiveness of Plumpy sup as a treatment for moderate acute malnutrition among 6 to 59 months old children in Turkana Central sub-county, Kenya

	Child recovered		UOR (95% CI)				AOR (95% CI)			
Variable	Yes (n=156)	No (n=67)	UOR	Lower	Upper	*p* value	AOR	Lower	Upper	*p* value
Water is boiled before drinking										
Yes	14	31	1.67	0.36	7.81	0.132	0.74	0.11	4.86	0.774
No	142	36	1				1			
Water is filtered before drinking										
Yes	27	10	1.22	0.47	3.16	0.654	0.80	0.24	2.65	0.542
No	129	57	1				1			
Caregivers wash their hands before feeding the child										
Yes	33	30	0.75	0.36	1.55	0.325	1.18	0.52	2.67	0.221
No	123	37	1				1			
Caregivers wash their hands after visiting toilet										
Yes	18	38	0.59	0.28	1.25	0.214	1.23	0.52	2.93	0.653
No	138	29	1				1			
Caregivers wash their hands before cooking food										
Yes	28	9	1.37	0.61	3.06	0.334	0.67	0.22	2.09	0.445
No	128	58	1				1			
Caregivers wash their hands after changing the diapers of the child										
Yes	27	19	1.49	0.54	4.13	0.932	0.66	0.26	1.64	0.552

No	129	48	1				1			

Table 4.31: Factors associated with the effectiveness of Plumpy sup as a treatment for moderate acute malnutrition among 6 to 59 months old children in Turkana Central sub-county, Kenya

	Child recovered		UOR (95% CI)				AOR (95% CI)			
Variable	Yes (n=156)	No (n=67)	UOR	Lower	Upper	*p* value	AOR	Lower	Upper	*p* value
Child Sickness										
Yes	107	41	0.42	0.20	0.88	0.823	2.31	0.96	5.55	0.244
No	71	12	1				1			
A child having an eye Infection										
Yes	10	5	2	0.44	9.18	0.211	0.53	0.10	2.80	0.883
No	146	62	1				1			
A child having ARI / Cough										
Yes	29	9	1.05	0.44	2.46	0.453	0.79	0.29	2.21	0.064
No	127	58	1				1			
A child having a bloody, watery diarrhea										
Yes	9	2	1.35	0.28	6.47	0.261	1.08	0.19	6.25	0.122
No	147	65	1				1			
A child having watery diarrhea but no blood										
Yes	34	12	1.23	0.53	2.86	0.862	0.48	0.18	1.34	0.073
No	122	55	1				1			
A child having fever like malaria										
Yes	41	21	0.42	0.22	0.81	0.554	2.00	0.91	4.41	0.092
No	115	46	1				1			
A child having other infection										
Yes	13	3	1.2	0.33	4.43	0.523	0.68	0.15	3.16	0.372
No	143	64	1				1			

CHAPTER FIVE: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

This study found that Plumpy sup as a treatment for moderate acute malnutrition in children aged 6 to 59 falls short of SPHERE standards and Kenyan guidelines on integrated management of acute malnutrition.

5.2 Socio-demographics and socio-economic status of caregivers with 6 to 59 months old children receiving Plumpy sup as a treatment for moderate acute malnutrition in Turkana county, Kenya

According to this study, the sub-county has a very low primary education completion rate (14.0 %), indicating a problem with formal education uptake. The 2019 SMART survey revealed a 14.30 % primary completion rate and a 3.9 % tertiary completion rate. This low completion rate in formal education can be attributed to the study group's pastoral nature and a lack of opportunity in learning facilities. Despite this low formal completion rate, a recent survey shows that literacy in Turkana is rising (SMART, 2019). Several studies have shown that caregiver education contributes to the improved status of a child’s nutrition (Abuya et al., 2012; Galgamuwa et al., 2017; Khattak et al., 2017; Miller et al., 2009). The literacy level of the caregiver is also important in understanding the instructions for administering malnutrition-related therapeutics such as plumpy sup.

The low formal education level is reflected in the caregivers' low socioeconomic status, with the majority being poor (84.3%). As a result of their low formal education, these caregivers were forced to rely on informal sources of income, primarily petty trading and casual labour. High

socioeconomic status among caregivers is critical in ensuring that the child has access to basic needs like water, clothing, health services, water, and food, all of which are mostly market-based, necessitating the caregiver's purchasing power. The absence of this resulted in the child not being able to access the necessary services for improved nutritional status (Galgamuwa et al., 2017; Kamiya et al., 2011).

5.3 Caregivers' attitude on young and infant child feeding among 6 to 59 months old children receiving Plumpy sup as a treatment for moderate acute malnutrition in Turkana county, Kenya

The caregivers who participated in this study had a positive attitude toward starting breastfeeding one hour after birth, the benefits of colostrum, the duration of breastfeeding exclusively for six months, starting complementary feeding after the six months, and following up on the health worker's advice that Plumpy sup was only for children that suffer from moderate acute malnutrition. As a result, the Plumpy sup was only shared by a small percentage of the household. However, a focus group discussion revealed that there were times when a sibling was given Plumpy sup to increase their appetite. These findings corroborate maternal nutrition knowledge presented in the Kenya integrated household survey (GOK, 2018) and those observed by Ochola (2017) who found that attitude and cultural practices among caregivers in Turkana county were not a primary impediment to proper complementary feeding practices. The findings agree with a study conducted in Uganda's Arua district on the effect of supplementary feeding intervention on maternal nutrition knowledge (Kajjura et al., 2019). The inadequacy of a positive attitude on causes of wasting and micronutrient deficiencies was a concern for the current study, as most caregivers did not understand the causes of the condition that their children were suffering from. Thus, this study demonstrates that primary caregiver nutritional knowledge

influences weight-for-height z scores and, hence, the child's recovery rate. The caregivers' apparent low education level, with the majority having dropped out of primary school, is a factor in ensuring that the caregivers adequately understand the root causes of wasting (Kajjura et al., 2019).

5.4 Nutrient intake for 6 to 59 months old children receive Plumpy sup as a treatment for moderate acute malnutrition in Turkana County, Kenya

5.4.1 Infant and young child feeding practices

According to the findings of this study, children consumed more vitamin A-rich fruits, legumes, nuts, seeds, eggs, and fresh meat. Despite the study group being a pastoral community, the observed low proportion of flesh meat consumption (12.8 %) is of interest in these findings. Despite this, livestock ownership among caregivers in the study was significantly low, ranging from 1 to 5 livestock. The study also found that the appropriate proportion of children was breastfed. As a result, the food they ate was mostly complimentary, as evidenced by the caregivers' understanding of complementary feeding. However, evidence from focus group discussions revealed that, while most children were reported to be breastfeeding, the ability of the mother's breast to produce enough breast milk for the child was problematic, particularly during the lean season when the community was experiencing drought-like conditions.

5.4.2 Nutrient intakes by the children

The child's nutrient intake is a critical component in accelerating recovery from moderate acute malnutrition, and components such as energy, protein, fat, carbohydrates, iron, and vitamin A from food or dietary supplement should be consumed in sufficient and recommended dosage.

5.4.2.1 Energy intake

The mean energy intake, 556.1±56.9 kcal per day, of children aged 6 to 11months was below the recommended daily allowance of 675 to 806 kcal (WHO 2012; Golden 2009). Much lower observations were made for children aged 12 to 17 months, 560.3 ± 97.5 kcal per day, and those aged 37 to 59 months, 778.2 ± 22.2 kcal per day, with the lowest intake period being the lean months. However, this intake is like energy intake among children aged 8 to 18 months in the Mangochi district of Malawi (Thakwalakwa et al., 2015). The observation is also much higher than the energy intake recorded in micronutrients for children in Kenya (MOH, 2011). The energy intake is likely attributed to the consumption of Plumpy sup as it was a requirement that the child was supposed to be given one sachet a day; hence a significant proportion of the energy can be attributed to Plumpy sup.

5.4.2.2 Protein intake

The observed protein intake for 6 to 11 months old children was 11.3±3.9 g per day, which falls within the lower level of the recommended daily allowance (WHO 2012; Golden ,2009) though this observation was made on the 90^{th} day of the study. The increase in the protein intake from 8.1±6.1 g per day at baseline to 11.3±3.9 g per day was most likely due to improved food sources during the wet season in the study area. The reduced protein intake was mainly observed during the lean season when food sources are stressed due to the inadequate rainfall to boost food production. This was found with very low, 15.9±7.1 g per day, intake of protein from 12 to 17 months old children in the study group. These observations are like those of Mbogori (2016) in her study in Turkana county on determinants of maternal and child malnutrition. The protein

intake observed in this study is like those found at the national level (MOH, 2011) and by Thakwalawka et al. (2015) in Mangochi, Malawi.

5.4.2.3 Carbohydrates intake

In this study, the carbohydrate intake for 6 to 11 months old children was 74.3±5.7 g per day, lower than the recommended daily allowance of 130 to 135 g per day (Golden ,2009; WHO 2012). 18 to 23 months old children had a high intake, 95.5±3.7 g per day, compared to those aged six to11 months but lower than the intake by children aged 37 to 59 months, 103.9±1.9 g per day. A similar trend was observed by Mbogori (2016) who recorded a carbohydrate intake of 128.6 (93.4, 170) g per day.

5.4.2.4 Fat intake

The study has shown a probable decrease in fat intake for 6 to 11 months old children from 27.1±2.1 mg per day to 22.1±2.3 mg per day. While for children aged 12 to 17 months, the consumption increased from 20.26±2.4 mg per day to 20.7±5.5 per day. An interesting observation for fat intake for 37 to 59 months old children increased from 26.6±0.6 mg per day to 35.3±1.3 mg per day. Similar comments were made by Mbogori (2016) in Turkana county.

5.4.2.5 Iron intake

Iron intake was lower in children aged 6 to 11 months, at 5.1±0.5mg per day, whereas observations in the other age groups revealed a gradual increase in fat intake and compliance with the recommended daily allowance (Golden, 2009; WHO, 2012). However, because the study did not assess the iron content of the children's blood samples, the low iron intake indicates

that the children are at risk of anaemia. In a research done in Bangladesh on the association between anaemia and stunting, the authors discovered that stunted children were more vulnerable to anaemia, but this was linked to maternal and child dietary patterns (Rahman et al., 2019). This agrees with the findings of this study that revealed that the child being treated for moderate acute malnutrition had a low dietary intake. Even though Plumpy sup has been fortified with iron, the extent to which the presence of iron in Plumpy sup can prevent anaemia has yet to be determined. Saka et al. discovered a high anaemia prevalence among malnourished children in Nigeria (Saka et al., 2019). They attributed this to the children's poor feeding habits, which agrees with the study's findings (Saka et al., 2019). In a knowledge and attitude survey conducted in Turkana County, it was discovered that only 47.6 % of children consumed iron-rich foods, supporting the findings of this study (Ochola, 2017).

5.4.2.6 Vitamin A Intake

Vitamin A intake was significantly below the recommended daily allowance, a major concern for children suffering from vitamin A deficiency. This observation concurs with that made by Manary et al. (2012) in their vitamin A systematic supplementation review in treating children with severe acute malnutrition, where they discovered that researchers in Brazil discovered that low serum retinol (less than 0.70μmol/l) was more common in children suffering from severe acute malnutrition in Brazil (Manary et al., 2012).

5.5 Morbidity status of 6 to 59 months old children receiving Plumpy sup as a treatment for moderate acute malnutrition in Turkana county, Kenya

According to this study, fever, such as malaria, was the most common childhood illness reported by caregivers (393.3 %). Watery diarrhoea (21.7 %) and ARI cough (21.7 %) were also reported.

With a significant association between fever like malaria and child recovery, it shows that a child presenting with fever child malaria was likely to take longer to recover from moderate acute malnutrition, contributing to the poor performance of Plumpy sup as a treatment for the same. Similarly, Fikrie et al. discovered that malaria was strongly (CHR=2.48, 95 % CI=1.02 – 6.02) connected with the recovery rate for children being treated for malnutrition. In Ethiopia, studies have shown that pneumonia and diarrhoea were common co-morbidities among children receiving treatment for moderate acute malnutrition (Derseh et al., 2018), which agrees with this study's findings. The diarrhoea prevalence indicates that water sources have been contaminated with *Escherichia coli* or other diarrhoea-causing agents, emphasizing the need to protect and treat drinking water before use.

5.6 Recovery rate of using Plumpy sup among children aged 6 to 59 months as a treatment for moderate acute malnutrition in Turkana County, Kenya

Based on the 22,080 sachets of Plumpy sup distributed to the four health facilities in the study area, the coverage rate for children suffering from moderate acute malnutrition was 60.1 %. Lolupe dispensary (51.6 % coverage rate), Loturerei dispensary (61.9 % coverage rate), and Nayanaeanga ikallaio (60.6 %). These coverage rates exceed the SPHERE standard recommendation of 50 % for coverage of supplementary programs in rural areas (SPHERE, 2018). However, because Lodwar referral hospital is in an urban area, its coverage rate of 63.5 % fell short of the SPHERE standard of 70 % (SPHERE, 2018).

The recovery rate for children who used Plumpy sup was 66.3 %, compared to a default rate of 19.0 %. The recovery rate was less than the SPHERE standard recommendation of more than 75 %, while the default rate was greater than the recommended rate of less than 15 %. The

proportion of children whose MAM status did not change was 27.8 %. This is critical information because the higher default and nonresponse rates indicate that MAM among children is a chronic issue that may not be addressed through the distribution of Plumpy sup or any other supplementary feeding program in Turkana central sub-county through investment in strategies that improve household food security. The difficulty with the defaulting rates for the supplementary feeding program is determining what happened to the children who defaulted or lost follow up due to relocation. There is an equal chance that the children recovered, died, or remained moderately acutely malnourished in the area where they were relocated. In a study conducted in rural Ethiopia, 54.2 % of children recovered from moderate acute malnutrition, and supplemental food stock out was observed (James et al., 2016). Ahimbisibwe (2013) made a similar observation in a study conducted in the Acholi region of Uganda, as did Lelijveld et al. (2021) in their systematic review of the moderate acute malnutrition treatment using food products. The observed low recovery rate and high nonresponse rate may be factors in the relapse of moderate acute malnutrition in children (Stobaugh & Manaryet , 2018). The recovery rate observed in this study is comparable to that of Malawian children who were given soy/peanut food supplements (Matilsky et al., 2009; Chang et al., 2013).

The weight-for-height z score decreased from minus 2.3±0.9 at baseline to minus 2.2±0.5 at the end of the program, while the weight-for-age z score decreased from minus 2.9±1.4 to minus 2.1±1.6 at the beginning and end of the program, respectively. This observed weight-for-height z score is notably lower than those observed in the SMART survey 2019, albeit with the caveat that the SMART survey was generalized to include all children regardless of malnutrition status (SMART survey, 2019). These findings back up observations made by Karakochuk (2012)

among children undergoing MAM treatment with a corn-soy blend in Ethiopia and a systemic review conducted by Ger et al. (2017), who discovered a rise in weight-for-height z scores among children treated with lipid-based supplementary food.

5.6.1 Relationship between caregivers' socioeconomic status scores (wealth index) and effectiveness (weight gain) of Plumpy sup

This study found that the caregiver's socioeconomic status influenced a child's weight gain being treated for moderate acute malnutrition. The ability of caregivers to access other services like food, water, and the purchase of medical supplies required by the child during the treatment period is critical in moderate acute malnutrition management. A study conducted in Ghana discovered that when their caregivers earned USD 250 (equivalent to Ksh 27,137 as of April 25th, 2021), the number of children suffering from malnutrition decreased (Tette et al., 2016).

5.6.2 Relationship between caregivers' attitude on IYCF and Plumpy sup effectiveness (weight gain)

This study found that caregivers' attitudes toward IYCF have no effect on the efficacy of Plumpy sup as a treatment for moderate acute malnutrition. The interpretation of attitude and understanding of IYCF would be linked to the educational status of the caregivers, which according to this study, a large proportion did not have formal education. Even though this study did not find a link between IYCF and the effectiveness of Plumpy sup, other studies have found a link between caregivers' attitudes and knowledge about IYCF's contribution to a child's nutritional status (Apondi, 2008).

5.6.3 Relationship between effectiveness (weight gain) of Plumpy sup and the morbidity status

Even though there were children who reported some form of illness during the study period, the study discovered no statistically significant association between the morbidity status of the children and the effectiveness of plumpy sup. The prevalence of disease observed in this study corroborates findings from Burkina Faso, where Nikiema et al. (2014) documented diarrhoea, cough, and fever prevalence among children receiving treatment for moderate acute malnutrition (Nikiema et al., 2014). These findings are contrary to Derseh et al. (2018) in Ethiopia, who discovered a link between comorbidities and the rate of recovery for children being treated for severe acute malnutrition. It would imply that while morbidity status is not an issue in moderate acute malnutrition treatment, it is an issue in severe acute malnutrition treatment. As a result, the presence of which does not affect the efficacy of plumpy sup as a therapeutic for moderate acute malnutrition. Although the child's morbidity status does not affect the effectiveness of plumpy sup, studies have shown that a morbidity and mortality risk is notable in a child with moderate acute malnutrition, as demonstrated in this study (Brenda et al., 2015). A recent study discovered that children's recovery from moderate acute malnutrition was related to the child's underlying health status (Stobaugh & Manaryet, 2018).

5.7 Factors that influence the effectiveness of Plumpy sup among children aged 6 to 59 months in Turkana county, Kenya

5.7.1 Caregiver income and expenditure

The average caregiver's income was 2142.4 ± 1760.8.1 Kenya shillings, with 67 % earning between 1,000 and 5,000 Kenya shillings. This fell to 2004.9 ± 1407.1 Kenya shillings at the end of the program, indicating a decrease in the primary caregiver's purchasing power for essential services. The earnings are mostly spent on food, with 1281.3 ± 963.8 Kenya shillings and 1497.9 ± 969.7 Kenya shillings spent on food at the beginning and end of the program, respectively. This demonstrates that the cost of food increased at the program's end due to the additional need for food for the child, as advised by community health workers on the importance of dietary diversification for the child. Even though the study was conducted in a pastoral community, the primary caregiver's main occupation was petty trading (36.7 %) and daily waged casual labour (34.0 %). The study discovered that the primary caregiver's income level does contribute to the child's recovery rate; however, a direct association on its contribution to Plumpy sup performance was not documented due to confounding factors associated with moderate acute malnutrition community-based management. Caregivers who participated in focus group discussions at the three health facilities reported this.

5.7.2 Access to water

According to the findings of this study, boreholes and public protected wells are the primary water sources for the households in the study group. There was a good response, 60.1 %, of caregivers treating the water before drinking, but this appears to have dropped to 53.4 % by the end of the program. This decrease was primarily attributed to decreased resources and

inadequacy of water during the dry seasons, resulting in savings on fuel for food preparation, primarily for those caregivers (36.6 %) who confirmed using boiling as the primary water treatment method. During the focus group discussions, chlorine-based chemicals such as aqua tab were also observed and approved. Surprisingly, traditional herbs were also found in some households. These results are related to the ones of the Turkana SMART survey, which found that boiling and chlorine-based chemicals are the most used water treatment methods; however, the use of traditional herbs was discovered in neighboring sub-counties of Turkana South, Turkana North, and Turkana West (SMART survey, 2019). Water treatment methods and the children's recovery rate did not significantly differ, and thus no effect on Plumpy sup. This finding agrees with an Ethiopian study, which found no link between waste and improved water sources (van Cooten et al., 2019).

5.7.3 Sanitation practices

The use of open bush for defecation was the main sanitation option for primary caregivers in this study, accounting for 68.2 % of the total, with 13.9 % admitting to using a neighbour's toilet. Sanitation is a major issue among pastoral communities, such as those in Turkana Central, and as a result, temporary sanitation facilities are required, with the use of the bush being the preferred option (SMART survey, 2019). The safe disposal of human faeces is critical to reducing related diarrheal cases among children receiving treatment for moderate acute malnutrition. Aside from the bush, traditional pit latrines (6.3 %) and ventilated pit latrines (9.0 %) were observed as options used by caregivers. This also applied to how the children's faeces were disposed of. Those aged two years and above defecated in the open spaces behind the homestead, a practice well documented by caregivers and interviews with community health workers.

5.7.4 Hygiene practices

The study found that, before eating, only 28.3 % of caregivers washed their hands and 23.3 % after changing the children's soiled clothes during critical events. The study found that the proportion of caregivers who washed their hands after using the toilet decreased from 35 % at the program's start to 25.1 % at the end. One of the reasons was a reduction in water availability during the dry seasons, so drinking and cooking were prioritized. They were even washing hands before cooking received a lower positive response, 16.1 % when compared to the other critical events. Hygiene practices, specifically hand washing before eating and after using the toilet, were found to significantly contribute to the child's recovery rate and thus the contribution of Plumpy sup in treating moderate acute malnutrition.

5.8 Conclusions

The caregivers had a good understanding of young and infant child feeding practices, with the majority demonstrating high knowledge of when to breastfeed children, the duration of exclusive breastfeeding, how and when to give Plumpy sup to children, and the benefits of colostrum, and when to begin complementary feeding. However, there was a lack of knowledge about the minimum meal frequency, the causes of marasmus, and the benefits of micronutrients. Nutrient intake was lower than the WHO recommended daily nutrient allowance for 6 to 59 months old children receiving Plumpy sup as a treatment for moderate acute malnutrition. As a result, there is a high risk of children being wasted, which will impact their childhood development process.

Most children were reported being sick in the previous 14 days, with fever, watery diarrhea, bloody diarrhea, and ARI cough being the most common illnesses. The illness did not significantly contribute to the recovery of the child being treated for moderate acute malnutrition,

but it did place additional strain on caregivers to mobilize resources for treatment. Plumpy sup does not meet the SPHERE standards for treating moderate acute malnutrition in a community-based supplementary feeding program. The majority of children treated for moderate acute malnutrition with Plumpy sup recovered by the 90th day, despite this proportion being lower than the above recommended by SPHERE standards. A slight proportion were lost to follow-up, and nearly six percent had their status deteriorate to severe acute malnutrition.

After adjusting for confounders, petty trade and chemical treatment contributed significantly to the model on factors influencing the effectiveness of Plumpy sup out of the 21 independent variables subjected to multiple logistic regression. With the Turkana community's pastoral way of life, the risk of wasting among children remains high, as do incidences of water-related diseases, particularly diarrhea.

5.9 Recommendations

i. The national government, Turkana county government, and humanitarian actors should continue with the social mobilization programme on infant and young child feeding practices among caregivers to increase positive attitudes on the causes of acute malnutrition among children aged 6 – 59 months.

ii. The national government, Turkana county government, and humanitarian actors should consider social mobilization programmes for caregivers on recommended nutrient intake and nutrient diversity for children aged 6 – 59 months to mitigate the risk of wasting.

iii. The national government, Turkana county government, and humanitarian actors should strengthen prevention and management moderate acute malnutrition co-morbidities to improve the recovery rate of children suffering from moderate acute malnutrition.

iv. In collaboration with humanitarian actors, the national government and Turkana county ministries of health should Initiate a mechanism to ensure that plumpy sup and supplementary feeding programmes meet the SPHERE standards on moderate acute malnutrition management.

5.10 Recommendations for further research

i) The national government, the Turkana county government, and humanitarian actors should conduct a rigorous causal analysis of the length of stay in supplementary feeding programs.

ii) Based on the observed Plumpy nut recovery rate, a cost-effective analysis of Plumpy sup, or any other commercially manufactured ready-to-use supplementary food, should be conducted in Turkana County.

iii) Evaluate the sustained recovery rate of children using Plumpy sup after the 90th day of treatment to document the relapse rate of children to moderate acute malnutrition or worsening to severe acute malnutrition.

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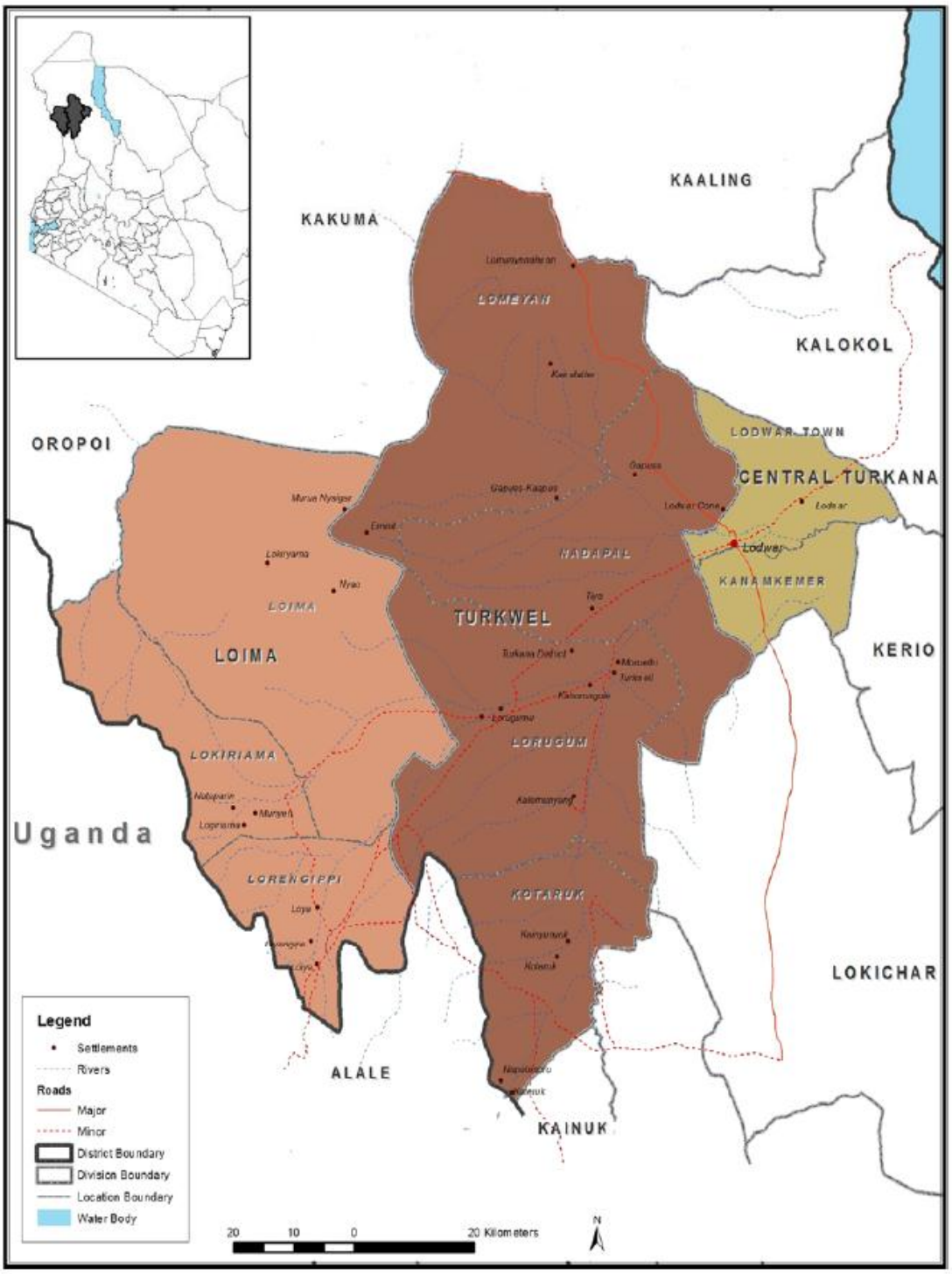
APPENDICES

Appendix 1: Map of Turkana county



Appendix 2: Consent form

TITLE: ASSESSMENT OF PLUMPY SUP IN MANAGEMENT OF MODERATE ACUTE MALNUTRITION AMONG CHILDREN AGED 6 – 59 MONTHS IN TURKANA CENTRAL SUB COUNTY, KENYA

Name of Primary investigator: Philimon Majwa Omondi (Master in Public Health)
Name of 1st Co-investigator: Professor Margaret Keraka
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STUDY PURPOSE

This study's purpose is to assess the effectiveness of Plumpy Sup in the management of moderate acute malnutrition among children aged 6 – 59 months in Turkana central sub county, Kenya. This study will be beneficial to the Government of Kenya (ministry of health) and humanitarian agencies like WHO, UNICEF, UNWFP and NGOs in decision making concerning the use of ready to use supplementary foods in the management of moderate acute malnutrition. The results of the study will also contribute to strengthening the policy on moderate acute malnutrition management in Kenya and to build on the knowledge base on how community based interventions for moderate acute malnutrition management can be sustained.

STUDY PROCEDURES

If you concent to take part in this study, you will be required to give infromation on your under five child nutrition status focusing on the use of the various methods you use to manage malnutrition in your child. Your child's weight, age, height and mid upper arm circumference will be taken through measurement. If you do not wish to respond to any of the question asked during the inerview, indicate so and the interviewer will proceed to the subsequent question. This interview will be held at your house and only the interviewer will be present. You will further be needed to give information on the food type the child has taken over a period of 3 months which will be the research period.

TIME INVOLVEMENT

The expected time for each interview is about 20 minutes. A total of 3 interviews will be conducted once per month.

THE STUDY' RISKS AND BENEFITS

This research has minimal risk to you and your child, however, you may decline to respond to any question or not participate in an interview portion if you feel uncormfortable responding to the questions. You will not get any direct benefit but by taking part, you will probably assist us in finding out additional informtion on how moderate acute malnutrition management in this

area. In case of any complications developed by the child, we will inform the nearby health facility for prompt treatment and further management of the complications. The result of this research will also benefit the policy makers and humanitarian agencies in developing focused nutrition interventions with a specific focus on treatment of moderate acute malnutrition.

No monetary benefits will be given to you and the re wiil be no loss incurred regarding the services you are given from the community malnutrition management programmes by the humanitarian agencies or by the Kenyan Government through the Health facilities in your area.

COSTS

No incentive will be provided to you nor will you be charged to participate in this study.

CONFIDENTIALITY

Confidentiality of the collected information will be strictly kept. When youjoin this research, a household study identification number will be given to you. Data will be gathered on coded forms using the number. Your identity and that of your chilld will not be diclosed on the forms but solely on a master list that the researcher has separately kept under lock and key. Your identity will never be used in relation with any published reports or scientific papares resulting from the reerch findings or any of the databases in which the information is kept. Only the researcher will view the collected information.

VOLUNTARY NATURE OF THE STUDY

If you decide not to take part your participation in the community malnutrition programme will not be affected.

CONTACT INFORMATION

Incase of any concrens not or in future concrening your right in thestudy or associated injury, you get in touch with me 0713764507 or the Kenyatta University (KU) Ethical Review: P.O Box 43884-00100 Nairobi, Kenya.

You may also get in touch with the Co-investigators of the study: Professor Margaret Keraka (0721817521) or Dr Sophie Ocholla (0721449803) - Kenyatta University

CONSENT FORM

Signing below is an indication that you are well informed concerning the study in which you agree voluntarily to take part; that you have made all the inquaries concerning the study that you may have; and that the information provided has enabled make a fully informed decisison concerning your involvement in the study. By signing the consent form you do not waive any legal rights and the investigator (s) or sponsor (s) is not relieved of any liability they may have. A copy of this consent form will be provided to you.

The above information concerning the study and the participation basis have been explained to me in Kiswahili / English/ Turkana language and I consent to participate in the study.

Participant Thumb mark/ signature……Date……
Research assistant: ……signature……Date……
Principal investigator: signature……Date……
(Affirming subject eligibility for the study and that informed consent has been obtained).

Appendix 3: Household questionnaire

Note to the enumerator: The questions in this survey are for the **PRINCIPAL CAREGIVER** in the household. If there is more than one mother in a household, choose one mother at random to be interviewed about her household and her child. Ask the principal caregiver the number and ages of all the members of your household who reside in the household, sleep and eat from the same pot, including herself / himself. This information should be kept confidential and should not be shared with anyone. Names should only be used in the interview and should not be related to data in the report.

SECTION 1. Household identification

101. Village Name			
102. Household Number.			
103. Interviewer's Name.			
104. Date of Interview.	Date:	Month:	Year: 2018
105. Time Interview Commenced.			

SECTION 2. Demographics

Please tell me the ages of each person living / sleeping here (including yourself):					
201	What is the number of people aged between 0 and 5 years?	1=1 5=5 7=7	2=2 6=6 8=8	3=3 9=9	4=4 10=0
202	What is the number of people aged 6-18 years?	1=1 5=5 7=7	2=2 6=6 8=8	3=3 9=9	4=4 10=0
203	What is the number of people aged 6- 18 years are in School?	1=1 5=5 7=7	2=2 6=6 8=8	3=3 9=9	4=4 10=0
204	What is the gender of the child aged 6- 59 months targeted by supplementary feeding?	1= Male		2 = Female	
205	What is gender of the household head?	1 = Male		2 = Female	

206	What is the occupation of household head?	1= livestock rearing 2=Employed (Formal) 3= Unemployed 4= Petty trade 5= large scale Business 7= Peasant Farmer 8= Casual labour 9= Religious leader 10= Large scale farmer 11= Retired 12= Livestock rearing and peasant farming
207	What is the gender of the Caregiver?	1=Male 2= Female
208	What is the age of the Caregiver in years?	1= 10 – 15 2= 16 – 20 3= 21 – 25 4=26-30 5= 31-35 6= 36 – 40 7= 41- 45 8= 46 – 50 9= 51- 55 10= More than 56

SECTION 3. Socioeconomics

301	What is the highest level of education for the caregiver?	1= Did not complete Primary education 2 = Completed Primary education 3= Did not complete secondary education 4= Completed Secondary education 5= Graduated from a tertiary college 6 = Graduated from University 7 = No formal education
302	What is the occupation of Caregiver? (CIRCLE only ONE)	1= Housewife 2= livestock rearing 3=Employed (Formal) 4= Unemployed 5= Petty trade 6= Business 7= Peasant Farmer 8= Casual labour 9= Religious leader 10= Large scale farmer 11= Retired 12= Livestock rearing and peasant farming
303	What is your average household monthly Income (State figure in Kenya shillings)?	1= less than 1,000 2= 1,001 – 5,000 3= 5,001 - 10,000 4= 10,001 - 15,000 5= 15,001 – 20,000 6= 20,001 – 30,000 7= 30,001 – 40,000 8= 40,001 – 50,000 9= More than 50,001
How have you spent your monthly income in the past 30 days? (Note: Sum of 304+305+306+307+308+309+310 = 100%)		
304	Household Food expenses (%)	1= less than 10% 2= between 11% and 20% 3= Between 21% and 30% 4= Between 31% and 40% 5= Between 41% and 50% 6= Between 51% and 60% 7= Between 61% and 70% 8= Between 71% and 80% 9= Between 81% and 90% 10 = Between 91% and 100

305	Children Education expenses (%)	1= less than 10% 3= Between 21% and 30% 5= Between 41% and 50% 7= Between 61% and 70% 9= Between 81% and 90%	2= between 11% and 20% 4= Between 31% and 40% 6= Between 51% and 60% 8= Between 71% and 80% 10 = Between 91% and 100
306	Household Water Expenses (%)	1= less than 10% 3= Between 21% and 30% 5= Between 41% and 50% 7= Between 61% and 70% 9= Between 81% and 90%	2= between 11% and 20% 4= Between 31% and 40% 6= Between 51% and 60% 8= Between 71% and 80% 10 = Between 91% and 100
307	Children Health Expenses (%)	1= less than 10% 3= Between 21% and 30% 5= Between 41% and 50% 7= Between 61% and 70% 9= Between 81% and 90%	2= between 11% and 20% 4= Between 31% and 40% 6= Between 51% and 60% 8= Between 71% and 80% 10 = Between 91% and 100
308	Entertainment expenses (%)	1= less than 10% 3= Between 21% and 30% 5= Between 41% and 50% 7= Between 61% and 70% 9= Between 81% and 90%	2= between 11% and 20% 4= Between 31% and 40% 6= Between 51% and 60% 8= Between 71% and 80% 10 = Between 91% and 100
309	Communication expenses (%)	1= less than 10% 3= Between 21% and 30% 5= Between 41% and 50% 7= Between 61% and 70% 9= Between 81% and 90%	2= between 11% and 20% 4= Between 31% and 40% 6= Between 51% and 60% 8= Between 71% and 80% 10 = Between 91% and 100

310	Savings for future use (%)	1= less than 10% 2= between 11% and 20% 3= Between 21% and 30% 4= Between 31% and 40% 5= Between 41% and 50% 6= Between 51% and 60% 7= Between 61% and 70% 8= Between 71% and 80% 9= Between 81% and 90% 10 = Between 91% and 100
311	Do you own a mobile Phone?	1= Yes 2= No
312	Do you own any livestock? (Chicken, cow, goat, sheep, camel, donkey etc)	1=Yes 2=No
313	If Yes, how many?	1= Less than 5 2=Between 6 and 10 livestock 3=Between 11 and 20 livestock 4=More than 21 livestock

SECTION 4. Access to Water services

401	What is the <u>household MAIN</u> source of water? (CIRCLE only ONE)	1= Piped water into the house 2= Public tap 3= Open public well 4= Protected personal well in compound / plot 5= Protected public well 6= Pond / water pan/ Lake / dam 7= Rainwater (With roof catchment facility and tank) 8= Water Tanker truck 9= Bottled water 10= Borehole
402	Who constructed the water source you have chosen above? (CIRCLE only ONE)	1=Self/Household 2= National Government 3=Community 4=NGOs 5= Natural water source 6= County Government of Turkana 7=Don't know
403	How long does the water source supply water in a year?	1= less than 6 months 2= between 6 months to 1 year 3=Throughout the year
404	Who manages the water source?	1= Individual household 2=community committee 3= village Elders 4=No one 5=I dont know
405	How much water has been collected in the past one day for your household use (cooking, drinking, bathing, washing and cleaning)? Write the estimated number of litres, to the right here.	1= Less than 5 litres 2= Between 6- 10 litres 3= Between 11 -15 litres 4= Between 16-20 litres 5=Between 21- 25 litres 6= Between 26 – 30 litres 7= Between 31 – 35 litres 8= Between 36 – 40 litres 9= Between 41 – 45 litres 10= More than 46 litres

406	Was the amount of water you collected enough for your household needs?	1 =Yes 2= No
407	**What is the distance of your household and the water source?**	1= Less than 500 m 2= 501m--Less than 1km 3= 1.1km-Less than 2 km 4= 2.1Km - Less than 3 km. 5=More than 3.1 Km.
408	**Has this distance reduced in the past one month?**	1=Yes 2=No
409	If it has reduced who contributed to its reduction? (CIRCLE only ONE)	**1= County Government of Turkana 2= National Government of Kenya 3= NGO 4= CBO 5= Faith Based Organization 6= Don't Know**

SECTION 5: Access to Sanitation and Hygiene services

501	Does your household have a dish drying	1= Yes 2= No
502	Does your household have a pit for dumping	1= Yes 2= No
503	Does your household have a leaky tin for	1=Yes 2= No
504	What is the type of latrine being used by the household	1.Traditional Pit latrine 2.Ventilated Pit Latrine latrine 3. Flush toilet with Septic Tank 4.Open field 5.Neighbour's Toilet 6.Open pit
505	Who built the latrine / toilet?	1. National Government of Kenya 2= NGOs 3= Community members
506	Did you wash your hands after visiting latrine in the past 24	1= Yes 2= No 3= Occasionally
507	Did you wash your hands before feeding a	1= Yes 2= No 3= Occasionally
508	Did you wash your hands after changing the nappies of the child?	1= Yes 2= No 3= Occasionally

SECTION 6: Nutrition practice

601	What is the main source of food for this household? (CIRCLE only TWO)	1= Purchase from Market 2=From the family farmland 3= Kitchen Garden 4= Food ration from WFP 5= Donation Food from Community members 6=From NGOs.
602	Do you breastfeed your 6 – 59 months old child?	1= Yes 2 = No
603	If Yes, for how many	1= 1 – 3 months 2= 4 – 6 months 3=7 – 12 months 4=13

	months has the child been breastfeeding?	– 24 months 5= 25 months to 60 months 6= Not Applicable
604	At what age did you introduce your child to liquid/solid food?	1= less than one month 2= between 1 and 2 months 3 = between 3 and 6 months 4= between 7 and 10 months 5= between 11 and 15 months 6= between 16 and 24 months
605	How was the child served the food in his last three meals?	1=Given by care giver / parent 2= Given in Own plate 3= Given in Shared plate with children 4= Given in plate shared with adult

SECTION 7: Assessment of Supplementary feeding programme

701	When was your child registered for the current supplementary feeding programme?	1= Less 5 days ago 2 = Between 5 days to 10 days 3= Between 11 days and 20 days 4= More than 20 days
702	What type of supplementary feeding is your child (6- 59) receiving? (CIRCLE only ONE)	1= Plumpy Sup 2= Super Cereal 3= Plumpy Nut 4= Unimix
703	What is the quantity of supplementary feeding which you have received? (respond according to the type of the feeding programme in 702 above).	1= 3 Sachets 2= 6 sachets 3= 12 sachets 4 = 25 sachets 5 = 50 sachets 6= 75 Sachets 7 = 150 sachets 8= 1 Kilograms 9= 2 Kilogram 10= 4 kilogram 11= 5 Kilogram 12= 8 Kilogram 13= 15 kilogram
704	Who in the household regularly eat the Supplementary Food?	1= sick (malnourished) child 2= another child in the Household less than 5 years of age 3= another child in the household older than 5 years of age 4=father 5=mother 6=elderly members of the household 7=visitors to the household 8=no one in the household
705	Is the child taking the supplementary food as directed by the health workers?	1= Yes 2= No
706	If No, when did the child stop taking the supplementary food? Last..	1= 1- 10 days 2= 11- 20 days 3= 21- 30 days 4= 31- 40 days 5= 41- 50 days 6= 51– 60 days 7= 61- 70 days 8= 71 – 80 days 9= 81- 90 days 10 = More than 91 days ago 11= Not Applicable
707	What was the main reason why the child stopped taking the	1= The child did not like the taste of the supplementary food. 2= The supplementary food ration got finished. 3= There was no instructions given on the dosage of the

	supplementary food?	supplementary food. 4= The child is allergic to the supplementary food. 5= its labor intensive to prepare the supplementary food.
708	If other children in the household share the supplementary food, by how many children aged 6-59 months is it shared in total?	1= one 2= two 3=three 4=Four 5= Five or more 6= Food is shared with No children
709	What proportion of the Supplementary food did the malnourished child eat?	1= None 2= less 25% 3= between 25% and 50% 4= Between 51% and 75% 5= More than 75% 6= 100%
710	How long did the Supplementary food last in the household?	1= 14 days 2= 11-13 days 3= 8 -10 days 4= 7 days or less 5= More than 30 days
711	What portion of the supplementary food was sold or exchanged for other household items?	1= Between 1% and 25% 2= Between 26% and 50% 3=Between 51% and 75% 4= 100% 5= None
712	What proportion of the supplementary food was given to the neighbor to treat their malnourished child?	1= Less than 25% 2= Between 25% and 50% 3=About 50% 4= 100% 5= None
713	How is the appetite of the child for the regular household food? (Not the supplementary food)	1= Good 2= Poor 3= Partially good
714	After how many days after receiving the supplementary feeding did the health workers tell you that your child has recovered from MAM?	1= 1- 10 days 2= 11- 20 days 3= 21- 30 days 4= 31- 40 days 5= 41- 50 days 6= 51– 60 days 7= 61- 70 days 8= 71 – 80 days 9= 81- 90 days 10 = More than 91 days
715	After how many days after receiving the supplementary feeding did you transfer your child to the hospital for further treatment due to deterioration of his / her malnutrition status?	1= 1- 10 days 2= 11- 20 days 3= 21- 30 days 4= 31- 40 days 5= 41- 50 days 6= 51– 60 days 7= 61- 70 days 8= 71 – 80 days 9= 81- 90 days 10 = More than 91 days

716	How many times has your child been re admitted for another episode of MAM treatment for supplementary feeding after being discharged from the supplementary feeding programme?	1= once 2 = twice 3=Thrice 4= Four times 5= Five times 6= Six times 7= Seven times 8= Eight times 9= Nine times 10= More than 10 times

SECTION 8: Access to Health services

801	Has malnourished child been immunized?	1 = Yes with an immunization card 2 = Yes with no immunization card 3 = No with immunization card 4= No without immunization card
802	Has the malnourished child aged 6- 59 months suffered from diarrhea in the last 2 weeks?	1= Yes 2= No
803	Did you observe any blood in the diarrhea?	1= Yes 2= No 3= Not Applicable
804	How was the diarrhea treated?	1 = No treatment / No remedy 2= The child was given ORS at home 3 = Given sugar and salt solution 4 = Given traditional herbal remedy 5 = Received professional help from hospital or clinic 6 = The child drank a lot of water 8= Not Applicable
805	Did a trained health provider attend to sick	1=Yes 2=No
806	If No, why?	1=The health center is far away. 2=I had no money to pay at the health center. 3=I prefer traditional medicine 4=There are no trained health providers in our community. 5= Not
807	Has the child been dewormed in the last 6	1= Yes 2=No
808	If No, why?	1=There is no deworming medicine in the hospital. 2=There is no information about deworming. 3=I have no money to pay for deworming exercise. 4=I don't know. 5= Not Applicable

809	Since receiving the supplementary food, have you taken your child for medical assessment at the community outreach center?	1= Yes 2 = No
810	Since receiving the supplementary food, has the community health workers visited your household to check on the progress of the child?	1= Yes 2= No
811	Has any child died in this household within the last month?	1=Yes 2= No

Section 9: Anthropometric measurement
(Note to the interviewer: Refer to the attached procedures on how to take the weight, height and MUAC of the target child)

901	Measure the weight (Kg) of the target child (6-59 months) receiving supplementary food?	Weight= ……Kg
902	Measure the Height (cm) of the target child (6- 59 months) receiving supplementary food?	Height = ……cm
903	Measure the Mid Upper Arm Circumference (MUAC) in cm of the target child (6- 59 months) receiving supplementary food?	MUAC =……cm

Section 10: Sustainability of supplementary feeding programme

1001	Are you a member of a programme committee within your community?	1= Yes 2 = No

1002	Which committee are you a member to?	1= Water committee 2 = Health Committee 3= Sanitation and Hygiene Committee 4 = Nutrition committee 5= Not Applicable
1003	Have you participated in supplementary feeding needs assessment exercise to identify households with children who are suffering from malnutrition?	1= Yes 2= No
1004	In your opinion, do you feel community project on malnutrition management adequately involve women through skill development?	1= Yes 2 = No
1005	Have you invested your money, materials or time in supplementary feeding programme for moderate acute malnutrition treatment among children 6- 59 months?	1=Yes 2= No
1006	Do you feel the county government and partners invest appropriately in moderate acute malnutrition prevention strategies in your community?	1=Yes 2= No
1007	Do you participate in monitoring of the progress of the programme?	1= Yes 2 = No
1008	If yes how do you participate in monitoring	1= Monitoring the response of the child recovery status 2= Monitoring the programme performance indicators 3= Monitoring the sale of supplementary food in the market 4= Not Applicable

1009	Which of the following training have you gotten in the past 12 months?	1=Water source utilization and management. 2=Sanitation facility construction and maintenance. 3= breastfeeding and complementary feeding needs of your child. 4= Preparation of local recipe for management of moderate acute malnutrition. 5= Financial management for small scale income generation activities.
1010	Which organization supported you or organized the training	1= Government of Kenya 2= NGO 3= County Government of Turkana 4= Community Members 5= Self-Sponsored 6= Faith Based organization 7= Private Sector
1011	Which of the following best describe how you are using the skills you got from the training	1= Applying/ teaching the skills with confidence 2= Applying/ teaching the skills with difficulty 3= Not applying because lack of opportunity 4= Not applying because not confident about quality 5= Not applying because the training was not relevant

SECTION 11: Access to Food Aid humanitarian Assistance

1101	Did your household receive food aid in the past one month?	1=Yes 2=No
1102	The months your child received food for education	1=January 2=February 3=March 4=April 5=May 6=June 7=July 8=August 9=September 10= October 11 = November 12=December
1103	Which month did you receive food for work / Assets?	1=January 2=February 3=March 4=April 5=May 6=June 7=July 8=August 9=September 10= October 11 = November 12=December
1104	Have you receive cash transfer from the Government / NGO Social Protection safety net programme in the past one month?	1 = Yes 2 = No
1105	In which form did you receive the cash transfer?	1= Cash in the bank account 2= Cash through MPESA / AIRTEL Money 3= Cash in Hand 4= Cash Voucher 5= Not Applicable

1107	What was the value of the cash received in Kenya shillings?	1= 1 - 500 1,001 – 1,500 2,001 – 2,500 7= 3,001 – 3,500 9 = 4,001 – 4,500	2= 501 – 1,000 4= 1,501 – 2,000 6= 2,501 – 3,000 8= 3,501 – 4,000 10= 5,001 and above

THANK YOU VERY MUCH.
THIS IS THE END OF THE SURVEY.

Appendix 4: Bi-weekly questionnaire

Date …….. Child's MAM ID……..

1. Who in the household regularly eat the Supplementary Food? (Circle **ALL** given answers)
   1= malnourished child
   2= another child in the Household less than 5 years of age
   3= another child in the household older than 5 years of age
   4=father
   5=mother
   6=elderly members of the household
   7=visitors to the household
   8=no one in the household
   9=don't Know
   10= Other (Specify)
2. If the food is shared by other children in the household, by how many children less than 5 years of age is it shared in total (Circle **ONE** as appropriate)
   1= one 2= two 3=three 4=Four 5= Five or more
   6= Food is shared with No children 7= Don't Know
3. What portion of the Supplementary food did the malnourished child eat? (Circle only **ONE**)
   1= None 2= less 25% 3= between 25% and 50%
   4= About 50% 5= Between 50% and 75% 6= More than 75% 7= 100%
   8 = Don't Know
4. How long did the Supplementary food last in the household? (Circle only **ONE**)
   1= 14 days 2= 11-13 days 3= 8 -10 days 4= 7 days or less
   5= 30 days or more 6= don't know
5. What portion of the supplementary food was sold or exchanged for other household items? (Circle only **ONE**)
   1= Less than 25% 2= Between 25% and 50% 3=About 50%
   4= 100% 5= Don't know
6. Has the child fallen sick in the last 14 days?
   1=Yes 2=No 3 Don't Know
7. Which of the following sickness was the child suffering from?
   1= Fever like malaria 2= Watery Diarrhea 3=Bloody Diarrhea 4= Cough
   5=Eye infection 6=Other
8. How is the appetite of the child for the regular household food? (Not the supplementary food)
   1= Good 2= Poor 3= Don't Know
9. Record the weight of the child in Kilograms (KG)
   Weight =……Kg
10. Record the Height of child in Centimeters (cm).
    Height = ……..cm

11. Record the Upper Arm Circumference of the child in Centimeters (cm).
    MUAC = ……cm

Caregiver attitude on infant and young child feeding practice

How would you rate your understanding on the following topics regarding your child feeding practices?

1. I know when to initiate breast feeding for my child.

1= Strongly agree 2= Agree 3=Disagree 4=Strongly disagree

2. I understand the benefits of colostrum to my child.
1= Strongly agree 2= Agree 3=Disagree 4=Strongly disagree

3. I know when to start complementary feeding for my child.
1= Strongly agree 2= Agree 3=Disagree 4=Strongly disagree

4. I know the benefits of micronutrients to my child.
1= Strongly agree 2= Agree 3=Disagree 4=Strongly disagree

5. I understand the causes of Kwashiorkor in children.
1= Strongly agree 2= Agree 3=Disagree 4=Strongly disagree

6. I understand the causes of Marasmus in children.
1= Strongly agree 2= Agree 3=Disagree 4=Strongly disagree

7. I know that when my child needs to breastfeed, I give her/him the breast regardless of the number of times I had already breastfed the child.
1= Strongly agree 2= Agree 3=Disagree 4=Strongly disagree

8. I know the duration for exclusive breastfeeding.
1= Strongly agree 2= Agree 3=Disagree 4=Strongly disagree

9. I understand the minimum meal frequency for the child in a day.
1= Strongly agree 2= Agree 3=Disagree 4=Strongly disagree

10. I understand the different types of food which am supposed to give my child.
1= Strongly agree 2= Agree 3=Disagree 4=Strongly disagree

11. I know how to give my child plumpy sup.
1= Strongly agree 2= Agree 3=Disagree 4=Strongly disagree

12. I understand that plumpy sup is only meant to be given to my child who is being treated for malnutrition.
1= Strongly agree 2= Agree 3=Disagree 4=Strongly disagree

Appendix 5: Focus group discussion guide

The focus groupd discussion will target between 10 - 12 mothers / care givers with children who are being treated for moderate acute malnutrition using plumpy sup. A similar number of community health workers, community health volunteers will also be targeted for a separate focus group discussion. Consent for the focus group discussions will be sort one week in advance.

Introduction

Welcome all to today's activity, let us introduce ourselves before proceeding. The reason for this meeting is to hear your perceptions and views on the treatement of moderate acute malnutrition using Plumpy Sup. All the information you give will be utilized soley for purposes of the study. To assist me with the analysis, I request your permission to record the interview. The interview will take approximately 45 minutes.

Section one: General view on the intervention

1. What comes to your mind when you think about the Plumpy Sup?
2. Have you ever thought of withdrawing your child the treatment?
3. Were your expectations met by the treatment regime?
4. What did you like most about the treatment?
5. What challenges did you experience while administering the treatement to your child?
6. What recommendations would you have based on the treatment?

Section two: Spidergram assessment

7. In a scale of 1 to 5 where 1 is the lowest and 5 is the highest, can you provide an assessment of community members participation in the supplementary feeding programme.

Closing remarks and vote of thanks

I take this opportunity to thank you for your time and participation in the interview. I acknowledge the candid opinion in all we have discussed and I promise to respect your views and get back the feedback of our discussion as appropriate. Once again thank you so much for taking your time off your tight schedules to take part in this activity.

Appendix 6: Key informant interview guide

Introduction

Thank you for agreeing to participate in the study. The objective of our meeting today is to hear your views and perceptions on moderate acute malnutrition treatment mainly on adoption and implemnation of nutrition policies . All information will be used soley for purposes of the study. To assist me with analysis, I request your permission to allow me to record the interview. The interview will take approximately 30 minutes.

Guiding questions

1 In your opinion, what are the factors that lead to increase in moderate acute malnutrition in Turkana?
2 To what extent has the county adopted and implemented nutrition policies in turkana county?
3 Which factors hinders or promotes the adoption / implementation or lack of in Turkana county?
4 What is your opinion on the ability of households in Turkana central to sustain moderate acute malnutrition treatement ?
5 What strategies have been put in place to ensure continuation of treatement of moderate acute malnutrition using plumpy sup after the expiry of donor/ funder programme?

Closing remarks

I take this opportunity to thank you for your time and participation in the interview. I acknowledge the candid opinion in all we have discussed and I promise to respect your views and get back the feedback of our discussion as appropriate. Once again thank you so much for taking your time from your busy schedules to participate in this activity.

Appendix 7: Observation guide

STRUCTURED OBSERVATION SCORE SHEET

Location details: v	

HYGIENE

1. What and how many hand-washing facilities are available in the compound?
(If there are several facilities, more than one answer can be given)
Project-provided movable washstand with drip
Project-provided washstand with tap
Tub with several taps
None

2. What is the facilities' condition?
Functioning
Not functioning
Leaking

3. Where are the facilities located?
(If there are several facilities, more than one answer can be given))
Inside the school
Outside the school
Next to the toilet

4. What is the approximate distance from the toilet to the hand-washing facility?

5. Is water available?
Yes
No

6. Is soap/ash/mud available?
Yes
No

7. What water source is used for the handwashing stand?
Pipe
Water brought to a barrel
Other

8. If a barrel or a tub, is water available?
Yes
No

9. What is condition of the school yard?
Clean
Dirty

10. Are feces visible in the compound?
Yes
No

11. (If observable) what is done with collected garbage?
Burned
Dumped outside school yard
Dumped inside school yard

Buried

QUALITY OF WATER

12. What is the source of water for general use and for drinking?
A. Water from a slow sand filter
B. Water tap or hand pump
C. Well
D. Piped water
E. Surface water
F. None
G. Other
13. Which source did you observe children using most frequently?
14. What is the approximate distance from the main drinking water source to the compound / school?
15. Is this source protected?
Yes
No
16. Slow sand filter – is there water on top?
Yes
No
17. Water tap--does water flow out of the tap?
Yes
No
18. Does the tap leak?
Yes
No

WATER CONTAINERS
19. What is the condition inside of water containers?
Clean
Dirty
20. Are drinking water containers properly covered?
Yes
No
21. How do children drink?
A. With their own cups
B. With one single cup
C. With their hands
D. With their mouths

Appendix 8: Child Dietary Intake tool

Introduction

Thank you for giving me the opportunity to follow up on the progress of your child. I would like you to help me understand the food that your child took in the past 7 days. I will be asking you questions and answer the questions to the best of your knowledge.

Food type	Days food is eaten by the child in the past 7 days	Amount of food taken by the child in the past 7 days	Metric of measurement (g)
Staples (Ugali, potatoes, rice, green bananas, maize)			
Other cereals			
Milk			
Legumes			
Yellow/red/orange vegetables			
Dark green vegetables			
Flesh meat			
Fish			
Eggs			
Fats, nuts			

Appendix 9: Child Food intake in the past 24 hours

Introduction

Thank you for giving me the opportunity to follow up on the progress of your child. I would like you to help me understand the food that your child took in the past 24 hours. I will be asking you questions and answer the questions to the best of your knowledge.

Food	Time taken	Meals	Ingredient	Quantity	Metric (g)	Cooking method	Amount cooked	Metric (g)	Amount consumed	Metric (g)

Appendix 10: Kenyatta University Ethics Review PLEASE ENSURE YOU PASTE THE FULL LETTER FROM KU

KENYATTA UNIVERSITY
ETHICS REVIEW COMMITTE

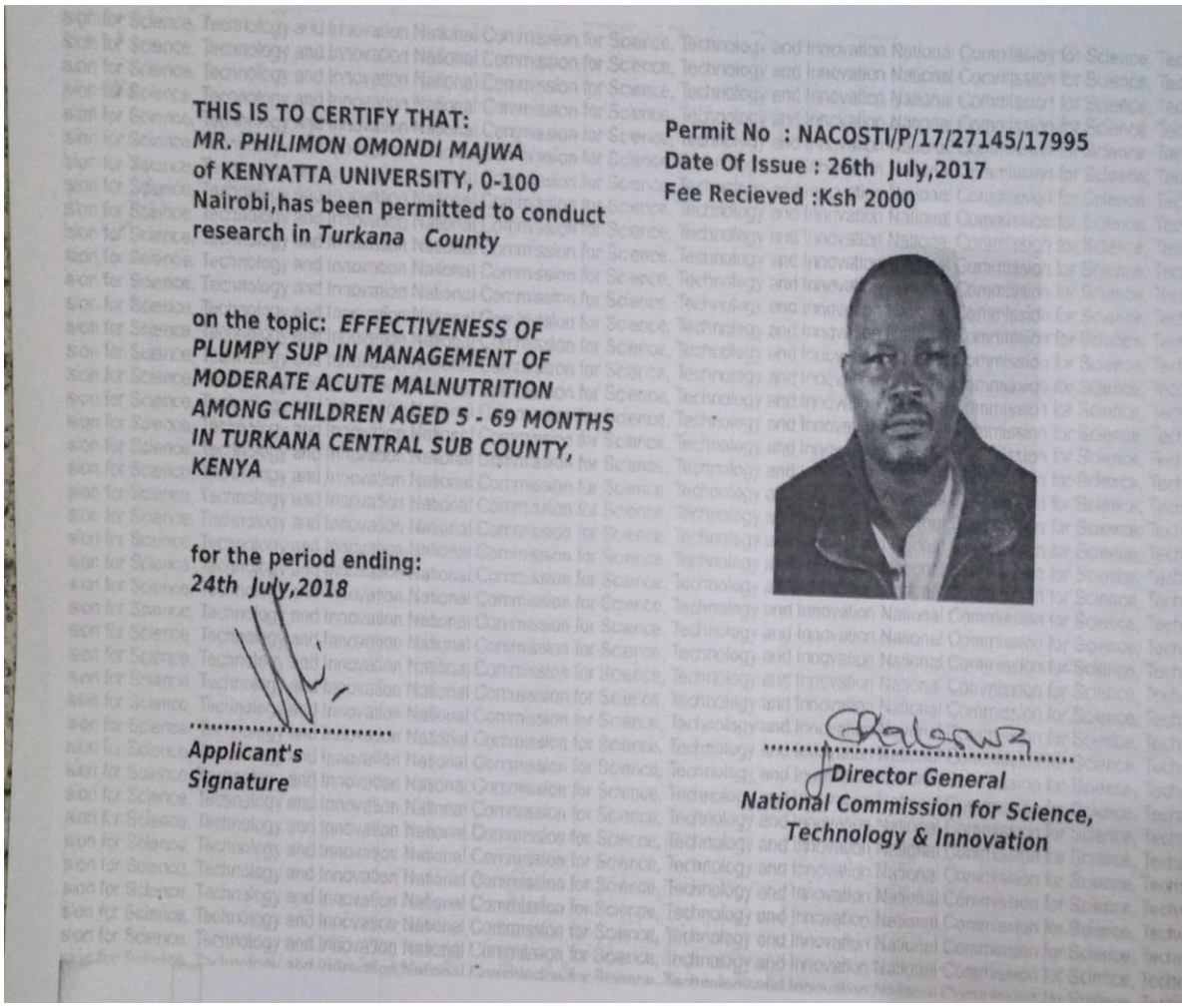
Fax: 8711242/8711575
Email: kuerc.chairman@ku.ac.ke
kuerc.secretary@ku.ac.ke
secretariat.kuerc@ku.ac.ke
Website: www.ku.ac.ke

Our Ref: **KU/ERC/APPROVAL/VOL.1** (53)

Philimon Omondi Majwa
Kenyatta University,
P.O Box 43844,
Nairobi

Dear Majwa

Appendix 11: Research permit National Council for Science, Technology, and Innovation



THIS IS TO CERTIFY THAT:
MR. PHILIMON OMONDI MAJWA
of KENYATTA UNIVERSITY, 0-100
Nairobi,has been permitted to conduct
research in *Turkana County*

on the topic: *EFFECTIVENESS OF PLUMPY SUP IN MANAGEMENT OF MODERATE ACUTE MALNUTRITION AMONG CHILDREN AGED 5 - 69 MONTHS IN TURKANA CENTRAL SUB COUNTY, KENYA*

for the period ending:
24th July,2018

.....
Applicant's Signature

Permit No : NACOSTI/P/17/27145/17995
Date Of Issue : 26th July,2017
Fee Recieved :Ksh 2000

.....
Director General
National Commission for Science, Technology & Innovation

Appendix 12: Turkana County commissioner approval letter

THE PRESIDENCY

MINISTRY OF INTERIOR AND CO-ORDINATION OF NATIONAL GOVERNMENT

Telegraphic address: COUNTY COMMISSIONER" LODWAR"
Telephone: LODWAR 21240
Telex:
Fax:
When replying please quote
Ref No. CC.CONF.ED.12/1/VOL.I/(209)
and date

COUNTY COMMISSIONER'S OFFICE
TURKANA COUNTY
P.O. BOX 1 – 30500
LODWAR

7th December, 2017

Deputy County Commissioner,
TURKANA CENTRAL SUB-COUNTY.

RE: RESEARCH AUTHORIZATION: PHILIMON OMONDI MAJWA

The above mentioned who is from Kenyatta University is authorized to carry out research on " ***Effectiveness of plumpy sup in management of moderate acute malnutrition among children aged 5-69 months in Turkana Central Sub-county, Kenya*** ". The research period ends on 24th July, 2018.

Any assistance accorded to him will be appreciated.

A. M. KIMANZI,
FOR: COUNTY COMMISSIONER,
TURKANA COUNTY.

C.C. The County Director of Education,
TURKANA COUNTY.

PHILIMON OMONDI MAJWA