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ACCEPTABILITY OF PLUMPY'NUT (A PEANUT-BASED READY- TO -USE THERAPEUTIC FOOD) AMONG MALNOURISHED CHILDREN IN SELECTED REHABILITATION CENTRES IN ACCRA METROPOLIS

BY

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DECLARATION

This is to certify that this dissertation is the result of a research undertaken by Emelia Dery supervised by Dr. Joana Ainuson-Quampah, Mrs. Freda Dzifa Intiful and Rev. Dr. Thomas Akuettey Ndanu, towards the award of a Master of Science (MSc) degree in Dietetics in the Department of Nutrition and Dietetics, School of Biomedical and Allied Health Sciences, College of Health Sciences, University of Ghana. This dissertation has never been presented in part or whole to any Institution for the honor of any degree or diploma.

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ABSTRACT

Background: The efficacy of Plumpy'nuts (PPN) has been technically and medically documented as an appropriate product for the treatment of severe acute malnutrition (SAM) in children. SAM is a chief killer of children < 5 years, responsible for 1 million deaths yearly. Children with SAM risk dying 9 times more than non-SAM children.

Aim: To evaluate the acceptability of PPN, "a ready-to-use therapeutic food" among malnourished children in selected rehabilitation centers in the Accra Metropolis.

Method: A cross-sectional study based on 100 subjects (child-caregiver pair) with the children 6-59 months of age, were chosen using total enumeration. Semi-structured questionnaire was employed to gather data on caregiver and child acceptability of PPN. Anthropometric measurements (weight, length and MUAC) of children were assessed. Associations between acceptability and PPN's organoleptic properties and socio-demographic variables were analyzed.

Results: Key findings showed PPN acceptability of 75% to 92% by caregivers towards the various organoleptic properties and 93% tolerability by children. The mean age of the children was 13 months. The mean MUAC, weight and height of the children after intake of plumpy'nut was 11.75±0.86, 6.65±1.11 and 69.46±5.92 respectively representing a significant improvement from 11.02±0.62, 5.86±1.11 and 67.89±5.94 respectively before plumpy'nut intervention. The association between the children's PPN acceptability and the children's current nutritional status was woefully insignificant (p-value > 0.05). There were no significant associations between acceptability and any socio-demographic variables assessed (p-value > 0.05).

Conclusion: There was high acceptability of plumpy'nuts which is associated with its organoleptic properties as well as its beneficial effect on nutritional status. The educational status of the caregivers as well as the health education/information provided by health workers pertaining to plumpy'nut could also account for its acceptability. Appropriate health education coupled with quality standards of manufactured plumy'nuts is paramount to its acceptability.

DEDICATION

This dissertation is dedicated to my husband for his unfailing love and support for me throughout the trying moments of my study, to my mother whose tremendous support, encouragements and prayers has brought me this far and my dedicated friends and siblings for their prayers.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of variance
BMI	Body mass index
CFRs	Case fatality rates
CMAM	Community based management of severe acute malnutrition
CMV	Combined multivitamin
GAM	Global acute malnutrition
GDHS	Ghana demographic health survey
GDP	Gross domestic product
GHC	Ghana cedi
g	gram(s)
HFA	Height for Age
HIV	Human Immune Virus
IQ	Intelligent Quotient
JHS	Junior High School
KCAL	Kilo calories
Kg	Kilogram(s)
MAM	Moderate acute malnutrition
MSF	Médecins Sans Frontières
MUAC	Mid upper arm circumference
NGOs	Non-governmental organizations
PhD	Philosophy in development
PPN	Plumpy'nut
PUFA	Polyunsaturated fatty acid
RUTF	Ready-to-use therapeutic food
SAM	Severe acute malnutrition
SCN	Standing Committee on Nutrition
SD	Standard Deviation
SHS	Senior High School

SPSS	Statistical Package for Social Sciences
TFC	Therapeutic feeding centre
UN	United Nations
UNICEF	United Nations Children's Fund
USD	United States Dollar
WFA	Weight for age
WFH	Weight for Height
WFP	World food program
WHO	World Health Organization
WHZ	Weight for height Z-score

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND

The use of ready-to-use therapeutic foods (RUTFs) as the main treatment source for the community-based management of uncomplicated severe acute malnutrition (SAM) among children is the most recent treatment endorsed by the World Health Organization (WHO, 2007). Malnutrition according to WHO (2010), emanates from eating a diet in which nutrients are either not enough or too much such that the diet causes health problems. Although malnourishment denotes both under-nourishment and over-nourishment, it commonly indicates under-nourishment including protein-energy malnutrition (Severe Acute Malnutrition) and insufficiency of micronutrients (WHO, 2010).

According to the survey report of joint trends in child malnutrition by UNICEF-WHO- World Bank (2012), 52 million children under-five years of age were wasted in 2011. In spite of an 11% decrease in wasting cases since 1990, wasting malnutrition still affects 8% of all children under 5 years (Caulfield et al., 2004). Wasted children are at increased danger of severe acute malnourishment as well as dying, in which malnourishments accounts for more than 50% of all death of children globally (Caulfield et al., 2004). Though at least 1 million children die due to malnourishments, acute malnourishment may predispose up to 3.5 million children less than 5 years to death (Black et al., 2008), (Collins, et al., 2006) . Mason et al. (2003) showed that, at least one third of all mortality and morbidity of children could be averted if malnutrition were properly managed. Severe acute malnutrition (SAM) continues to be a key problematic health issue of the public all through the developing world, predominantly in sub-Saharan Africa and

South Asia. An estimated 20 million children suffer from SAM (WHO, WFP, SCN & UNICEF, 2007).

In this research, malnutrition among children will be focused on under nutrition, where the nutrients consumed are not enough to support adequate and/or normal growth of children. Malnutrition may be assessed in many ways. Clinical grading standard, weight-for-height (WFH) index, height-for-age (HFA) index, weight-for-age (WFA) index, body mass index, and skin fold thickness are among those utilized most often in the field in accordance to the WHO child growth standards (WHO, 2010).

Malnutrition can emanate from diverse causes which can be categorized into three main forms in children. Acute malnourishment arises from acute food deficiency and is defined by a decrease of two standard deviations (SD) below the WFH index (WHO, 2010). Severe acute malnutrition is often complicated by diarrhea, respiratory infection and malaria and is well-defined by a decrease of minus three SD below the WFH index. While prolonged starvation, termed as "stunting", is defined by a decrease of minus two SD below the HFA index. Furthermore, an amalgamated form of both "stunting" and "wasting" is defined by a decline in the "WFA index" (WHO, 2010).

Though the malnutrition situation in Ghana is reducing, it is rather on a slow pace. According to the Ghana demographic and health survey report, the prevalence of "stunting, underweight and wasting" among children below 5 years in the year 2008 were 28%, 14% and 9% respectively as compared to that of the year 2014 which recorded the prevalence of 19% for stunting, 11% for underweight and 5% for wasting (GDHS, 2008 and 2014). The wasting situation in Ghana for instance is still worrying considering the 3% rate of reduction within a period of six years. This is coupled with the fact that "wasted children" are at greater threat of dying (Caulfield, et al.,

2004). As a result, the problem of child mortality may not be solved if childhood wasting is not addressed head-on.

Plumpy'nut is the most extensively administered RUTF in Africa, for the treatment of severe acute malnutrition (WHO, 2007). It is a peanut-based mixture made from milk powder, sugar, vegetable oil, minerals and vitamins. Some of the benefits for its use are that, it does not need preparation or dilution with water or other liquid foods, and thus useful in resource limited settlements/households. It is also safe microbiologically, and therefore can be kept for a number of months in monotonous household settings (Collins et. al., 2006).

1.2 PROBLEM STATEMENT

Most studies within Africa, have established the acceptability and effectiveness of RUTF in the treatment of SAM (Briend et al., 1999, Diop, 2003, Ciliberto, 2005 & Navarro-Colorado, 2005). Hence, the World Health Organization and UNICEF vouch for RUTF for the cure of SAM, both in non-emergency circumstances as well as adversity liberation programmes (WHO, 2007).

Africa and Asia shares the greatest of all forms of malnutrition. According to a joint child malnutrition findings by UNICEF, WHO, World Bank, (2016), whereas Asia recorded 56% and 68% respectively for stunting and wasting amid children below five years, Africa on the other hand recorded stunting and wasting values of 37% and 28% respectively in the world's children under five population.

An acceptability trial conducted in Cambodia on "Plumpy'nut", the utmost commonly used "RUTF" within Africa, revealed it was not accepted among Cambodian children (Bourdier, 2009). Several additional hitches were documented with the premiering of "plumpy'nut" in Cambodia. These include inadequate information and understanding by both health staff and care-givers (Bourdier, 2009). This inability to fruitfully introduce plumpy'nut for the

management of SAM in Cambodia has led to concerns in South East-Asia about the tolerability of presently used "RUTF's".

The acceptability of the plumpy'nut still remains unanswered in most of the countries that use it. In Ghana, there is paucity of information on the acceptability of the standard plumpy'nut among malnourished children. A recent research conducted in Ghana was on the acceptability of locally produced RUTF (Weber et al., 2016) and not the commercially produced RUTF. The locally produced RUTF was however not accepted by the caregivers/mothers.

Though the malnutrition situation in Ghana is reducing, it is rather on a slow pace. According to the Ghana demographic and health survey report, the prevalence of "stunting, underweight and wasting" among children below 5 years in the year 2008 were 28%, 14% and 9% respectively as compared to that of the year 2014 which recorded the prevalence of 19% for stunting, 11% for underweight and 5% for wasting (GDHS, 2008 and 2014). The wasting situation in Ghana for instance is still worrying considering the 3% rate of reduction within a period of six years. This is coupled with the fact that "wasted children" are at greater threat of dying (Caulfield et al., 2004). As a result, the problem of child mortality may not be solved if childhood wasting is not addressed head-on.

In spite of the effectiveness of the use of plumpy'nut in increasing the nourishment levels of the malnourished children, the default frequency for children in the rehabilitation programme was high (Saaka et al., 2015). It is against this background that this research is being conducted on the acceptability of the standard "peanut based RUTF (plumpy'nut)" in the Accra metropolis of Ghana.

1.3 SIGNIFICANCE OF STUDY

The World Health Organization and UNICEF endorse plumpy'nut as the main treatment source for children with SAM in Africa and for that matter Ghana (WHO, 2007). Malnourished children in the northern region of Ghana who were enrolled in a rehabilitation programme and received weekly rations of Plumpy'nut showed an increase in weight of 28g/kg/day (Saaka et al., 2015). In spite of the effectiveness of the use of plumpy'nut in increasing the nourishment levels of the malnourished children, the default frequency for children in the rehabilitation programme was high (Saaka et al., 2015). It is against this background that this research is being conducted on the acceptability of the standard "peanut based RUTF (plumpy'nut)" in the Accra metropolis of Ghana. Plumpy'nut is one of the main treatment regimens for the controlling of "severe acute malnutrition" in Ghana. Therefore it is imperative that its acceptability among malnourished children is investigated. Thus the study on the acceptability of plumpy'nut could help ascertain its effectiveness in managing malnutrition among children; the perception of the caregivers on the acceptability of plumpy'nut would also be ascertained, as against its impact on the "community-based management of malnutrition" programme. This survey outcome could also serve as a baseline upon which other larger studies could be done elsewhere in Ghana, in order to find sustainable and effective management approach to malnutrition and its effects.

1.4 AIM

This research is aimed at assessing the acceptability of plumpy'nut (a peanut based RUTF) among malnourished children in some selected Rehabilitation centers in the Accra Metropolis.

1.5 SPECIFIC OBJECTIVES

1. To determine the caregiver's/mother's perception of the child's acceptability of the plumpy'nut.

2. To assess the child's acceptability of the plumpy'nut.

3. To determine association between acceptability and caregivers/mothers socio-economic variables.

4. To determine association between acceptability and child's nutritional status

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 MALNUTRITION

2.1.1 Global Acute Malnutrition

According to research by Kouam and colleagues, the prevalence of global acute malnutrition (GAM) is 13.5%, indicating around 2.2 million of the world's children, among which 10.1% undergo moderate acute malnutrition (MAM) and 3.4% (almost 500,000 children) suffer from severe acute malnutrition (SAM) at every point in time (Kouam et al., 2014).

Globally, a probable 852 million persons lived with malnutrition (starvation) in 2000–2002, among which a maximum of 815 million live in developing countries (Muller & Kranwinkel, 2005). Generally, the quantum of affected individuals has reduced slightly in the past ten years. Even so, while countries like China had great declines in its quantum of affected children with SAM, the reduction in China was added up by an equivalent surge in SAM cases in the rest of the under developed world (Muller & Kranwinkel, 2005).

Overall, nutritional status of children has been improving universally within the last two decades; nonetheless, the situation is different for sub-Saharan Africa. According to Duggan and Golden (2005), the anticipated improvement is mired by "poverty, infection and ineffective governance" in the case of sub-Saharan Africa.

In developing countries including Ghana and in southern Asia specifically, under nutrition is a major well-being problem. Universal malnutrition is the utmost vital threat factor for disease as well as death and about half of the lives lost are connected to under nutrition, where largely younger children fall victims (Nga et al., 2013). In South-east Asia, in 2001, underweight accounted for 30% among children below age five, starvation for 10% and stunting 33%, causing persistent poor healthiness and insufficient food (Nga et al., 2013).

Recent studies in Vietnam showed that 19.7% - 27.7% of children under three years of age were underweight, 23.4% - 36% were stunted and 5.3% - 10.2% were wasting. This attests to the fact that children in Vietnam are still in a poor state of nutrition, and their nutritional status vary within areas in the country (Nga et al., 2013).

It is a worrying situation to note that, in India nearly 20% of children less than the age of five years are severely "wasted" (Shanghvi et al., 2014). Approximations from current national surveys, points out that 6.4% of children below five years of age have weight-for-height below third standard deviation. In present-day Indian population of "1.2 billion, there are around 132 million children under five years (12% of population), of which 6.4% or conversely 8 million are assumed to be suffering from severe acute malnutrition" (Shanghvi et al., 2014).

2.1.1.1 Causes of Global Acute Malnutrition

According to UNICEF, the causes of poor nutrition is extensively recognized and characterized as immediate, underlying, and basic causes. The UNICEF structure of malnutrition pinpoints inadequate dietary intake and disease as the immediate causes of malnutrition, and poor food security, inadequate care of children, deprived access to health services, and poor environments to be the underlying cause (UNICEF, 1998). The significance of these four causative factors differs by context. The events of many non-emergency circumstances, the occurrence of "severe wasting" typically arises after six months, and increases around one to two years, and drops when the child passes two years (Ashworth, 2005). During the period of introduction of complementary food, usually around six months old, when firsthand foods are incorporated into the child's food, it is usually challenging for children eating adequate nutritious meals to attain a high rate of growth (Ashworth, 2005).

In localities in which hygiene is deprived, contagious illness and under-nutrition act in synergy, reducing immunological capability to protect against disease. In relation to fundamental wellbeing concerns, a child suffering from "SAM" by and large needs about five to seven weeks to recuperate, to achieve a "Weight-for-Height more than two standard deviations". There is minute suggestions concerning the length of time children with MAM needs to improve since they are not usually followed by health delivery systems. Subject to the nature of SAM management, setback proportions can differ between zero and 18% (Ashworth, 2005). Researches that incorporated six-month sequel visits for children after management revealed setback levels of "0-23%" (Ashworth, 2005).

2.1.2 Prevalence of Malnutrition

The WHO projected that 20 million children less than five years went through the pain of SAM and that between "36 and 60 million children suffered from MAM" (WHO, 2000). In sub-Saharan Africa about 5.6 million (3.9%) children were severely wasted, and that of South Asia, 13.3 million children (WHO, 2000). Being underweight upsurges the chances that a person will fall ill and perish through a disease.

It was estimated that about 5.1% of pneumonia, diarrhea, and malaria morbidity was attributable to being moderately to severely underweight. The threat of dying of malnourishment is unswervingly linked to severity. Moderate wasting is associated with a mortality rate of 30.1 per 1,000 children per year, and severe wasting is associated with a mortality rate of 73-187 per 1,000 children per year (Black, et al., 2008). Eradicating malnutrition would avert 53% of deaths in children. According to WHO, prevalence of under nutrition in Ghana was last measured at 5% in 2010 (WHO, 2010).

Severe acute malnutrition (SAM) lingers on as a key public health concern all through the under developed countries, especially in sub-Saharan Africa and South Asia. An estimated "20 million

children suffer from SAM" (Nga et al., 2013). In 2015, about 68% of children who were wasted were from Asia, contributing for "more than two thirds of all wasted children below five years". While 68% of wasted children lived in Asia, 28% also lived in Africa at the same time. These also added up for more than a quarter of the populace of children who have "low weight-for-height" (UNICEF, WHO, World Bank, 2016). Diets short of both adequate macronutrients and micronutrients coupled with affliction of infection are fundamental reasons for child malnutrition. Children suffering from SAM need to be managed using expert therapeutic diets alongside the diagnosis and treatment of contagious and other complications (Nga et al., 2013).

According to WHO guidelines for the management of severe acute malnutrition, in rehabilitation centers, malnutrition among children is classified into two groups; "severe acute malnutrition (SAM) with or without medical complication" and "Moderate acute malnutrition (MAM) without medical complication" (WHO, 2010).

In both instances, children are screened using mid upper arm circumference (MUAC) or weight for height, expressed in Z-scores (WHZ). The second is obtained by assessing the weight and height equating it to standards.

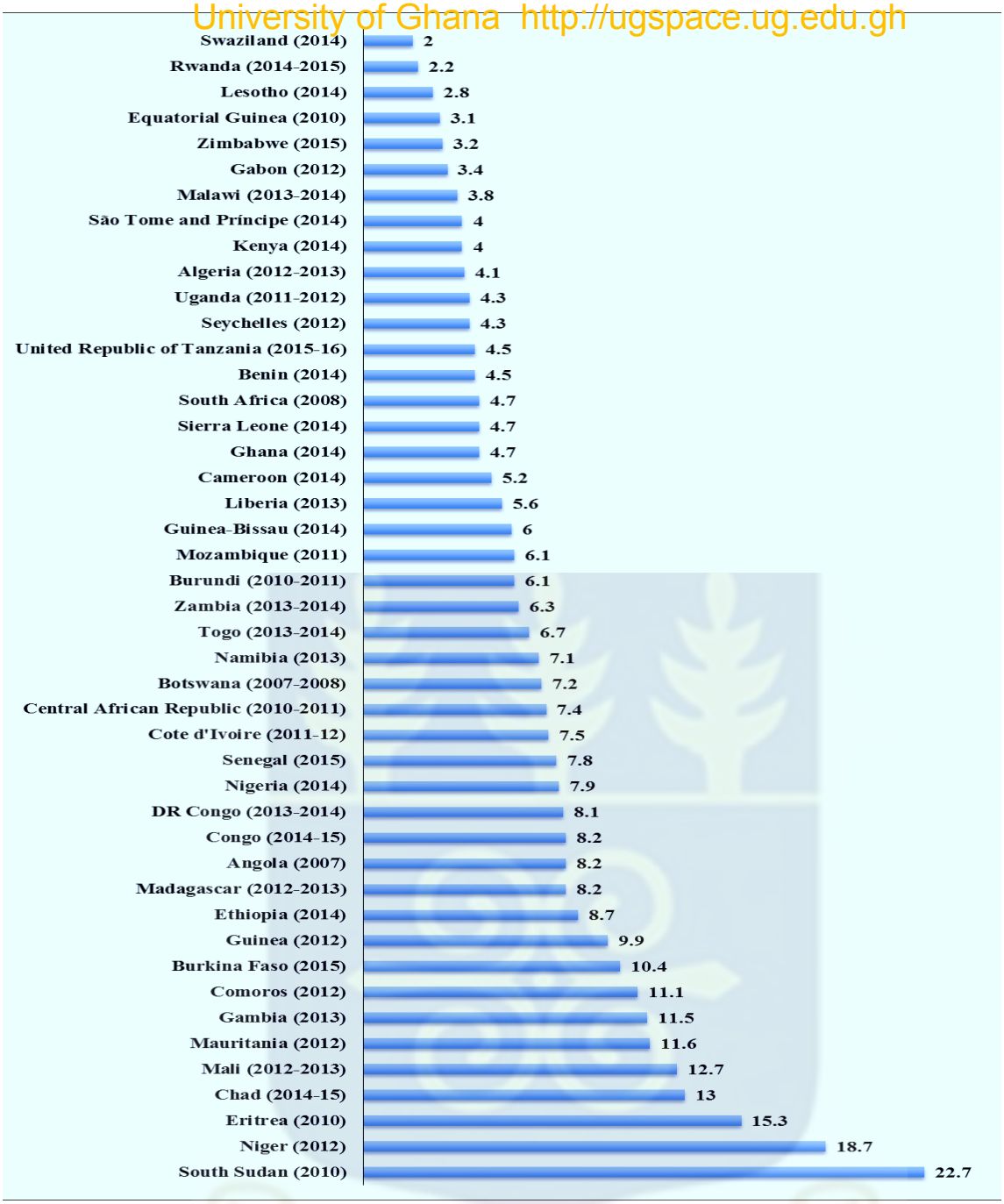
According to the National Center for Health Statistics reference values a child with severe acute malnutrition (SAM) is defined as "weight-for-height (WHZ) measurement of 70% or less below the median, or (WHZ < -3 and /or MUAC ≤ 11.5 cm and/or nutritional edema)" (Collins et al., 2006). Children who have moderate acute malnutrition (MAM; WHZ > -3 to < -2 and / or MUAC of between 11.5 cm to 12.5 cm) associated with medical complications are also taken care of under the rehabilitation care process (Collins et al., 2006).

2.1.2.1 Prevalence of Severe Acute Malnutrition (Wasting)

Wasting is prone to quick spurt in the occasions of cyclical shocks, climate changes and political or civic crises. For this reason, the malnutrition estimates published jointly by UNICEF, WHO and the World Bank, is done on a year by year estimates rather than trends (UNICEF, WHO and World Bank, 2016). According to the joint estimates report of 2016, an aggregate of 14.1 million children less than the age of 5 in the United Nations (UN) African Region were wasted (4.3 million of them severely), in 2015. On the other hand, an estimated total of 33.9 million children below 5 years were also reported wasted in Asia, of which 11.9 million were severely wasted (UNICEF, WHO and World Bank, 2016).

Nutrition data in the WHO African Region (2017), collected within the years of 2007 and 2015 in 45 African countries, showed that wasting prevalence, ranged from 2% in Swaziland to as high as 22.7% in South Sudan. This is shown in figure 2.1, with specific distributions of the performances of the various countries. On account of public health emergency thresholds, only 17 countries had acceptable prevalence of less than 5%, of which Ghana is inclusive. Another 19 recorded poor prevalence of (5% - 9%). Some six other countries had wasting rates ranging between 10% and 14%, which is considered serious public health emergency. Worse of all were three other countries namely, Ertrea, Niger, and South Sudan exceeding the 15% critical public health emergency threshold recording, 15.3%, 18.7% and 22.7 % respectively (Figure 2.1) (WHO, 2017).

In all 45 WHO African Countries, out of those countries which had data within the period of 2007 to 2015, it was an abysmal performance to see that only six countries had wasting prevalence of low levels ranging from 2% to 3.2%. this include; Swaziland (2%), Rwanda (2.2%), Lesotho (2.8%), Equatorial Guinea (3.1%), Zimbabwe (3.2%) and Gabon (3.4%) (WHO, 2017).



[1] Most recent data: 2007–2015. Data sources:
"Algeria,[3] Angola,[4] Benin,[5] Botswana,[6] Burkina Faso,[7] Burundi,[8] Cameroon,[9] Central African Republic,[10] Chad,[11] Comoros,[12] Congo,[13] Côte d'Ivoire,[14] Democratic Republic of the Congo,[15] Equatorial Guinea,[16] Eritrea,[17] Ethiopia,[18] Gabon,[19] Gambia,[20] Ghana,[21] Guinea,[22] Guinea-Bissau,[23] Kenya,[24] Lesotho,[25] Liberia,[26] Madagascar,[27] Malawi,[28] Mali,[29] Mauritania,[30] Mozambique,[31] Namibia,[32] Niger,[33] Nigeria,[34] Rwanda,[35] Sao Tome and Principe,[36] Senegal,[37] Seychelles,[38] Sierra Leone,[39] South Africa,[40] South Sudan,[41] Swaziland,[42] Togo,[43] Uganda,[44] United Republic of Tanzania,[45] Zambia,[46] Zimbabwe".[47]

Figure 2.1: Prevalence of wasting amid children < 5 years old in the WHO African Region. Source: Nutrition in the WHO African Region, (2017) page 57.

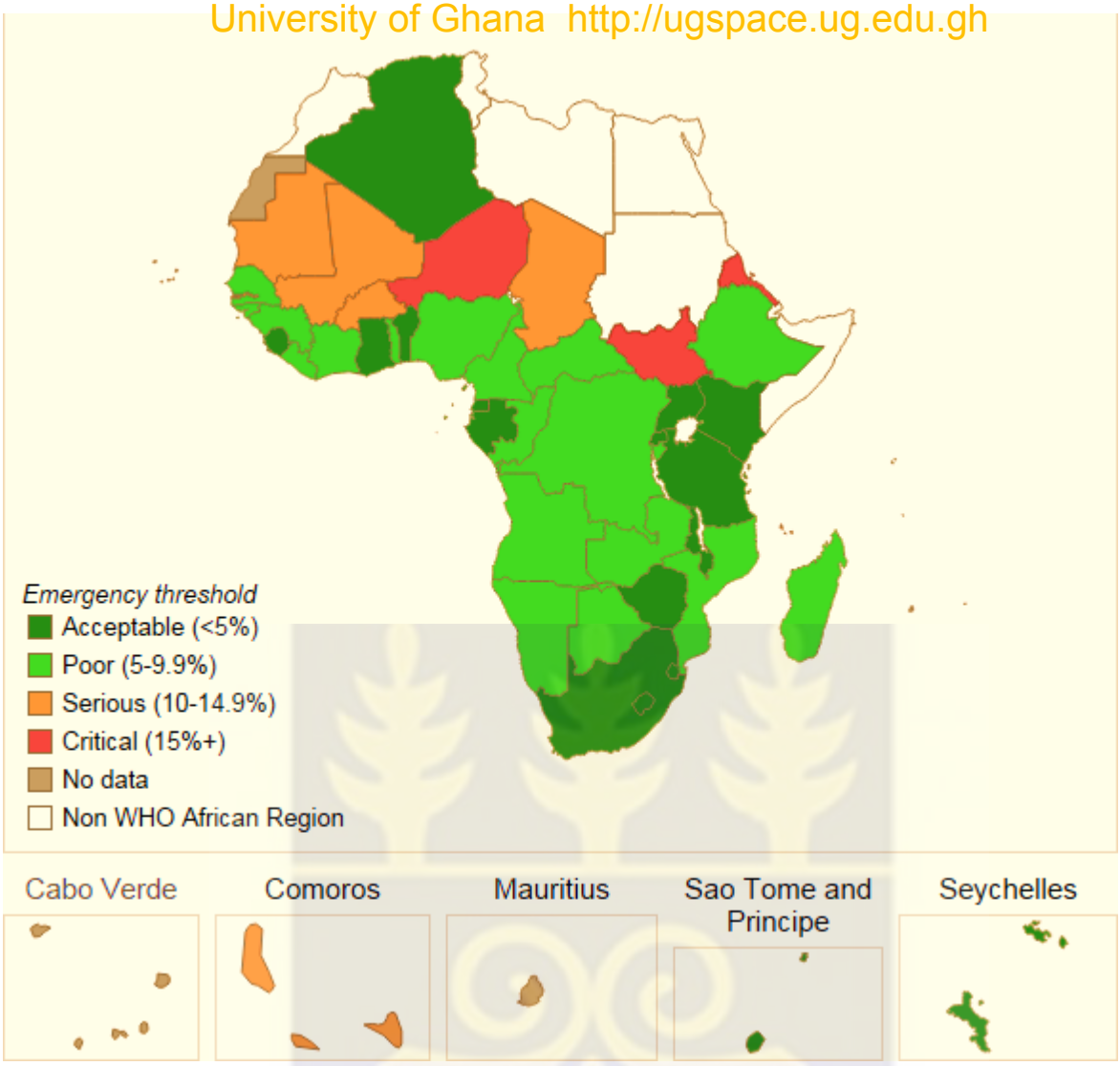


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Figure 2.2: Prevalence of wasting amongst children below 5 years old in the WHO African Region

Source: Nutrition in the WHO African Region, (2017) page 12.

2.1.3 Effects of Malnutrition

The effects of childhood malnutrition on people as well as economies are enormous. Children with SAM have mortality rates 5-20 times higher than well-nourished children, and SAM directly and indirectly causes approximately 1 million deaths each year (WHO, 2007). Children who go through the pain of severe malnutrition can exhibit long-standing developmental problems. Several research works have identified that intelligent quotient (IQ) scores were "8-18 points lower" in children severely malnourished (Ashworth, 2005). Later in life, ill-nourished children would usually turn out to begin formal education later, are more probable to abandon school, and more likely to be less successful as grown persons (Ashworth, 2005).

Investment in worldwide nourishment connected activities between 2000 and 2005 was estimated at USD 250-300 million per year. This incorporated rudimentary nourishment involvements and development and crisis food aid (Hill et al., 2011).

As stated by Muller and Krawinkel (2005), under nourishment has the potential to escalate the danger and worsen the intensity of infections. Malnourished children, have the greater possibility of dying than their well-nourished counterparts (Caulfield *et al*., 2004).

2.2 TREATING SEVERE ACUTE MALNUTRITION

2.2.1 Historic Treatment Options

In the years 1999 and 2000 the World Health Organization published two guidebooks regulating how to treat acute malnutrition. Before these guides were published in the public domain, four distinct guiding principles, two by the WHO from 1978 and 1981 and two by NGOs in 1978 and 1987 aimed at curing acute malnutrition were in use, every one of them comprising dissimilar material (WHO, 1999). The prerequisite for a very uniform procedure arose from

the point that between the "1950s and the 1990s", the main limitations of previous care approach led to numerous casualties in hospitals among children with "severe wasting" remaining constantly at 20-30% and were as high as 50-60% for malnourished children with edema (WHO, 1999). None the less, WHO findings showed that hospitals that observed medical treatment procedures founded on the most current proof managed to lessen casualties in the hospitals to under 5% (WHO, 1999), which was a remarkable improvement.

The WHO, 1999 and 2000 guidelines for the treatment of severe malnutrition contained 10 procedures in two management phases; a one to two-week "stabilization phase" and a four-week "rehabilitation phase". The "rehabilitation phase" could begin in an "in-patient centre" and finalized in the house (WHO, 1999). According to the guidelines the "stabilization phase" included ascertaining and managing the high risk conditions of malnutrition in children such as hypoglycemia, hypothermia, dehydration, septic shock, cardiac failure, underlying infections, and vitamin deficiencies. The "rehabilitation phase" focused on thorough nourishing and weight increase (WHO, 2000).

Severe acute malnutrition (SAM) is pronounced globally, to affect about 20 million children below the age of 5 years (WHO et al., 2007). These affected children are said to have about 9-fold increased threat of dying when equated to their counterparts who are not malnourished (Black et al., 2008). Hitherto, the recognized method for the management of "SAM" was limited to health facilities or therapeutic feeding centres (TFC) reason being that the only endorsed product at the time, "F100, a milk based therapeutic food" is mainly for in-patient use only (WHO, 1999). The development which led to the production of "ready-to-use therapeutic food (RUTF)" in the middle of the years 1990s therefore brought a profoundly fresh method to the treatment of SAM (Briend et al., 1999). "RUTFs are high-energy, lipid-based spreads" that offers the suitable "energy, protein, fat, vitamins and minerals" to treat SAM in children from 6

months to 59 months and comparable in nutritive profile to "F100 therapeutic milk" (Briend et al., 1999; UNICEF, 2013). Studies conducted earlier discovered that RUTFs are greatly acceptable and can be used to manage SAM in different sceneries (Manary et al., 2004; Sandige et al., 2004; Linneman et al., 2007; Briend & Collins 2010).

The World Health Organization (WHO) and United Nations Children's Fund (UNICEF), presently endorses community-based management of acute malnutrition (CMAM). In the CMAM approach most patients of SAM are treated as outpatients in their home environment through the supply of "RUTF" and other vital medicines, whereas in-patient management becomes the reserve for the management of complex SAM cases (Ashwort, 2006; Gatchell et al., 2006; WHO et al., 2007). The "CMAM programme" is run by screening children for SAM in the various communities using trained community health volunteers or health care workers and referring affected children to primary health care entities where their health and nutritional status is further assessed by health workers. The caregivers of the affected children are provided with RUTF, medication as well as counseling on subjects such as how to feed RUTF. Caregivers are then asked to go home to manage the SAM child at home according to the guidelines provided. Caregivers are then scheduled to make their next visit to the health facility in a week. This is to enable health workers reassess the SAM child for progress and provide the recommended RUTF ration for the next one week (Valid International, 2006).

Operation of CMAM begun as small-scale outwardly funded non-governmental programmes with the objective to manage large numbers of SAM cases that arise during nutritional emergencies (Chamois, 2009). The CMAM programme has minimized the case fatality rate as well as improves coverage of SAM treatment remarkably. As a result of this mark attained, CMAM got expanded and incorporated into existing governmental health organizations for the

treatment of the rare occurrences of SAM cases outside emergency situation for the treatment of the rare occurrences of SAM cases outside emergency situation (Deconinck et al., 2008).

2.2.1.1 Alternative Treatment of Severe Acute Malnutrition (SAM)

Though hospital-based management of SAM continued to be the custom throughout the 1990s, it was expensive, and there were inadequate levels of adherence. In Bangladesh, for example, only 14% of caregivers of children with acute malnutrition who were referred to hospitals followed the recommendations of the hospital-based management of SAM. Caregivers mentioned challenging factors at home, perceptions about disease severity, fear of hospitals, costs of transport, and perceptions about the cost and quality of hospital care as main deterrents (Collins et al., 2006).

Challenges with hospital treatment stimulated some experts to explore other health provision methods for the "rehabilitation phase" of management, comprising "daycare nutrition centers, residential nutrition centers, primary health clinics, and home rehabilitation". Each of these health provision systems had success stories based on death rates lower than 5% and weight increases more than or equivalent to 5g/kg/day. In settings where "high energy and high protein" food combinations could be given at home as well as adequate monitoring by the health system, home rehabilitation was chosen (Collins et al., 2006).

2.2.2 The RUTF Revolution

In the mid-1990s relief organizations working in crises situation to develop their nutrition programs approached Dr. André Briend, a French physician with a PhD in nutrition for his technical contribution on the effective management of SAM. Briend's previous work included anthropological assessment of malnutrition, the role of extended breastfeeding in high burden malnutrition regions, and the relationship between diarrhea and nutritional status

in Africa and Asia. After executing a valuation for the aid agencies, he recognized the "easily-contaminated, milk-based diets were not adapted for treating large numbers of children" (Briend, 2001).

Briend operated with Nutriset, a reserved French company that manufactured nutritious produces for philanthropic purposes, to produce Plumpy'nut, the trademarked name of peanut butter-based RUTFs. Five years preceding, Nutriset became the first to manufacture in large quantities for sale, available "F-75 and F-100". Three NGOs; "Valid International, Concern Worldwide, and Action Against Hunger" swiftly embraced "RUTFs" for use in crises situations where customary in-patient care was not probable due to safety measures, logistical issues, or government rules. Outcomes from these home-based management programmes surpassed "Sphere Project minimum standards for recovery, case-fatality, and coverage rates" (Briend, 2001).

2.2.2.1 Policy Development

Between 1999 and 2005, over 10 efficacy trials of RUTF were performed. Most research work revealed that when RUTF was administered at 175kcal/kg/day in the course of the rehabilitation phase, average increment in weight for non-HIV-infected children was over 5g/kg/day and death rates were below 5% (Briend, 2001). "Home-based" management using "RUTF" demonstrated to have the rate of recovery higher and that of relapse lower as children experienced speedy weight improvement and lesser symptoms of infection "less cough, diarrhea, and fever" during recuperation than children on standard treatment (Briend, 2001). In spite of verified effectiveness of "RUTFs" in managing SAM, patrons remained uncertain if "RUTF" can be distributed efficiently on a large scale.

Between the years 2000 and 2006, "25,000" malnourished children had undergone RUTF therapy by means of "community-based management of acute malnutrition (CMAM)

delivery model" formed by "Valid International and Concern Worldwide" (Enserink, 2008). The turnaround moments was in the year 2005, when in responding to the emergency situation in Niger, Doctors Without Borders (MSF) distributed RUTF, "UNICEF joined the World Food Program (WFP), the UN standing Committee on Nutrition, and the WHO to produce a Joint Statement of Community Based Management of Severe Acute Malnutrition" targeted at policy makers. The declaration, put out in the public domain in May 2007, became the premier document representing the WHO policy of RUTFs. It was a dire moment of revolution that paved way to a political introductory to UN establishments, donors, and NGOs to move ahead with RUTFs and provided the opportunity for these establishments to work with governments (Enserink, 2008).

In order to manage all 19 million children in the world who are suffering from SAM, it was necessary for nearly 238,000 tons of produce, which would cost USD 713 million plus an additional USD 285 million for supply". Manufacturing capability in the year 2007 was projected to be below 19,000 tons. Though UNICEF had set a target of improving manufacturing volume of RUTF to about 50,000 metric tons by the year 2011, this was meant to have only covered about 3,330,000 children suffering from acute malnourishment. Despite the achievement of RUTF in the field, the Lancet series on Maternal and Child Under-nutrition available in the public domain in January 2008 failed to approve "community-based treatment of SAM". The Lancet series however argued that, due to the absence of sampled research probing the administration of RUTFs in relation to mortality, the observational studies relating to RUTF, which testified great recovery and coverage could not be matched with the facility-based management. Furthermore, in the medical trials most children in the trial become stable by the hospital therapy before their participation in the trial, while in practice children were managed mainly in the community as long as they do not show any symptoms of complication. This was settled on the fact that "community based" therapy for SAM "ought to be formally assessed

in representative populations' but that withstanding, ready-to-use therapeutic foods seems practicable in community settings (Enserink, 2008).

2.2.3 The use of Ready-to-use therapeutic foods (RUTF)

RUTF is a "peanut-based mixture of milk powder, sugar, vegetable oil, minerals and vitamins". Its usage needs no preparation or mixing with water hence, making it practical for use where resources are scarce. Most importantly for it use which is of enormous benefit is that, it is safe against microbial infestation (Ali et al., 2013 & Manary, 2006).

2.2.3.1 Plumpy'nut

Plumpy'nut is the original RUTF product.

It is a solid crushable pre-packed RUTF purposely produced for the treatment of acute malnourishment without medical difficulties and has the following characteristics:

i. It's nutrients are comparable to that of F-100, a therapeutic milk used for in-patient care in Phase2,
ii. A single packed product contains energy value of 500Kcal.
iii. A lone package weighs up to 92 g.

2.2.4 The advantage and Nutritional composition of RUTF

i. The amount dispensed to individual children is easily calculated based on the weight.
ii. The sachet packaging is easy to open for one to consume the product.
iii. No culinary preparation or heat cooking is needed.
iv. The paste like form makes it ready for consumption without the dilution with water. This reduces risk of contamination.
v. The length of stay in hospital or Therapeutic Feeding Centre is shortened due to the easy and handy measure of the product.

vi. It decreases the quantum of human resource required for preparation and dispensing of the therapeutic food.

vii. Has a quicker recovery rate and greater acceptability than F100.

viii. Can be preserved at room temperature for a prolonged period of time.

ix. Has an increased shelf life, even without refrigeration (24 months).

Table 2.1: Nutrients and Energy Composition of Plumpy'Nut

NUTRIENT	Per sachet of 92 g	NUTRIENT	Per sachet of 92 g
Energy	500 kcal	Vitamin A	840 mcg
Proteins	12.5 g	Vitamin D	15 mcg
Lipids	32.86 g	Vitamin E	18.4 mg
Calcium	276 mg	Vitamin C	49 mg
Phosphorus	276 mg	Vitamin B1	0.55 mg
Potassium	1 022 mg	Vitamin B2	1.66 mg
Magnesium	84.6 mg	Vitamin B6	0.55 mg
Zinc	12.9 mg	Vitamin B12	1.7 mcg
Copper	1.6 mg	Vitamin K	19.3 mcg
Iron	10.6 mg	Biotin	60 mcg
Iodine	92 mcg	Folic acid	193 mcg
Selenium	27.6 mcg	Pantothenic acid	2.85 mg
Sodium	< 267 mg	Niacin	4.88 mg

Source: Plumpy'Nut Technical data sheet Nutriset 2010

2.2.5 SAM Management using RUTF (Plumpy'nut)

A child over six months and/or an adolescent can receive plumpy'nut according to the following criteria:

i. A severely malnourished patient without medical complication, who has passed the appetite test, and has been signed on in outpatient care.

ii. HIV positive, moderately malnourished fellow without medical impediment, have passed the appetite test, and have been registered in outpatient care.

iii. Ability to drink liquids.

iv. Non allergic to milk or nuts.

In Ghana, the use of RUTF is the recommended treatment regimen for managing uncomplicated malnutrition (severe acute malnutrition) among children between "6 months to 59 months" old (WHO 2010) in rehabilitation centers. The formulation and use of the peanut based RUTF contains numerous benefits; it lessens the logistics burden for the end user, permits quick roll-out and access to management, allows "home-based ambulatory care", hygienically secure and is less expensive (Collins et al, 2006).

Children who have severe acute malnutrition require harmless, pleasant diets with high energy content and sufficient amounts of vitamins and minerals. Thus RUTF are soft and crushable foods that can be consumed easily by children from the age of six months without adding water (Jones, et al., 2015). The technical design for nutritional conformation of RUTF is virtually equal to that for 'F-100', a therapeutic milk, being the standard treatment for hospital based nutritional rehabilitation of children suffering from acute malnourishment. This was based, for the greatest part, on public specifications for infant formula production, according to Jones, et al. (2015). In a survey conducted by UNICEF, there have been key alterations to the configuration stipulations of F-100 or RUTF since they were first designed Jones, et al. *(*2015).

2.3 NUTRITIONAL REHABILITATION OF MALNOURISHED CHILDREN

Severe acute malnutrition (SAM) affects roughly "13 million children under the age of 5 and is associated with 1-2 million preventable child deaths each year". Mostly in under developed countries, case fatality rates (CFRs) in hospitals managing SAM persist at 20-30% yet a small group of those who need therapy really obtain care (Collins et al., 2006).

Recently the management of SAM in the community-based therapeutic care programs, managing many of the cases of SAM mainly as outpatient have drastically minimized the CFRs and added on the number of the cases receiving care. The use of the RUTFs in the community-based management programs is also aimed to increase access to the services. Therefore the nutritional rehabilitation of malnourished children involves the blend of center-based and community-based care. This in turn promotes the early reporting and adherence, thereby improving handling and healing rates, as well as making services cost effective (Collins et al., 2006).

Plumpy'nut (PPN) is the principal RUTF administered in the nutrition rehabilitation program. Children with uncomplicated acute malnutrition need to undertake attest for the ability to eat plumpy'nut. If child pass the appetite test, management is initiated and sustained at home (WHO, 2010).

Children are put off the product from program after attaining a "WHZ of >-2 (maintained on two consecutive weighing 1 week apart), have no edema or medical complications and have adequate food intake" (WHO, 2010).

2.4 EMPIRICAL REVIEW ON ACCEPTABILITY TRIAL ON READY- TO -USE THERAPEUTIC FOOD (PLUMPY'NUT) AMONG MALNOURISHED CHILDREN

2.4.1 Acceptability

Acceptability is a very important measure to employ in the design, running and implementing wellbeing interventions. It is a multi-faceted concept that reveals the level to which people providing or getting a healthcare intervention consider it to be appropriate, based on anticipated or experienced cognitive and emotional responses to the intervention (Sekhon et al., 2017).

Evaluating acceptability in children <3 years of age is challenging, as dependable answers on organoleptic qualities (taste, color, smell, consistency) are hard to obtain. (Nga et al, 2013).

Most studies, many in Africa, have revealed the acceptability and efficacy of RUTF in the management of Severe Acute Malnutrition (SAM). Thus, the "World Health Organization and UNICEF recommend RUTF '(Nga et al., 2013).

Studies in Africa have revealed that "peanut-based RUTF has good acceptability and compliance among severely malnourished children". Conversely other studies have demonstrated obstacles to its use and insufficient submission, largely due to sharing within the households. (Ali et al., 2013).There is, however, limited published literature on plumpy'nut (PPN) acceptability in some countries that use the product such as South Asia (Ali et al., 2013) and Ghana alike.

While generally accepted as an effective management intervention for severe acute malnutrition in some research work, the use of RUTF is not without criticism.

In a landmark study in Bangladesh, a country with the greatest prevalence rates of childhood malnutrition in the world. Nearly 46% of children aged < 5 years are stunted (low height for age) and 15% were wasted (low weight for height) (Ali et al., 2013). Ali et al. argued that the acceptability of PPN or RUTF among children evaluated in an urban slum in Dhaka, Bangladesh,

would have been deemed acceptable if the care givers did not associate any problems with "taste, smell, colour and consistency" (Ali et al., 2013).

The latest development on the use of RUTF is a research conducted by Jones et al. (2015) in rural Kenya. In the trial conducted by Kesley et al they compared the standard RUTF with RUTF with "elevated n-3 polyunsaturated fatty acid (n-3 PUFA) content with and without fish oil in the treatment of severe acute malnutrition". The objective of the research was to develop an "RUTF with elevated short-chain n-3 PUFA and measure its impact with and without fish oil supplementation on children's PUFA status" and the acceptability among the children in the management of severe acute malnutrition (Jones, et al., 2015).

Although the study recommended a larger scale roll-out of the trial to assess more representative findings, the result from this initial trial showed a significantly higher erythrocyte long-chain n-3 PUFA content in participants following the treatment among those receiving fish oil than those receiving RUTF with elevated short-chain n-3 PUFA or standard RUTF alone. In addition the RUTF with elevated short-chain n-3 PUFA and fish oil capsules were acceptable to participants and caregivers, and there were no significant differences in safety outcomes (Jones, et al., 2015).

CHAPTER THREE

3.0 METHODS

3.1 STUDY DESIGN

A cross sectional study design was employed.

3.2 STUDY SITE

This study was conducted in five selected Rehabilitation Centers in the Accra Metropolitan Area of the Greater Accra Region of Ghana. These selected centers are Princess Marie Louise Hospital, Maamobi General Hospital, Usher polyclinic, Kaneshie polyclinic and Mamprobi polyclinic. These hospitals were used because they run rehabilitation clinics that monitor the growth of malnourished children. These hospitals also serve densely populated areas in the Metropolis and attend to high malnutrition cases in the Accra Metropolis.

3.3 STUDY PARTICIPANTS

The study population from which the sample was drawn was caregivers/mothers whose children were malnourished (Severe Acute Malnutrition) and between the ages of 6 to 59 months old and were on admission at the rehabilitation centers. Caregivers/mothers served as the respondents on behalf of their children since the children were too young to respond for themselves.

3.3.1 Inclusion Criteria

Caregivers/Mothers with malnourished children who were between the ages of 6 months and 59 months and being fed on plumpy'nut for at least 3 weeks. The justification to select a minimum of 3 weeks of PPN consumption as a study inclusion criterion was founded on the grounds that it takes at least 2 weeks (and often 3 weeks) for both a caregiver and child to become used to PPN in terms of how to give it and its taste and smell etc. (Ali et al., 2013). Participants were only recruited from the rehabilitation centers.

3.3.2 Exclusion Criteria

Caregivers/Mothers with malnourished children who were within the age range but showed other medical complications were excluded.

3.4 SAMPLE SIZE DETERMINATION

The sample size was calculated using the formula:

$N = Z^2 \times P (1-P) / d^2$ (Charan & Biswas, 2013).

Where

N is the required sample size

Z = is standard normal variation (at 5% type 1 error, $p < 0.05$) is 1.96

P = expected proportion in population based on previous studies

P will be taken to be 40% based on Plumpy'nut acceptability studies done in Bangladesh (Ali et al., 2013)

d = absolute error or precision at 10%

$N = 1.96^2 \times 0.4 (1-0.4) / 0.1^2$

N = 92

Therefore a sample size of 100 malnourished children was taken to make up for non-response and participants who withdrew during the period of the study.

3.5 SAMPLING PROCEDURE

The sampling procedure was total enumeration. This was done by targeting every client at the five rehabilitation centres. Every caregiver/mother that was available on the PPN program at the rehabilitation centers were interviewed after they had consented to the research (Appendix III) until the required sample size was obtained.

3.6 ETHICAL CONSIDERATIONS

Ethical approval to conduct research was obtained from the Ethical and Protocol Review Committee of the College of Health Sciences, University of Ghana, Korle-Bu [Protocol Identification Number: CHS-ET/M.10 – P 3.5/2016-2017]

Written permission was obtained from the Greater Accra Regional Health Directorate of the Ghana Health Service as well as the following health facilities:

- Princess Marie Louis Hospital
- Maamobi Polyclinic
- Usher polyclinic
- Kaneshe polyclinic
- Mamprobi polyclinic

Written consent was obtained from the caregivers/mothers of eligible children, using participant informed consent form (appendix III) which was signed. Information obtained was treated with confidentiality and kept within the limits of the research objectives. Withdrawal from the study did not compromise management and quality of care given to the patient and this was stated to the caregivers/mothers and health workers. There were no additional costs to the caregivers/mothers.

3.7 PRE-TESTING OF QUESTIONNAIRES

Ten percent (10%) of the questionnaires were pre-tested on other mothers/caregivers of malnourished children in La General Hospital and Lekma Hospital, which are outside the study area to ascertain their validity and reliability before use on the field. Incorrect wording and other shortfalls observed during pre-testing were corrected and/or modified to suit the context of the research. In all 10 caregivers/mothers of malnourished children receiving plumpy'nuts were sampled and their caregivers interviewed with the questionnaire in appendix I.

3.8 DATA COLLECTION

The essence of the research was explained to the caregivers/mothers whose children were malnourished and admitted on the rehabilitation program. Those caregivers/mothers who gave their consent to the study were recruited and the appropriate questionnaires administered on them using a one on one interview and response approach.

3.8.1 Socio-demographic Variables

- Data on socio-demographic variables such as age, gender, educational status of caregivers/mothers, caregivers'/mothers' occupation as well as households weekly income were collected using semi-structured questionnaire (appendix I)

3.8.2 Perception and Acceptability of Plumpy'nut

- Data on the perception and acceptability of plumpy'nut by caregivers/mothers was assessed by administering a semi-structured questionnaire adopted from a research conducted by Ali *et al*. (2013) on acceptability of ready-to-use therapeutic foods among malnourished children in Bangladesh and modified to suite tradition and way of life of Ghanaians (appendix I).
- Acceptability was tested among the children by interviewing the caregivers/mothers of the malnourished children with questionnaires based on the child's attitude shown upon feeding him/her with the PPN as well as side effect exhibited by the child after eating PPN (appendix III)

3.8.3 Anthropometric Measurements

- Data on anthropometric measurements were collected using a non-stretch MUAC measuring tape, Seca length mat (Seca, Germany) and a Seca 2 in 1 weighing scale for mother and baby (Seca, China).
- Measurements taken were Mid-upper arm circumference (MUAC), length/heights and weights respectively. The Mid-Upper Arm Circumference (MUAC) was measured as the arm circumference taken at the midpoint between the tip of the shoulder (acromium

process) and the tip of the elbow (olecranon process). MUAC measurements were taken to the nearest 0.1cm and categorized and interpreted as severe malnutrition, moderate malnutrition and normal nutritional status, with their respective range of values as MUAC measurements of ≤ 11.5 cm, ≥ 11.5 cm – 12.5 cm and > 12.5 cm (Collins et al., 2006).

- Measurements of the length of the children were taken by lying the child on his/her back on the length mat, with the scalp and feet of the child gently pressed against the flat and hard board of the length mat on the opposite sites of the length mat. Measurements were read to the nearest 0.1 cm and recorded.
- Weights of the children were also determined using a 2 in 1 mother and child weighing scale, where the caregiver stands on the scale alone and his or her weight is read and scale is balanced to read zero while the caregiver remain standing on the scale, after which the child is handed over to the caregiver and only the child's weight is determined at this stage.
- BMI was calculated as weight divided by height in meters squared (kg/m^2). This was done by feeding the results of the weight and length measurements into the WHO anthroPlus software to automatically compute the BMI. The BMI values obtained were further used in the calculation of BMI for age z-scores of the children (Collins et al., 2006).

3.9 STATISTICAL ANALYSIS

The data obtained from the semi-structured questionnaires were coded, and analysis performed using SPSS version 20. WHO AnthroPlus calculator was used for standardized measurements of age, weight and height. Frequencies, means, standard deviations, and percentages were computed. Results are presented using tables, pie charts with statistical inference. Descriptive statistics were used to examine all variables. Pearson Chi-square test was applied to assess associations and the significance of categorical variables. Paired t- tests were used to compare

means and proportions in determining the level of acceptability among the children and their caregivers/mothers as well as examine weight and height gain after treatment. One-way ANOVA was used to compare means. Regression analysis was also employed to ascertain the influence of the various acceptability domains on number of weeks spent on the PPN consumption programme. Significance was set at $p<0.05$.

3.10 DATA MANAGEMENT

Information in hand were kept in a safe cabinet and soft copy of data generated relating to the research was saved electronically and password protected.

CHAPTER FOUR

4.0 RESULTS

4.1 BACKGROUND CHARACTERISTICS OF THE STUDY PARTICIPANTS

The background information of both the children and their caregivers/mothers are presented on table 4.1. Gender of caregivers/mothers were hundred percent (100%) female and that of the children were 57% (57) females and 43% (43) males. The mean age of the children was 13.28 ± 5.67 months. Majority of children were between the ages of 12 and 23 months (49%).

Majority (91%) of the caregivers were the biological mothers of the children, while the remaining 9% were either grandmothers or aunties of the children. A few of the caregivers/mothers had no formal education (10%). The rest had received some level of education. Most caregivers/mothers were traders, categorized under self-employed (67 %). The weekly income earning of households showed that, about 27% was below the national minimum daily wage of Ghana (GHC 8.00).

Table 4.1: Socio-demographic Characteristics of the Study Participants (N = 100)

Variable	Male (n=43) n (%)	Female (n=57) n (%)	Total (n=100) n (%)
Age of children			
Mean (SD) in months			13.28 (5.68)
Age Range in months			6-30
Age Category of children			
6-11 months	16 (16)	28 (28)	44 (44)
12-23 months	23 (23)	26 (26)	49 (49)
24-59 months	4 (4)	3 (3)	7 (7)
Caregivers relation to children			
Biological mother	0	91 (91)	91 (91)
Other family member (grandmother or aunty)	0	9 (9)	9 (9)
Caregivers Educational level			
No formal education	0	10 (10)	10 (10)
Primary education	0	14 (14)	14 (14)
JHS education	0	47 (47)	47 (47)
SHS education	0	27 (27)	27 (27)
Tertiary education	0	2 (2)	2 (2)

Table 4.1: Socio-demographic Characteristics of the Study Participants (N = 100)

Variable	Male (n=0) n (%)	Female (n=100) n (%)	Total (n=100) n (%)
Caregivers/mothers occupation			
Unemployed	0	26 (26)	26 (26)
Public sector worker	0	4 (4)	4 (4)
Private sector worker	0	3 (3)	3 (3)
Self employed	0	67 (67)	67 (67)
Household weekly Income			
of participants in GHC			
> 300.00	0	5 (5)	5 (5)
> 250.00 - 300.00	0	6 (6)	6 (6)
> 200.00 -250.00	0	7 (7)	7 (7)
> 150.00 - 200.00	0	8 (8)	8 (8)
> 100.00 - 150.00	0	13 (13)	13 (13)
> 50.00 - 100.00	0	34 (34)	34 (34)
0 - 50.00	0	27 (27)	27 (27)
Nutritional status of children at baseline			
Moderate malnutrition	9 (9)	2 (2)	11 (11)
Severe Acute Malnutrition	34 (34)	55 (55)	89 (89)
Length of time of PPN intake before study			
3 - 5 weeks	32 (32%)	36 (36%)	68(68%)
6 - 10 weeks	7 (7%)	11 (11%)	18 (18%)
11 - 18 weeks	4 (4%)	10 (10%)	14 (14%)

Table 4.2 shows changes in anthropometric indices before and after PPN intervention. Significant differences (improvements) were observed between the anthropometric indices of MUAC, weight and height after intervention of PPN ($p < 0.001$).

Table 4.2: Comparison between anthropometric indices before and after PPN intervention (N = 100).

Anthropometric Indices	Before PPN Mean ± SD	After PPN Mean ±SD	P-Value
MUAC (cm)	11.02 ± 0.62	11.75 ± 0.86	< 0.001
Weight (Kg)	5.86 ± 1.03	6.65 ± 1.11	< 0.001
Height (cm)	67.89 ± 5.94	69.46 ± 5.92	< 0.001

Significance set at p-value ≤ 0.05 Paired T-test

4.2: ACCEPTABILITY OF PLUMPY'NUTS IN RELATION TO FOUR (4) ORGANOLEPTIC CHARACTERISTICS ACCORDING TO CAREGIVERS/MOTHERS PERCEPTION

Figures 4.1-4.4 below shows generally high acceptability in taste, smell, consistency and colour by the caregivers concerning their children receiving PPN. This is represented in acceptability levels of about 76% to 92% across all organoleptic characteristics of PPN.

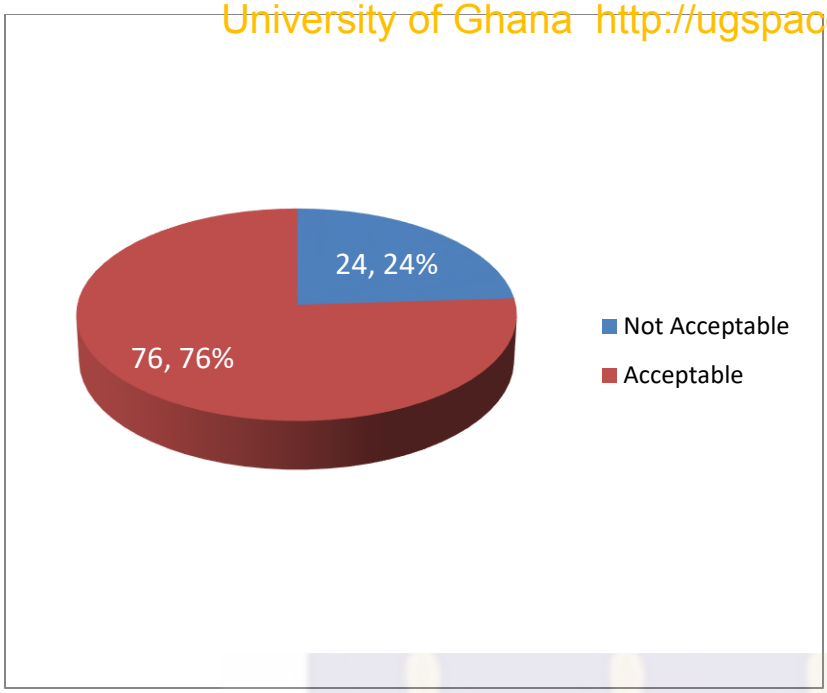

Figure 4.1: Taste Acceptability of PPN according to caregivers'/mothers' perception

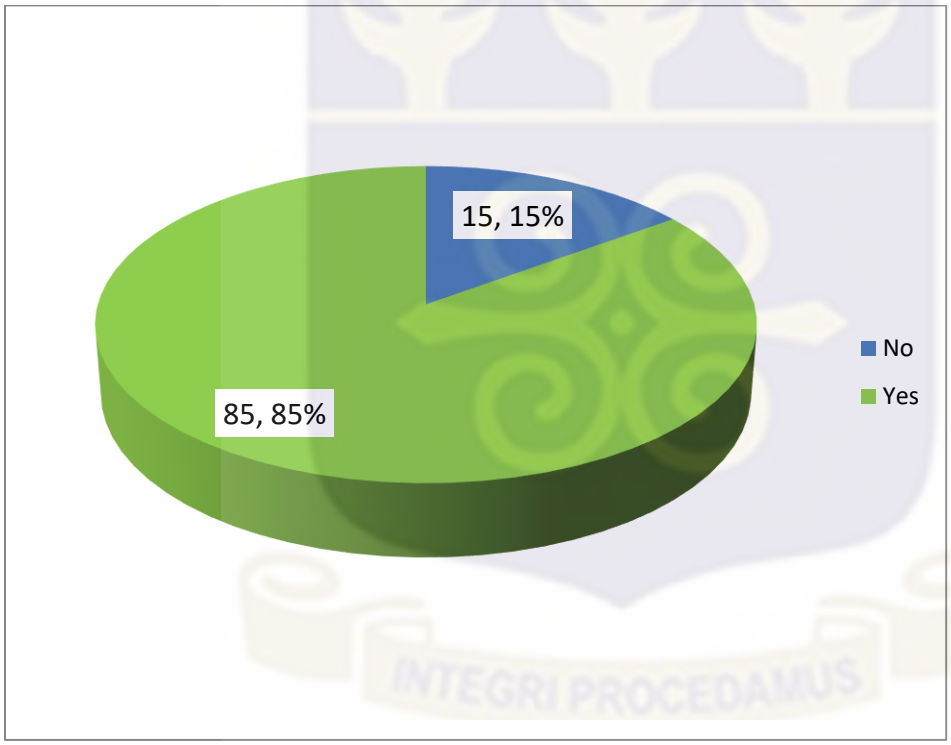

Figure 4.2: Smell Acceptability according to Caregivers'/mothers' perception.

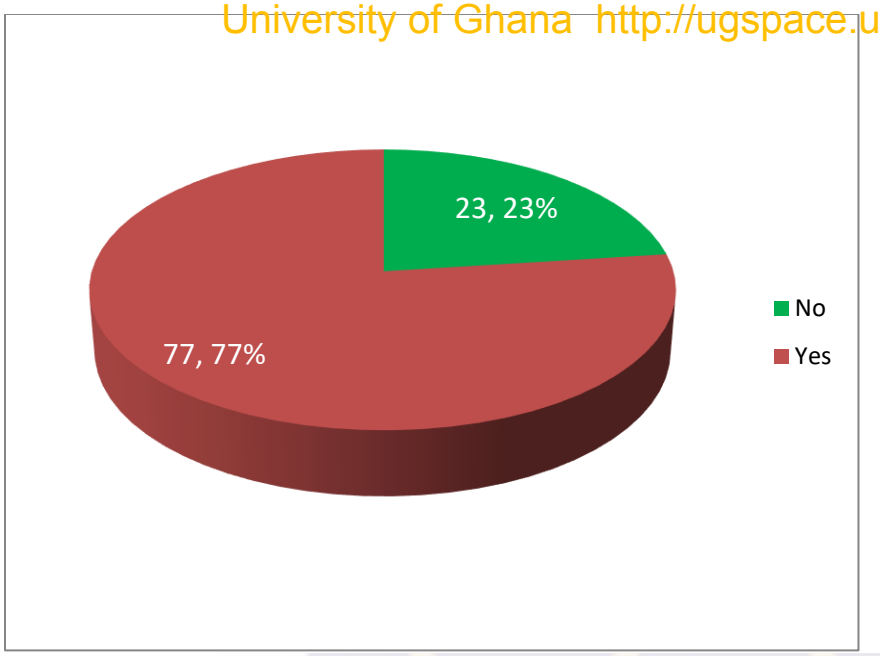

Figure 4.3: Consistency Acceptability according Caregivers'/mothers' perception.

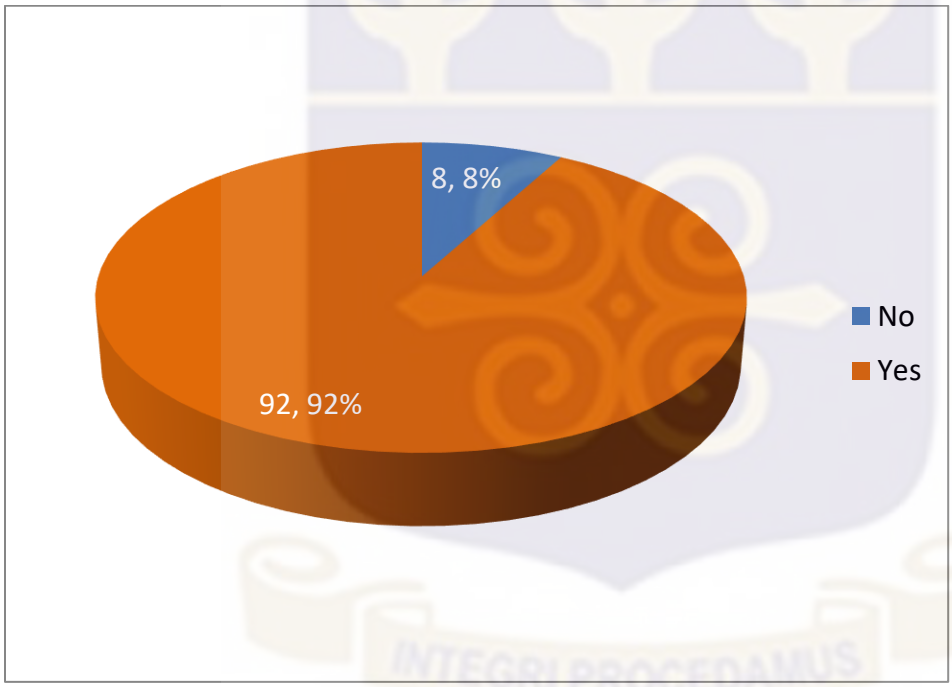

Figure 4.4: Colour Acceptability according to Caregivers'/mothers' perception

4.3 CHILD'S ACCEPTABILITY OF PLUMPY'NUT

The child's acceptability of PPN is shown on figure 4.5. Fifty three (53%) percent of the children accepted PPN readily when fed with it. Also 42% of the children accepted PPN after their caregivers'/mother's intervention (by encouragement or force feeding). In all 95% of the children can be said to have accepted PPN regardless of the mode of admission (by encouragements or force feeding).

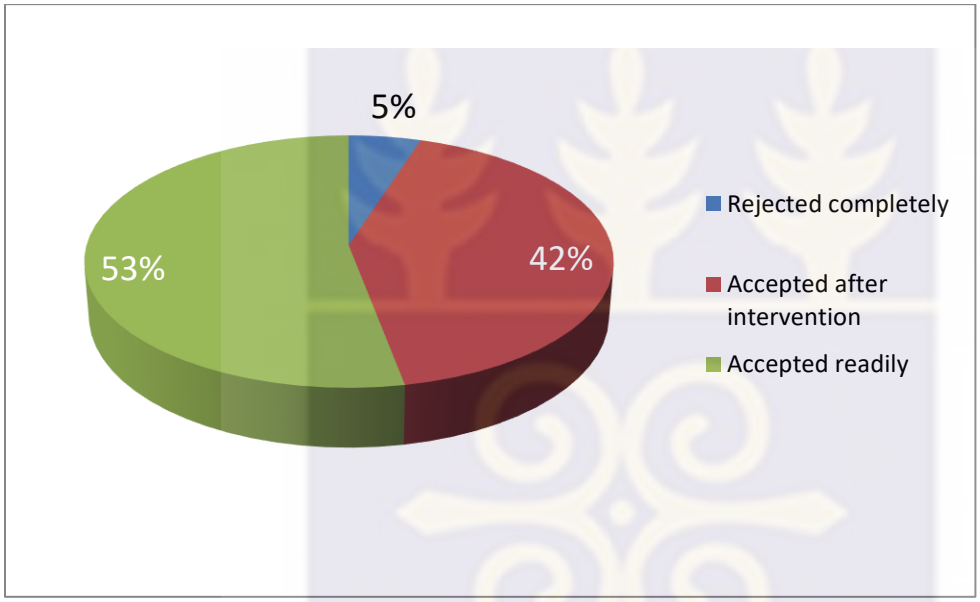

Figure 4.5: Child's acceptability of Plumpy'nuts

4.4 PLUMPY'NUT SIDE EFFECT AMONG THE CHILDREN

Negative reactions to the intake of PPN are reported on table 4.3. Ninety three percent (93%) of the children had reported no side effect upon eating the PPN offered to them. The rest of the 7% who showed side effects upon the consumption of PPN, showed various effects from abdominal pain, diarrhoea, loose stool to vomiting.

Table 4.3: PPN Side effect among children (N = 100)

PPN Side Effect	Frequency	Percentage (%)
Abdominal pain	2	2
Diarrhoea	1	1
Loose stool	2	2
Vomiting	2	2
No Side Effect	93	93
Total	100	100

4.5 CAREGIVERS'/MOTHERS' PERCEPTION OF PLUMPY'NUT EFFECTIVENESS AMONG THEIR CHILDREN

In general, 92% of the caregivers/mothers perceived that PPN was helping their children as shown in figure 4.6 below.

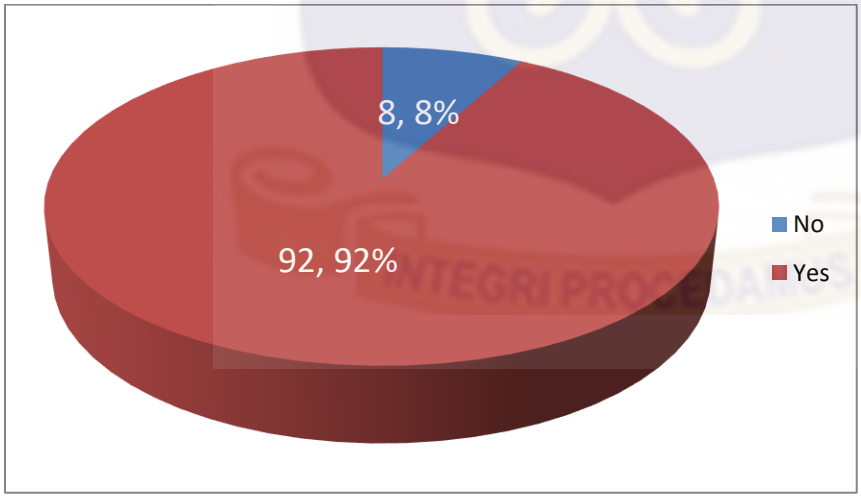

Figure 4.6: Caregiver's/mother's perception of PPN Effectiveness among their children

In figures 4.7 and 4.8 below, majority of care givers could not understand the package instructions on PPN. Sixty nine percent (69%) said they could not understand the writings on the package. The main reason given was because they could not read.

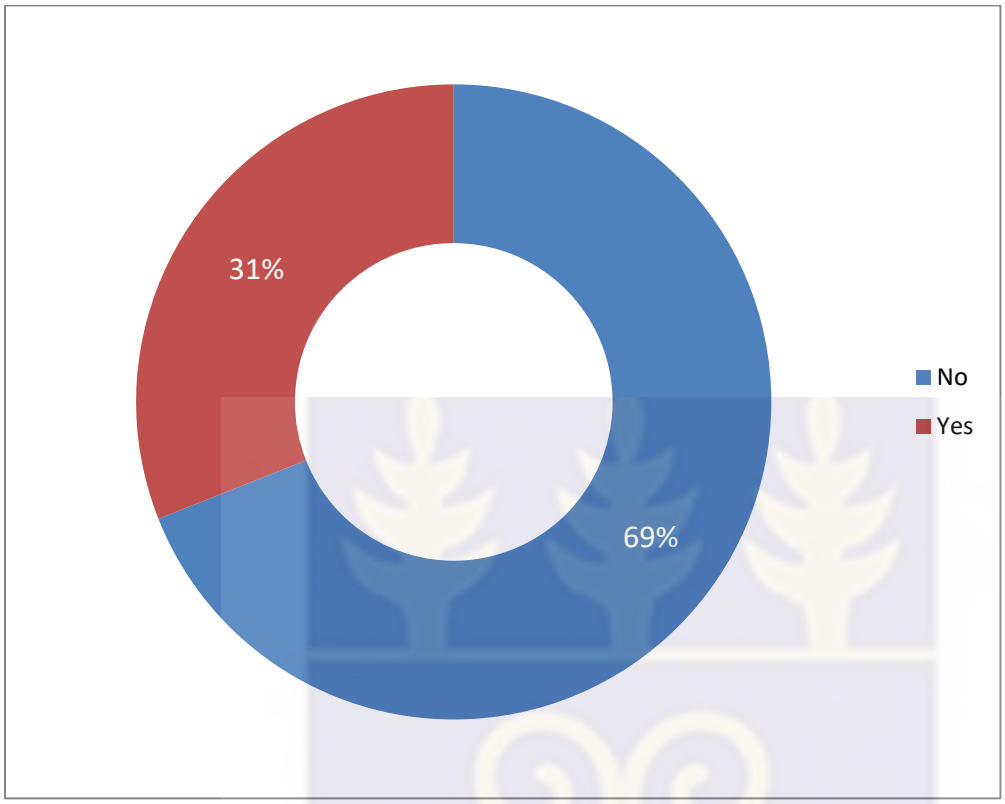

Figure 4.7: Caregivers'/Mothers' Understanding of Instructions on PPN package

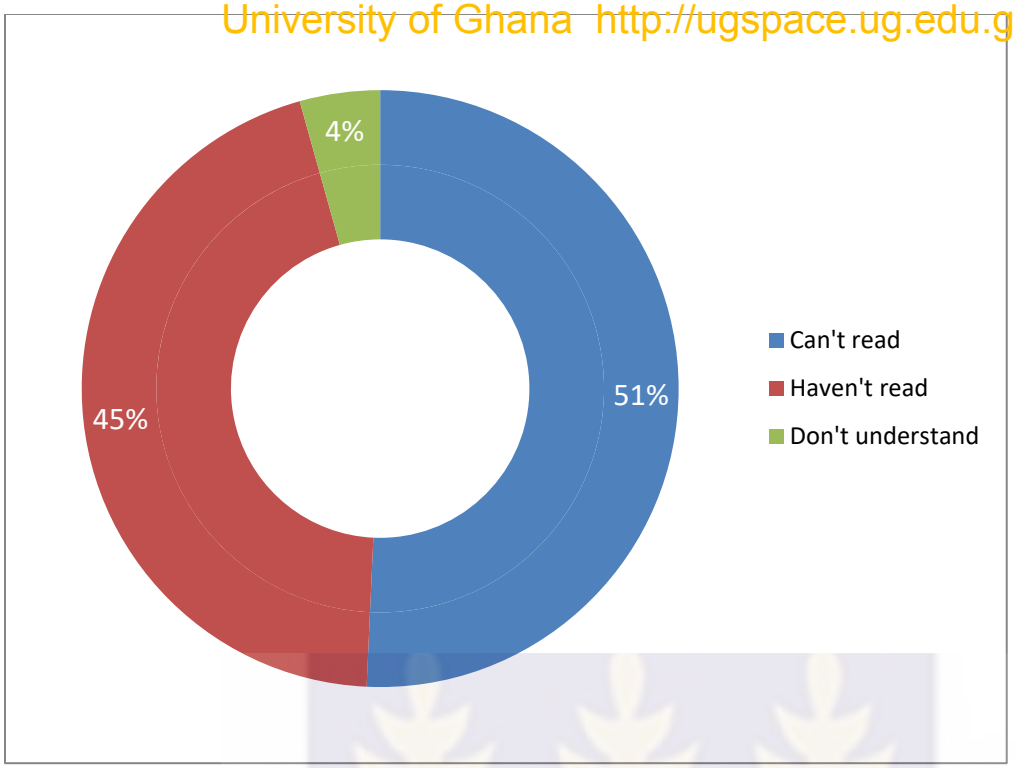

Figure 4.8: Caregivers'/Mothers' Reasons for not Understanding PPN package instructions

4.6 THE ASSOCIATION BETWEEN THE VARIOUS ORGANOLEPTIC PROPERTIES OF PLUMPY'NUT ACCEPTABILITY AND SOME SOCIO-DEMOGRAPHIC VARIABLES

Table 4.4 shows similar levels of acceptability among the various organoleptic characteristics such as: taste, smell, consistency and colour by the children of various age groups. There was however no significant association between the different age-category and the organoleptic characteristics of PPN.

Table 4.4: Association between age category of children and Taste, Smell, Consistency and Colour Acceptability of PPN (N = 100).

Age category in months	Taste Acceptability		P-value
	Yes	No	
	N (%)	N (%)	
6--11	32 (72.7)	12 (27.3)	0.71
12--23	39 (79.6)	10 (20.4)	
24--59	5 (71.4)	2 (28.6)	
	Smell Acceptability		
	Yes	**No**	
	N (%)	N (%)	
6--11	39 (88.6)	5 (11.4)	0.639
12--23	40 (81.6)	9 (18.4)	
24--59	6 (85.7)	1 (14.3)	
	Consistency Acceptability		
	Yes	**No**	
	N (%)	N (%)	
6--11	32 (72.7)	12 (27.30	0.625
12--23	39 (79.6)	10 (20.40)	
24--59	6 (85.7)	1 (14.3)	
	Colour Acceptability		
	Yes	**No**	
	N (%)	N (%)	
6--11	41 (93.2)	3 (6.8)	0.794
12--23	45 (91.8)	4 (8.2)	
24--59	6 (85.7)	1 (14.3)	

Significance was set at $p \leq 0.05$ Chi-Square test

The results of a Pearson Chi-square analysis to determine the association between the acceptability of PPN by caregivers/mothers and some socio-economic variables are shown on table 4.5 to 4.8. The results show that, no significant associations were observed between any of the socio-economic variables of the caregivers/mothers and any of the acceptability domains of PPN.

Table 4.5: Association between PPN Acceptability by Caregivers and the Caregivers' Educational Level. (N = 100)

	Taste Acceptability	Smell Acceptability	Consistency Acceptability	Colour Acceptability
Caregivers	Yes	Yes	Yes	Yes
Educational Level	N(%)	N(%)	N(%)	N(%)
No formal education	10(100)	10(100.0)	1(10.0)	10(100.0)
Primary education	7(50.0)	9(64.3)	7(50.0)	11(78.6)
JHS education	7(50.0)	9(64.3)	9(19.1)	44(93.6)
SHS education	35(74.5)	39(83.0)	6(22.2)	25(92.6)
Tertiary education	22(81.5)	25(92.6)	0 (0.0)	2(100.0)
Total	76(76.0)	85(85.0)	23(23.0)	92(92.0)
P-value	> 0.052	> 0.085	> 0.102	> 0.325

Significance is set at P-Value ≤ 0.05 Chi-Square test

Table 4.6: Association between PPN Acceptability by caregivers and Caregivers' Occupation (N = 100).

	Taste Acceptability	Smell Acceptability	Consistency Acceptability	Colour Acceptability
Caregivers Occupation	**Yes N(%)**	**Yes N(%)**	**Yes N(%)**	**Yes N(%)**
Unemployed	17(65.4)	22(84.6)	20(76.9)	23(88.5)
Public Sector Employed	4(100.0)	4(100.0)	4(100.0)	4(100.0)
Private Sector Employed	3(100.0)	3(100.0)	3(100.0)	3(100.0)
Self Employed	52(77.6)	56(83.6)	50(74.6)	62(92.5)
Total	76(76.0)	85(85.5)	77(77.0)	92(92.0)
P-value	> 0.271	> 0.719	> 0.512	> 0.783

Significance is set at p-value≤ 0.05 Chi -Square test

Table 4.7: Association between PPN Acceptability by caregivers and Caregivers' Weekly Income (N = 100)

Weekly Income in Cedis	Taste Acceptability Yes N(%)	Smell Acceptability Yes N(%)	Consistency Acceptability Yes N(%)	Colour Acceptability Yes N(%)
0.00 - 50.00	17(63.0)	23(85.2)	21(77.8)	23(85.2)
> 50.00 - 100.00	27(79.4)	28(82.4)	26(76.5)	32(94.1)
> 100.00 - 150.00	12(92.3)	11(84.6)	11(84.6)	12(92.3)
> 150.00 - 200.00	6(75.0)	7(87.5)	5(62.5)	8(100.0)
> 200.00 - 250.00	6(85.7)	7(100.0)	6(85.7)	7(100.0)
> 250.00 - 300.00	4(66.7)	5(83.3)	4(66.7)	6(100.0)
> 300.00	4(80.0)	4(80.0)	4(80.0)	4(92.0)
Total	76(76.0)	85(85.0)	77(77.0)	92(92.0)
P-value	> 0.503	> 0.954	> 0.912	> 0.581

Significance is set at P-Value ≤ 0.05 Chi-Square test

Table 4.8: Association between PPN Acceptability by Caregivers and Caregivers' relation to child (N = 100).

Caregivers' relation to child	Taste Acceptability Yes N(%)	Smell Acceptability Yes N(%)	Consistency Acceptability Yes N(%)	Colour Acceptability Yes N(%)
Biological Mother	69(90.8)	78(91.8)	71(92.2)	85(92.4)
Other family members (grandmother/aunty)	7(9.2)	7(8.2)	6(7.8)	7(7.6)
Total	76(76.0)	85(85.0)	77(77.0)	92(92.0)
P-value	> 0.630	> 0.404	> 0.341	> 0.152

Significance is set at P-Value ≤ 0.05 Chi-Square test

Association between child's attitude towards PPN and the acceptability of various organoleptic properties of PPN are shown on Table 4.9 Significant associations were observed between child's attitude and all the various domains of acceptability.

Table 4.9: Association between PPN Acceptability by the children and the children's Attitude towards PPN. (N = 100)

	Taste Acceptability	**Smell Acceptability**	**Consistency Acceptability**	**Colour Acceptability**
	Yes	**Yes**	**Yes**	**Yes**
Child's Attitude	**N(%)**	**N(%)**	**N(%)**	**N(%)**
Rejected Completely	0(0.0)	0(0.0)	0(0.0)	1(20.0)
Accepted after intervention	23(54.8)	32(76.2)	27(64.3)	38(90.5)
Accepted readily	53(100.0)	53(100.0)	50(94.3)	53(100.0)
Total	76(76.0)	85(85.0)	77(77.0)	92(92.0)
P-value	≤ 0.0001	≤ 0.0001	≤ 0.0001	≤ 0.0001

Significance is set at P-Value ≤ 0.05 Chi-Square test

Association between current nutritional status of the children and PPN acceptability are shown on tables 4.10 to 4.12 based on Pearson's chi-square test analysis. The current nutritional status of the children during the PPN intervention period only showed significant association between children with normal nutritional status who were previously underweight and consistency acceptability of PPN. However, that of PPN acceptability categories for underweight, wasting and stunting did not show any significant association.

Table 4.10: Association between PPN Acceptability by children previously underweight and their current nutritional status during PPN Intervention. (N = 100)

Current nutritional status of the undernourished	Taste Acceptability	Smell Acceptability	Consistency Acceptability	Colour Acceptability
	Yes N(%)	Yes N(%)	Yes N(%)	Yes N(%)
Normal	11(84.6)	12(92.3)	13(100.0)	12(92.3)
Moderate	23(76.6)	26(86.7)	19(63.3)	27(90.0)
Severe	42(73.7)	47(82.5)	45(78.9)	53(93.0)
Total	76(76.0)	85(85.0)	77(77.0)	92(92.0)
P-value	> 0.703	> 0.658	< **0.028**	> 0.887

Significance is set at P-Value ≤ 0.05 Chi-Square test

Table 4.11: Association between PPN Acceptability by children previously "wasting" and their current nutritional Status during PPN intervention. (N = 100)

Current nutritional status of those suffering from	Taste Acceptability	Smell Acceptability	Consistency Acceptability	Colour Acceptability
wasting malnutrition	Yes N(%)	Yes N(%)	Yes N(%)	Yes N(%)
Normal	31(77.5)	35(87.5)	35(87.5)	37(92.5)
Moderate	19(82.6)	21(91.3)	18(78.3)	21(91.3)
Severe	26(70.3)	29(78.4)	24(64.9)	34(91.9)
Total	76(76.0)	85(85.0)	77(77.0)	92(92.0)
P-value	> 0.531	> 0.335	> 0.061	> 0.985

Significance is set at P-Value ≤ 0.05 Chi-Square test

Table 4.12: Association between PPN Acceptability by previously stunted children and their current nutritional Status during PPN intervention. (N = 100)

Current nutritional status of the stunted	Taste Acceptability	Smell Acceptability	Consistency Acceptability	Colour Acceptability
	Yes	Yes	Yes	Yes
	N(%)	N(%)	N(%)	N(%)
Normal	36(78.3)	39(84.8)	32(69.6)	43(93.5)
Moderate	11(61.1)	15(83.3)	13(72.2)	15(83.3)
Severe	29(80.6)	31(86.1)	32(88.9)	34(94.4)
Total	76(76.0)	85(85.0)	77(77.0)	92(92.0)
P-value	> 0.256	> 0.963	> 0.103	> 0.332

Significance is set at P-Value ≤ 0.05 Chi -Square test

One-way ANOVA was used to test for the relationship between number of weeks a child stayed on the PPN consumption programme and the various acceptability domains. Those who accepted PPN were compared with those who did not accept PPN, using all four domains of acceptability. Table 4.13 below shows that there was no significant difference in the duration of PPN between those who accepted PPN and those who did not accept PPN intake.

Table 4.13: Relationship between child's Acceptability of PPN and the Number of Weeks Child spent receiving PPN

(N = 100)

Variable	Taste Acceptability		Smell Acceptability		Consistency Acceptability		Colour Acceptability	
	Yes	No	Yes	No	Yes	No	Yes	No
Number	76	24	85	15	77	23	92	8
Mean (weeks on PPN)	5.66	6.29	5.88	5.4	5.81	5.83	5.95	4.25
Standard Deviation	3.733	4.339	3.929	3.641	3.964	3.639	3.971	2.053
Significance (p-values)	0.487		0.659		0.982		0.237	

Significance is set at P-Value ≤ 0.05 One-way ANOVA

Using number of weeks as dependent variable in a regression analysis, there was no significant influence by the various acceptability domains on the length of stay by a child on the PPN consumption programme. This is shown on table 4.14 below.

Table 4.14: Model summary of regression analysis of the various acceptability domains and duration of PPN consumption (N=100)

Coefficients						
Model	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**	**95.0% Confidence Interval for B**
	B	**Std. Error**	**Beta**			**Lower Bound** / **Upper Bound**
(Constant)	2.95	2.806		1.051	.296	-2.620 / 8.521
Taste Acceptability	-1.58	1.133	-.175	-1.394	.166	-3.829 / .669
Smell Acceptability	-.032	1.645	-.003	-.019	.985	-3.298 / 3.235
Consistency Acceptability	-.280	1.094	-.031	-.256	.798	-2.452 / 1.891
Colour Acceptability	3.226	2.078	.227	1.553	.124	-.898 / 7.351

a. Dependent Variable: Number of weeks on PPN

The table below represents the satisfaction level of caregivers/mothers on PPN as a product for treating their children with severe acute malnutrition. As many as 58% of the caregivers were satisfied with the present form in which PPN was manufactured. The remaining 42% also expressed their views as in suggestions to how they would like the end product of PPN to appear to the satisfaction of their wards.

Table 4.15: Suggestions on how PPN can be improved

(N = 100)

Suggestions for PPN Improvement	Frequency (n = 100)	Percentage (%)
It should be made in the form of *cerelac	16	16
Reduce the smell of *CMV in it	3	3
Reduce the thickness/consistency	13	13
Reduce the sweetness	10	10
It is just best as it is presently	58	58
Total	**100**	**100**

*Cerelac: a commercially produced cereal mix (complementary food)

*CMV: combined multivitamin

CHAPTER FIVE

5.0 DISCUSSION AND CONCLUSION

Assessing the acceptability perception of caregivers/mothers of malnourished children on plumpy'nuts is an important step to improving the management of severely acute malnourished children using ready to-use-therapeutic foods. The aim of this research was to assess the acceptability of plumpy'nuts (PPN), a ready-to-use therapeutic food among malnourished children in selected rehabilitation centers of the Accra Metropolis in the Greater Accra Region of Ghana.

In this study, about 9 in 10 caregivers/mothers of malnourished children perceived PPN to be acceptable by their children. This finding contradicts that of a similar study in Bangladesh by Ali et al., (2013) where 6 in 10 mothers expressed dissatisfaction with their children's acceptability of PPN. Plumpy'nut was found acceptable by the children in this study as more than half (53%) of the malnourished children readily accepted PPN when they were fed with it. Forty two per cent (42%) accepted PPN after an intervention from their careers by either encouragement or force feeding, while the rest of the 5% rejected it completely. This is supported by the findings of Bashir and Zaman, (2016), who also found out that RUTF, was acceptable by approximately all children in a related study in Parkistan. The reason for the acceptability in the present study could also be attributed to the fact that it is found easy to eat. In consonance with the findings in the study by Ali et al., (2013) in Bangladesh, about 9 in 10 caregivers/mothers perceived PPN to be of therapeutic benefit for malnourished children. This was also confirmed by Bashir and Zaman, (2016) because their children's health was seen to be improving. RUTF has also been shown to progress the nutritional status of children living with HIV (Ndekha et al., 2005) and is easy to eat for adults with mouth sores or other HIV-related symptoms.

5.1 Socio-demographic characteristics of study participants

This study looked out for the level of formal education of caregivers/mothers among other social demographic characteristics to determine any significant effect on the care of their children. According to Smith and Haddad, 2000 cited in Bain et al., 2013, progresses in women's education have added by far the most, accounting for 43 per cent decline in child malnutrition between 1970 and 1995 while improvements in per capita food available added about 26 per cent. The findings of this study however revealed that only a few, about 10% had no formal education. By convention, the 90% of caregivers/mothers who have had at least a basic level of formal education should influence positively on their children's nutritional status. But this was not the case as malnutrition had already set in among the children irrespective of their caregivers'/mothers' educational level. However the education of the caregivers/mothers could be said to account for the high perception of acceptability of PPN by their children in this study.

Notable also in this study is the general low income levels of the study participants. Poverty is unquestionably the moving factor in the lack of funds to purchase or otherwise procure food. This consequently leads to malnutrition especially among children below five years, since they are the most vulnerable in the society. Thus the low income levels of the caregivers/mothers in this study, could lead to their children's malnutrition status. However, the varied income levels of caregivers/mothers did not have significant effects on the acceptability of plumpy'nuts among the study group. This finding was not different from all other socio-demographic factors including, caregivers'/mothers' occupation in this study.

5.1.1 Caregivers'/Mothers' Perception of PPN Acceptability by their Malnourished Children

In this study, about 76% to 92% of all caregivers/mothers interviewed, expressed satisfaction with PPN in relation to taste, smell, consistency and colour. This is in contrast with findings from other studies conducted in Bangladesh by Ali et al., (2013), where only 40% of caregivers/mothers were satisfied with PPN in relation to its taste, smell, consistency and colour. The findings of this study also contradict an earlier study in Cambodia, where plumpy'nut was not accepted by Cambodian children (Boudier, 2009). Remarkably, the acceptability problem appeared to reside more with the adults as it was noticed in a comparative study between plumpy'nuts and local RUTF among school children in Vietnam by Nga et al., 2013. The teachers in Vietnam study were hesitant to give the Plumpy'nut paste to the children initially, because it was so unlike the Vietnamese tastes and habits, while the local RUTF was straightaway accepted and understood by the teachers. However when detailed information about the plumpy'nuts were successfully provided in the Vietnam study, parents, school teachers, local authorities, and health staff became highly interested in both products (local RUTF and plumpy'nuts), Nga et al.,(2013) which is in contrast to the Cambodian study. The findings in the Vietnamese study therefore supported that of this present study in Ghana as plumpy'nut was reportedly accepted by both careers and children. Reasons for acceptability in Vietnam was based on the provision of information and effective communication on the product coupled with the spread-like property of PPN compared to the dryness of the local RUTF. Also the attractive packaging of PPN makes it preferable (Nga et al., 2013). Even though this present study in Ghana did not compare plumpy'nuts to any local or other products, same reasons for PPN acceptability could be ascribed to this study, as information on PPN was adequately provides to careers before the inception of the programme.

Furthermore, in terms of the therapeutic benefits of PPN on the malnourished children, caregivers/mothers were confident of its benefits to their children, hence about 9 in 10 caregivers in the study believed in this beneficial effect. This finding concurs with that of a related study by Ali et al., (2013).

The caregivers'/mothers' perception of acceptability was further confirmed by the children's attitude towards plumpy'nut intake. As there was significant level of acceptability among the children across the various categories of acceptability ($p < 0.05$).

It is also worth discussing that, of the 100 caregivers/mothers interviewed in this study, 69(69%) of them did not understand the instructions on the package of the PPN. This could be explained by the low educational levels of the careers. This is also a confirmation of the observation made by Bain et al., (2013) that, access to formal education for the girl child in certain communities is still a major burning challenge in Africa.

This observation should however raise concerns, because understanding of the package instruction is critical to the adaptation of the food product in a suitable manner, especially in the mist of cultural differences in the perception of plumpy'nut as food, as observed in this study. That notwithstanding, it was interesting to note that; despite the greater number who did not understand the written information on the PPN package; this did not influence their acceptability negatively on feeding their children with PPN. This positive effect could be attributed to giving credit to the health care workers for their education/instructions given to the caregivers/mothers on PPN prior to the introduction of their children to PPN in this study. This is supported by the report of Nga et al., (2013) where provision of information and effective communication improved acceptability. This development of detailed explanation of package instruction by the health care workers to the caregivers/mothers should therefore be encouraged to avoid hindrance to PPN acceptability in a highly illiterate society.

5.1.2 The Relationship between the various organoleptic properties of Plumpy'nut Acceptability and other variables

Analysis of the relationship between four organoleptic properties (Taste, Smell, Consistency and Colour) and age category showed that PPN was significantly acceptable among all age categories of the malnourished children. First of all the ages of the children were categorized into groups of similar characteristics. These categories include; 6-11 months, this can be characterized as a group who just began complementary feeding and still adjusting to new taste apart from breast milk; the second group ranges from one year to less than two years (12-23 months), characterized as a group which have adapted to different taste of family foods, but have increased needs of nutrients for their rapid growth requirement at that period; the third and final category of grouping are those two years and above (24-59 months), who are most likely to be weaned from breast milk and fully adapted to family foods.

Notable in this analysis was that, colour and smell acceptability recorded the highest form of acceptability among the age grouping of six to eleven (6-11) months, while that of taste and consistency was lower among same group. This could be attributed to the fact that, they are still learning to adapt to different taste and consistencies of food while colour and smell could not be a thing to trigger their likeness or dislike to a product due to their young age.

On the other hand, the age groupings of 24 to 59 months also had similar levels of acceptability in terms of taste, smell, consistency and colour. In general, taste acceptability recorded the least among all age categories though it was significantly accepted among all. This could be attributed to the fact that, since PPN is food and medicine for malnourished children, the addition of combined multivitamins (CMV) gives it a non-pleasant or non-familiar taste. As a result, the taste could be slightly different from the usual complementary/family foods known to the children, hence the results in acceptance. Some caregivers/mothers blamed the dislike of the taste

of PPN on its sweetness and requested for it to be reduced. This brings to notice the general perception of most caregivers/mothers against feeding their children with foods that are sweet; as a similar study in Bangladesh and Malawi saw mothers of malnourished children complain that the sweetness of a similar RUTF was unsuitable for their children with cough (Ali et al., 2013, Maleta et al., 2004).

5.1.3 Association between Plumpy'nut Acceptability and Caregivers'/mothers' Socio-economic variables

In Ghana the daily minimum wage is currently GHC 8.00 (www.ghana.gov.gh). Therefore weekly household minimum wage conversely should be at least GHC 56.00. However, this survey analysis showed that about seventy percent (70%) of the participants earned up to fifty Ghana cedis (GHC50.00) and above weekly. Arguably, the 70% of caregivers/mothers who earn above the weekly minimum wage did not significantly influence positively on the nutritional status of their children. However, this did not subsequently affect the acceptability of PPN among the children as there was no significant effect. On the other hand, considering the nutritional status of their wards, as malnourished as they are, suggest that, their socioeconomic status did not necessarily influence their attitude towards child care. This finding however contradicts other research findings by Novignon et al., (2015) which suggest that there has been enough evidence by literature in health economics that implies that the nutritional status of children is related to factors of demographics which includes household wealth, mother's educational level among others. The divergence observed with this particular survey cannot be readily explained. However, Hong et al., (2006) stated that children who are stunted or underweight are mostly from the poorest homes compared to households that are rich. This could be synonymous to the outcome of this study, though the household wealth of the subjects in this research has not been compared to that of known rich households.

5.1.4 PPN Impact on Child's Anthropometry

This study demonstrates a significant improvement of the anthropometric indices of the malnourished children after PPN intervention ($p < 0.05$). This finding is supported by a related systematic study which demonstrated that peanut-based RUTF is efficacious and effective in the management of severe acute malnutrition among children (Gera, 2010).

Wasting (Weight for height Z score <-2) essentially is a contributor of child mortality affecting about 10% of children less than 5 years the world all over (Isanaka et al., 2009). RUTFs have revealed positive results in the treatment of severe wasting (Bashir, and Zaman, 2016). Studies conducted in low and middle income countries have demonstrated comparable findings (Diop el et al., 2003). In their study among Malawian children, Isanaka et al., (2009) observed a significant difference in the Z-scores in weight for height and height for age between the intervention and non-intervention groups in their study (p=0.001). The children gained significant weight after the treatment for a period of one year. Though, data for this study was taken within four months, significant differences in weight, height and MUAC leading to improvements in the Z-scores in weight for height and height for age among others were also observed (p=0.001). This results has come to either confirm or has been confirmed by the findings of Isanaka et al., (2009). In a similar study with Indian children, conducted by Thakur et al, (2013), they also saw a significant difference in the rate of weight gain in the RUTFs group (p=0.0001). In the same way, Ciliberto et al., (2005) observed in their research that the RUTFs group was more probable to achieve a weight for height Z score >-2 as compared with those who received standard normal therapy (p<0.001). RUTFs are associated with better results for childhood malnutrition (Bashir & Zaman, 2016). As observed by Diop el et al., (2003) a larger effect of weight gain was observed among the most wasted children in Senegal (p<0.05). Dibari

et al., (2013) also established in a Kenyan study that, general preference, taste and sweetness scores for RUTFs were higher as compared to the control group, hence the beneficial effect on children.

5.2 Conclusion

The study participants who consist of the caregiver/mother-child pair accepted PPN; as over 75% to 92% of the proportion of caregivers/mothers perceives PPN to be acceptable according to the organoleptic properties by their wards. About 92% of careers also believed in the beneficial effect of PPN on their wards.

On the part of the children in this study, they accepted PPN by a 93% tolerability of PPN. This is represented by the 93% of children who show no side effects upon being fed with PPN. Again 53% of children readily accepted PPN as an indication of its acceptance among the children; this coupled with the 42% children who eventually accepted and consumed PPN after their careers intervention marks a significant overall acceptance.

Ninety percent (90%) of caregivers/mothers had formal education, which could be said to subsequently account for the acceptance/adherence to the information/education on PPN intake provided by health care professionals resulting in PPN acceptability.

Also in this study, about 73% of caregivers/mothers live within or above the national minimum daily wage. However this did not translate to a positive impact on their children's nutritional status, but seem to have positive impact on PPN acceptability.

Finally the acceptability of PPN by the children therefore improved significantly on their nutritional status as observed in this study as well as other studies around the world.

5.3 Limitations of Study

The following were possible limitations to the study;

1. Plumpy'nuts as a therapeutic food is not necessarily viewed culturally as food; hence this may influence its acceptability among caregivers/mothers.
2. Malnutrition on its own could affect the acceptability among the children, considering its related associated complications and symptoms.

5.4 Recommendations

Based on the findings of this study, some recommendations have been made for possible further studies, these are as follows;

1. Health care workers as well as community health volunteers should be encouraged to provide detailed health education/effective communication towards PPN to caregivers/mothers prior to the introduction of their wards to PPN.
2. Ministry of health and other health stakeholders should explore more on the production of less expensive local RUTFs comparable to PPN for the treatment of malnutrition in the country.
3. Further studies could be conducted by Ghana Health Service or the Department of Nutrition and Dietetics (University of Ghana) on the acceptability of PPN on a larger scale at other locations in the country.
4. Ministry of Health should engage more Nutrition experts at all levels with special focus at the community levels to ensure proper and adequate nutrition knowledge transfer and information to the populace.

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APPENDICES

APPENDIX I

RESEARCH PARTICIPANT INFORMATION SHEET

My name is Emelia Dery, a Master of Science in Dietetics student at the School of Biomedical and Allied Health sciences, University of Ghana. I am conducting a study in conjunction with the Department of Nutrition and Dietetics, School of Biomedical and Allied Health Sciences, College of Health Sciences, Korle-Bu. The principal objective of this study is to study the acceptability of pea nut-based (plumpy'nut) ready-to-use therapeutic foods among caregivers of malnourished children and community health workers in selected rehabilitation centers in Accra metropolis. You will be requested to answer questions based on your personal perception and observation on the acceptance of the plumpy'nuts by your child, as well as side effects of plumpy'nuts. Also on your general appreciation of plumpy'nuts as well as key socio-demographic characteristics that affects the health status of your child. Your child's weight, height, Body Mass Index will be measured based on your consent to ascertain their nutritional status. Questions asked and procedures that will be used are purely for academic purposes. Information sought will be kept strictly confidential. We believe that you will give us your best support in this study. Thank you very much.

APPENDIX II

INFORMED CONSENT FORM

I …… willingly agree to participate in this study being conducted by Emelia Dery, Dr. Joana Ainuson-Quampah and Mrs. Freda DzifaIntiful, all of the Department of Nutrition and Dietetics, School of Biomedical and Allied Health Sciences, Korle-Bu. I understand that I do not have to go ahead if I do not want to do so. There are no harms or benefits that I will get by taking part in this study. Findings of this study will be kept confidential and would be made available to me if I make a request. I may also ask any questions I have now or later.

I have been informed that this proposal is reviewed, approved and granted ethical clearance by the College of Allied Health Sciences, **Ethics and Protocol Review Committee**, Korle-Bu. They are responsible for protecting research participants from harm.

By signing this form, I am agreeing to take part in this research study.

…… …… ……..

Name of Principal Investigator Signature Date

……..... …… ……

Name of Participant Signature Date

Questions can be addressed to Principal Investigator (0249860504, derymelia@yahoo.com). Additional questions or problems concerning your rights as a research participant should be addressed to: The Chairman, Ethics and Protocol Review Committee, College of Allied Health Sciences, Korle-Bu, Accra, Ghana.

APPENDIX III

PLUMPY'NUT ACCEPTABILITY QUESTIONNAIRE AMONG CARE GIVERS

1	Name of the interviewer								
2	Date of interview	D	D	M	M	Y	Y	Y	Y
3	Name of the care giver being interviewed								
4	Address of the care giver								
5	Mobile phone number of the care giver								
Section 1: Demographic information of the child									
6	Child nutritional registration number								
7	Name of child								
8	Age (Please put 00 in years if <1 year)					Years			Months
9	sex (Please put √ on the correct choice)	1. Male				2. Female			
10	Date of admission	D	D	M	M	Y	Y	Y	Y

			On admission		Current	
11	Baseline measurements at admission	a)MUAC		Cm		Cm
		b)Weight		Kg		Kg
		c)Height		Cm		Cm
		d)Z-core				

Section 2: Demographic information on the care giver

12	Relation to the child								
13	Marital status	1.Single		2.Married					
14	Education level: number of years in school	Primary	JHS	SHS	Tertiary	None			
15	Occupation								
16	Household income per week in GH₵			Ghana Cedis					

Section 3: PPN acceptability among children according to care giver

17	Is the PPN package easy to open	1.Yes		2.No		If 1, go to 19
18	If not, why not?					
19	Do you understand the instructions on the	1.Yes		2.No		If 1, go to 21

	package?					
20	If not, why not?					
21	Is the taste of the paste accepted by your child	1.Yes		2.No		If 1, go to 23
22	If not, why not?					
23	Is the smell of the paste accepted by your child	1.Yes		2.No		If 1, go to 25
24	If not why not?					
25	Is the consistency of the paste accepted by your child?	1.Yes		2.No		If 1, go to 27
26	If not, why not?					
27	Is the paste colour accepted by your child?	1.Yes		2.No		If 1, go to 29
28	If not, why not?					
Section 4: Feeding the child with PPN						
29	Number of weeks already on PPN				Weeks	
30	Now when you feed PPN to your child, the child: ***(Please choose one of the options)***					
	1.Accepts it readily and ate by himself/herself					

	2.Needs encouragement	
	3.Needs to be forced	
	4.Rejects PPN completely	
	5.Others (Specify)	
31	If your child does not eat PPN readily, what do you think are the reasons? ***(Please choose ALL THAT APPLY of the options below)***	
	a. Does not like the paste taste	
	b. Too sweet	
	c. Too salty	
	d. Does not like the consistency	
	e. Too much fat	
	f. Does not like the smell	
	g. Is fed up with PPN	
	h. Has abdominal distension or gas	
	i. Others (Specify)	
Sections 5: Side effects of PPN		

32	Are there any particular problems you have noticed when the child eats PPN			If 2, go to next section
33	If yes, what kind of problem?		1.Yes	2.No
		a.Nausea		
		b. Vomiting		
		c. Loose motion		
		d. Diarrhoea		
		e. Abdominal distension		
		f. Abdominal pain		
		g. Others (Specify)		
Section 6: General appreciation of PPN				
34	Do you think that PPN is making your child better?	1.Yes	2.No	
35	Why?			
36	How in your opinion can we improve the PPN we offer your			

	child?	

PPN = Plumpy' nut; MUAC = mid upper arm circumference; GH₵= Ghana cedis

Adopted and modified from a survey conducted by Ali, *et al*. (2013): Peanut-based ready-to-use therapeutic food: acceptability among malnourished children and community workers in Bangladesh

UNIVERSITY OF GHANA
COLLEGE OF HEALTH SCIENCES
ETHICAL AND PROTOCOL REVIEW COMMITTEE

Ref. No.:.....

31st May, 2017.

Emelia Dery
Dept. of Nutrition and Dietetics
SBAHS
Korle-Bu.

ETHICAL CLEARANCE

Protocol Identification Number: **CHS-Et/M.10 – P 3.5/2016-2017**

The Ethical and Protocol Review Committee of the College of Health Sciences on the 29th May, 2017 unanimously approved your research proposal.

TITLE OF PROTOCOL: **"Acceptability of Plumpy'Nut (A Peanut-Based Ready-To-Use Therapeutic Food): Among Malnourished Children in selected Rehabilitation Centres in Accra Metropolis"**

PRINCIPAL INVESTIGATOR: **Ms Emelia Dery**

This approval requires that you submit six-monthly review reports of the protocol to the Committee and a final full review to the Ethical and Protocol Review Committee at the completion of the study. The Committee may observe, or cause to be observed, procedures and records of the study during and after implementation.

Please note that any significant modification of this project must be submitted to the Committee for review and approval before its implementation.

You are required to report all serious adverse events related to this study to the Ethical and Protocol Review Committee within seven (7) days verbally and fourteen (14) days in writing.

As part of the review process, it is the Committee's duty to review the ethical aspects of any manuscript that may be produced from this study. You will therefore be required to furnish the Committee with any manuscript for publication.

This ethical clearance is valid till 31st May, 2018.

Please always quote the protocol identification number in all future correspondence in relation to this protocol.

Signed: .....
PROFESSOR ANDREW A. ADJEI
CHAIRPERSON, ETHICAL AND PROTOCOL REVIEW COMMITTEE

cc: Provost, CHS
Dean SBAHS
Head of Department

file

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